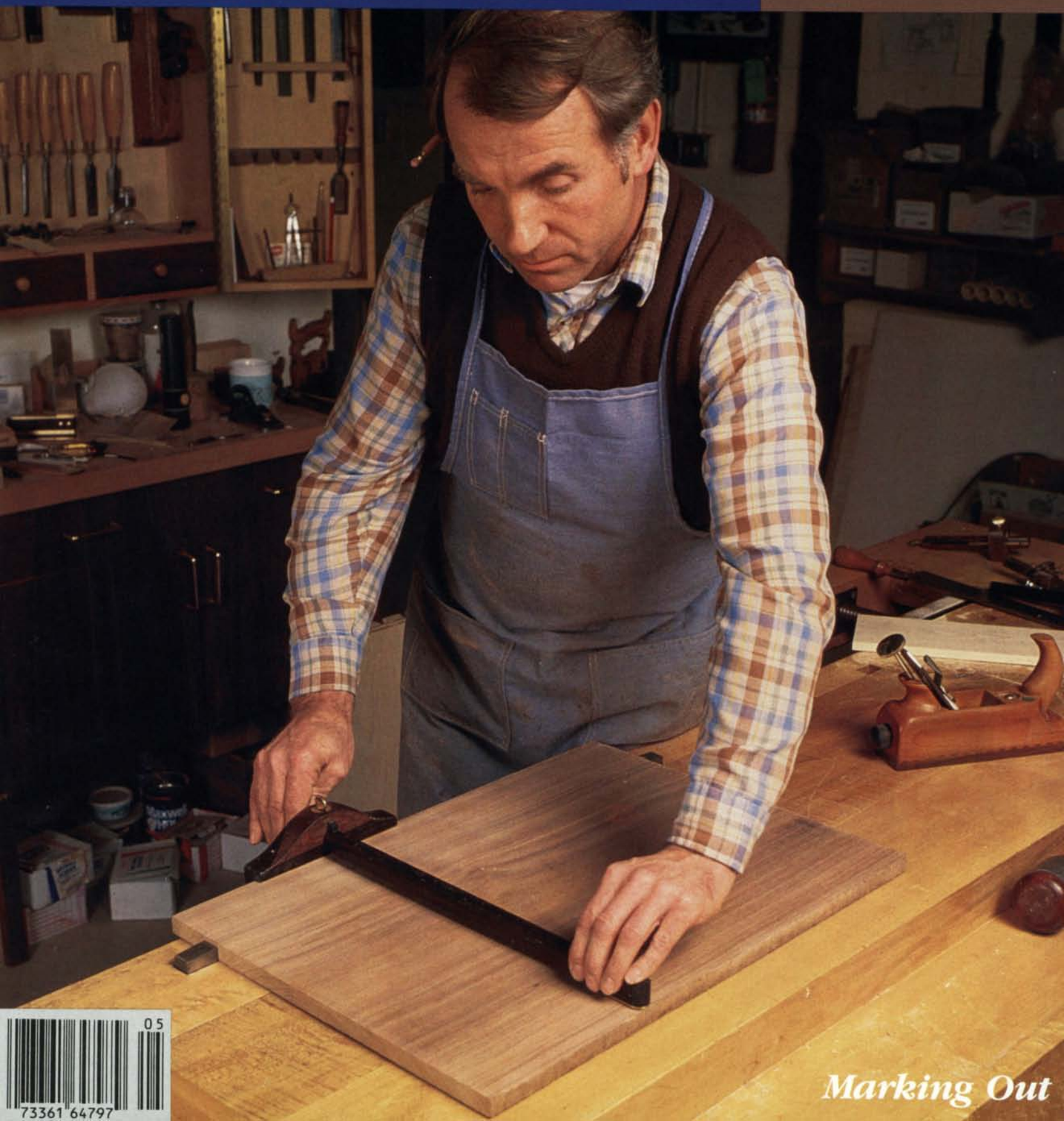
May/June 1988, No. 70, $3.75

Fine WoodWorking

- Choosing Sawblades
- Carcase Doweling
- Leg-and-Apron Table
- Wax Finishes
- Building Fireplace Mantels
- Planer Basics



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Fine WoodWorking®
May/June 1988

See anything wrong with this picture? For the answer and more tips on choosing carbide-tipped sawblades, turn to p. 36. Cover: Despite their ancient lineage, marking gauges are still the most consistent and accurate layout tools in the shop. See p. 74.

Fine Woodworking is a reader-written magazine. We welcome proposals, manuscripts, photographs and ideas from our readers, amateur or professional. We'll acknowledge all submissions and return within six weeks those we can't publish. Send your contributions to *Fine Woodworking*, Box 355, Newtown, Conn. 06470.

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DEPARTMENTS

ARTICLES

Postmaster: Send address changes to The Taunton Press, Inc., PO Box 355, Newtown, CT 06470.

A dust collector for every tool—After reading about dust collection systems in *FWW* #68, I wondered if it wasn't time to simplify the whole problem rather than build more elaborate systems. New systems tend to be inefficient and cumbersome. As time goes on, improvements make the system simpler and more efficient. When machine shops first started, for example, they were powered by water wheels or single-motor drives, which drove a line shaft that powered belts connected to individual machines. Now each machine has its own electric motor. Maybe it's time to look at dust collection in the same fashion and put a shop vacuum on each major machine or between pairs of lesser-used machines.

I have a small one-man shop in my basement. I have separate vacuums for my tablesaw, jointer, stroke sander and 6-in. belt sander. The thickness planer and shaper share a vacuum, as do the bandsaw and lathe.

Most of my power tools are 1950's vintage, so dust collecting parts had to be added to each tool. Each power tool has an electric outlet connected in parallel with the 110v drive motor. The vacuum is plugged into the outlet, so the dust collection starts when I turn on the tool. My system has good dust pickup and requires very little maintenance. The overall price was lower than a large single system with all its required piping and connections. My system may not be feasible for all shops, but it's worth considering. *—Don Seymour, Syracuse, N.Y.*

More on shop insurance—The articles on shop insurance and liability by Gary Savelli and Peter Lee (*FWW* #69) were done well and contain a great deal of information. But, I disagree with Savelli's claim that "trying to save money by not buying insurance is false economy, especially if you are an incorporated business and the premiums are tax deductible." The statement implies that you must be incorporated for the premiums to be tax deductible. This is not the case. Business insurance is deductible whether you are operating as a sole proprietor, a partner or a corporation.

Lee's point that it is difficult and unusual for a lawsuit to pierce the corporate veil and reach personal assets is well taken, but it is wise to have a lawyer periodically check your operation to make sure you are complying with all the formalities of operating as a corporation. This will lessen the chance of the corporate veil being pierced. A greater concern is that the corporation and any individual employee who may have been negligent might both be held liable in the case of a suit. Many states allow this type of claim under what is commonly referred to as "joint and several liability."

As the authors suggest, the best advice is to discuss your insurance needs with a competent lawyer or accountant. I also recommend you shop for insurance and take the time to talk with at least four different brokers about your needs.

—David Grant Willemain, Towson, Md.

Save the trees—On behalf of "commercial species" of trees everywhere, I'd like to say thanks for the article on backyard exotics (*FWW* #69). I'm both a woodworker and an environmentalist. I can no longer view any woodworking in blissful ignorance of the source of the material: The word "deforestation" keeps whispering in my ear. Ever-shrinking forests on this planet are under intense pressure from an ever-growing human population. Anytime we woodworkers work with trees that have met a natural or otherwise necessary death, we reduce this pressure.

None of us can completely avoid commercial timber products, but we should always be aware of whether our wood came from a tree killed in a chainsaw massacre or from a tree that voluntarily gave up the ghost, allowing us to create an enduring tribute to the beauty of its wood. If we strive for the latter source of wood, maybe our children can know the joys of woodworking, too.

—Tom Ness, San Francisco, Calif.

Seminars on water-base lacquer—There's been such an overwhelming response to Hydrocote following Michael Dresdner's article in *FWW* #69, that Hood Products has decided to offer seminars and starter kits for customers. Since Hydrocote is so different from nitrocellulose lacquer, we'll be offering a series of free workshops on Hydrocote application techniques. The four-hour classes, which will be open to professionals and amateurs, will be offered at various locations around the country. For people who can't attend a workshop, Hood is offering a Hydrocote starter kit for $95.95. The kit contains a gallon each of Hydrocote gloss, satin and sanding sealer lacquers, a fish-eye eliminator, special rubbing compound, mixing accessories and a use-and-troubleshooting booklet. For more details, check our catalog, which can be obtained in the East by calling Hood Products at (800) 223-0934 or (201) 247-2177, and in the Midwest and West by calling Amity Restoration Systems at (800) 334-4259 or (608) 221-3585.

—Erick Kasner, Hood Products, Freehold, N.J.

More on buying old planes—Many woodworkers hold tool collectors in low esteem. I, however, have found one in my area who's most helpful. He is willing to part with his non-rare, duplicate items at very reasonable prices. I have purchased a 22-in. Union jointer plane, a #5 Stanley and my favorite, a #4 Bailey. They were all in operable condition at the time of purchase and cost me a total of about $50.

I know that everyone does not need these basic planes, but collectors often have information that woodworkers lack. Collectors can suggest common planes that might be adapted to do the job of a rare plane that you can't afford. Or, they can help you locate cutters or parts for a plane you already have. Collectors are like old planes; some are better than others.

—Tim McCarthy, Oak Harbor, Wash.

Feedback on Mendocino show—Glenn Gordon's review of the Mendocino Gallery Fair show (*FWW* #68) needs some clarification. Gordon is inaccurate when he says that Sam Maloof and Alphonse Mattia made the final selections for the show and juried in their own work. Maloof and Mattia were asked by Bill Zimmer, the gallery director, to serve with him on a selection committee. Because of logistics, each reviewed work separately

The Taunton Press

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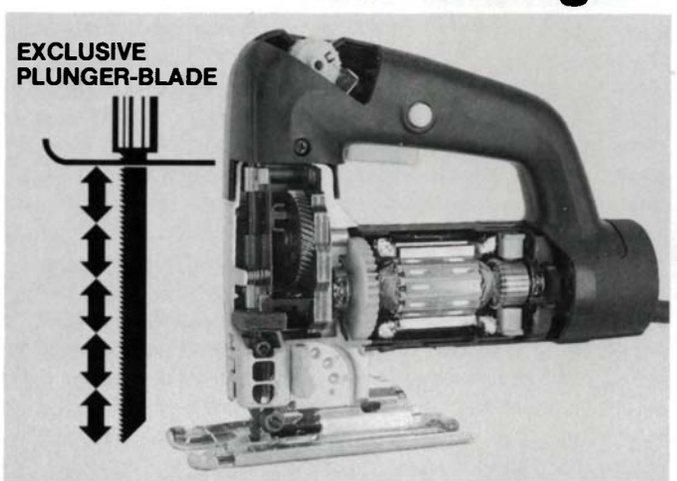

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and made selections. Zimmer decided last. Maloof and Mattia were invited to put work in the show, partially as a courtesy and partially as a way to entice others who hadn't worked with the gallery before to submit their own work.

I'm also wondering at what symposium Gordon heard me rise in an "impassioned defense of applied ornament." As he states my view, I disagree with myself—an interesting predicament. What I did present was an opinion about the importance of creating overall forms with surfaces that enhance one another and strengthen the concept of the piece. This is an entirely different point than one that waves a banner for applied ornament and decoration. I cringe at the superficial manner with which "applied ornament" is used in much contemporary architecture and design, and so I felt uncomfortable with Gordon's distortion, particularly with my name at its base.

I do not wish to dispute Gordon's conservative and somewhat parochial tastes, as I do not find them at all bothersome. In fact, I believe that the more views that are expressed with conviction, the richer the dialogue within the field. As faculty at one of the major furniture design programs in the country (Rhode Island School of Design), I stand in the front lines encouraging dialogue. When Gordon attempts to analyze design in terms of classical issues of balance, functional innovation, form, line weight, composition and other visual or sculptural elements, his weak background in these areas shows, and he begins to lose credibility. He commonly bases his observations on details that come from technical solutions rather than from more significant design issues.

I think Gordon made an admirable effort to write a thoughtful review. Zimmer's ambitious and successful undertaking deserved this kind of coverage. I just wish that the reviewer had done his homework a little more carefully, and that his personal bias would not have prevented a more rounded and insightful review. *—Rosanne Somerson, Westport, Mass.*

Lubricating plunge routers—Soon after buying a plunge router, I encountered problems when the plunge mechanism kept sticking. I relubricated the posts and bushings and coated them with silicone, as recommended in Bernard Maas's article (*FWW* #66), and then I went a step further. I lightly wiped the posts and bushings so as to leave only a very thin film of silicone, and then I gave them a thin coating of Vaseline. I feel the silicone seals and smooths the metal surfaces, and the Vaseline provides a much-needed heavier lubricant.

—Chuck Wheeler, Placentia, Calif.

Cheers for metrics—As a "foreign" reader of *FWW,* I was delighted to find two articles in issue #67 employing metric measurement. I would strongly recommend that you provide metric equivalence in all your articles in order to prepare North American woodworkers for the inevitable (hopeful) day when they will follow the rest of the world and adopt this most rational of all measuring systems.

I grew up with imperial, but it didn't take me long to see the advantages of metric. It takes getting accustomed to, but the metric system does make all calculations easier.

—Delton Hedges, Tasmania, Australia

Catalog threats—I'm a full-time designer/craftsman of hardwood furniture. I depend on mail-order firms for my tools and supplies, but I'm upset by the thinly veiled threats of "Buy or we'll cut you off" that accompany some catalogs. The people who initiated this "buy or else" marketing approach should be sent packing to marketing school. Their tactics are offensive, and rather than encourage me to buy, they leave me with the impression that the company is in financial difficulties or going out of business

I realize four-color, glossy catalogs are expensive, but I think the companies can cut down on "wasted" expenditures through a more positive approach. Give prospective customers several alternatives: 1. Ask if they want to continue receiving the catalog; 2. If they don't need a catalog, ask if they would like to receive a catalog summary periodically (with a return postcard for ordering the full catalog); 3. Print full catalogs once a year, then send supplemental product and price updates and a "continuing interest" reply card.

I believe most people, when *asked*, will cooperate; done properly, both parties will benefit. Talk *with* us, not *to* us. One more thing: Have you ever heard of a local store owner charging an entrance fee just to come in his store and look around? Why do companies charge a fee to a prospect who wants to see their catalogs? Isn't that like imposing a penalty on someone for showing interest in the company's products? In this age of free competition, it still amazes me how many sellers make it difficult, or distasteful, to do business with them.

—Douglas L. Peterson, Cincinnati, Ohio

Shop-built rip fence—I built the rip fence described by Marshall Young (*FWW* #68) and found that he overstated the time and cost by quite a bit. The materials cost me only $50, cut to size, and it took me only seven hours to build the fence. The fence has turned my $300 Taiwanese tablesaw into a precision machine that is a delight to use. I can't understand why saw manufacturers don't supply such a system: This system ought to be less expensive to make than many of the fence systems currently provided. *—Michael P. Burwen, Los Altos, Calif.*

High-priced turnings—I had the opportunity to meet Richard Raffan last year when he conducted a woodturning workshop sponsored by the Albuquerque Woodworkers Association. He has a captivating personality, and he is a good teacher and fine woodturner. His article in *FWW* #67, however, was at least inappropriate for someone dedicated to turning.

I've know a number of woodworking high-enders. Even with those "high prices" that constitute a "disturbing" trend, none of them are getting rich. As a matter of fact, many must supplement their income with writing, teaching and other kinds of work.

Is it art? The answer to this question is found in the marketplace. If there are people who will pay for, collect and admire these pieces, then turning is as much art as any other medium.

—Anthony Panagakos, Albuquerque, N.M.

Sawblade stabilizers—I'd like to add to the discussion on the value of sawblade stabilizers (*FWW* #68). Since Trend-Lines, Inc., has been promoting free stabilizers with all Freud blades, I think it is safe to say that we have developed considerable experience through our customers' observations and our own testing.

As stated, blade stabilizers don't reduce noise. They also won't help align a spindle that is out of whack. Use a dial indicator to check blade runout with and without the stabilizers—you'll find no significant difference. At this point, you might logically believe that stabilizers are useless (as we did when we first tested them).

However, that would be a hasty conclusion. Checking blade runout while sawing wood (a tricky setup) shows the real value of stabilizers. Cutting almost any material results in blade vibration and deflection. Composites or hardwoods that are either thick, hard or gummy often cause serious deflection. Blade stabilizers have a definite dampening effect on the vibration and deflection. While we are not equipped to measure accurately the long-term benefits of blade stabilizers, we feel certain that using them results in longer blade life and less wear and tear on equipment. *—Stanley D. Black, Trend-Lines, Chelsea, Mass.*

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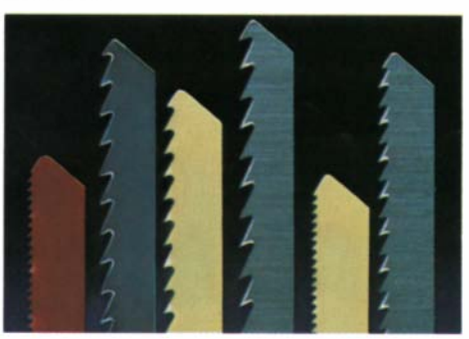

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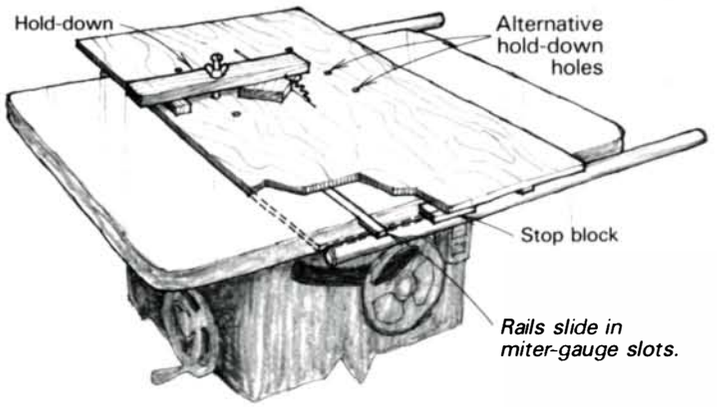
edited and drawn by Jim Richey

Cutting small parts on the tablesaw

I made this fixture to cut parts for small models and miniature furniture. It works so accurately and safely that I cut even conventional-size parts with it instead of using the miter gauge.

The fixture is made from a piece of plywood that is 8 in. to 14 in. longer than the table, depending on the length of cuts you plan to make. Screw hardwood runners underneath the plywood to slide in the miter-gauge slots, and screw stop blocks at both ends of the underside to prevent accidentally cutting the fixture in two. With the fixture in place, raise the blade through it to cut the blade slot.



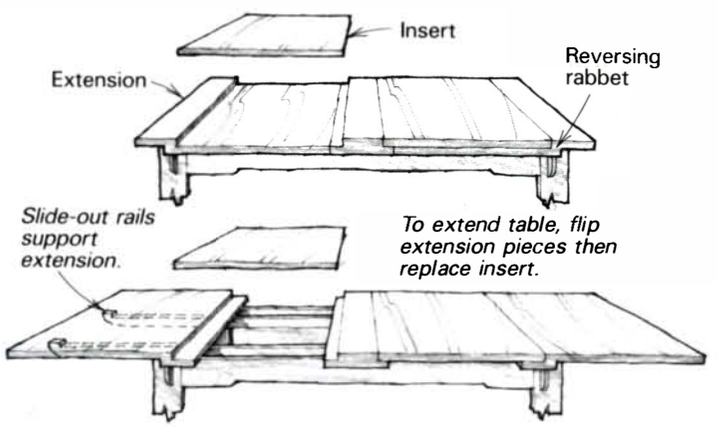
Drill several hold-down anchor holes through the plywood and install ⅜-in. T-nuts underneath. I have various anchor locations on my fixture to suit my individual operations. A small wood scrap will serve as a hold-down. Bore a hole through it for a ⅜-in. bolt, and thread a wing nut over the bolt before putting it through the wood block. Place the workpiece under the hold-down near the blade and place a block the same thickness as the workpiece at the other end of the hold-down—just tighten down on the wing nut to hold the workpiece in place.

I've found the hold-down applies enough force to lock the workpiece in place in just about any cutting operation, and my hands never come near the moving blade.

—Don H. Anderson, Sequim, Wash.

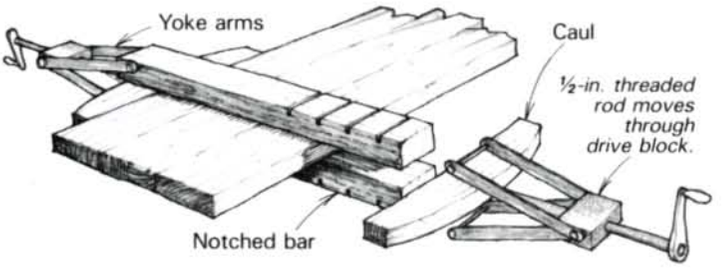
Quick tip: Woodturners: For a tight-spot smoothing tool, untwist a length of twine, then retwist it with steel-wool fibers trapped in the weave. *—Thomas S. North, Bloomfield, Conn.*

Built-in table extension



Here's a table that can be extended without the nuisance of separately stored leaves. The table's top consists of a fastened central piece, two inserts and two extensions. To extend the table, lift up the inserts, then flip the extensions so the rabbets under their ends are facing up. The two inserts fit into the rabbets, and two rails slide out from the table's ends to support the extensions. *—Brian Tinius, North Hollywood, Calif.*

Double-duty edge-gluing clamps



This shop-built edge-gluing clamp performs double duty. It not only is a terrific bar clamp, but it also aligns the various workpieces being glued, thus eliminating the need for a separate alignment "sandwich" made with scrap and C-clamps.

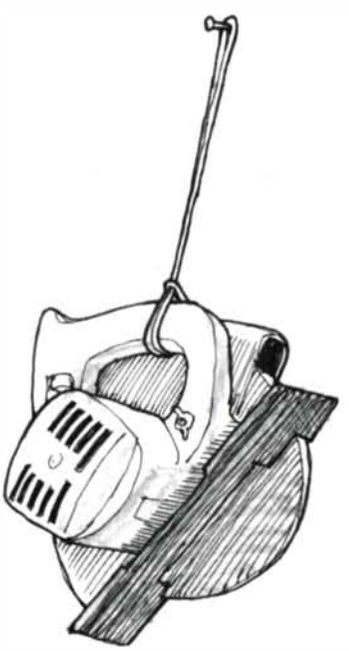
The clamps consist of two yokes and two notched wooden bars. Each yoke assembly has a pair of trapeze-like arms made from 8-in.-long pieces of strap iron that pivot on the sides of a block made from ¾-in.-thick mild steel. Drill and tap a hole through the block to accept a ½-in. threaded drive rod. Then, drill and tap ¼-in. holes in the sides of the block to bolt the arms in place.

Next, screw a length of ½-in. threaded rod through the block and attach a knob or crank to its outboard end. To distribute clamping pressure, make a wooden caul with a shallow ½-in. hole bored in its edge to locate the end of the rod. Plane a shallow concave curve in the caul edge that contacts the work to ensure even distribution of clamping pressure.

Cut the clamp's notched wooden bars from 1¼-in.-thick sticks of hardwood. The bars should be as wide as the space in the yoke arms. To make sure the notches in the bars are perfectly aligned, cut both bars at the same time with a ¼-in. dado blade. *—William Swartz, Modesto, Calif.*

Quick tip: When doweling with dowel points, I always drill the first holes in the endgrain side of the joint, because drill bits in endgrain are much more likely to drift a little off the intended center. *—John W. Wood, Tyler, Tex.*

Cord-loop storage



Here's a looped-cord storage system that has proved to be a great way to put empty wall space to use. It can be made to work with just about any kind of shop item. I use it to hang tools, bags of hardware or tin cans holding small wood parts. The last time I counted, I had about 50 different things suspended on my shop walls, and they are all plainly visible and easy to get at. I much prefer this to having everything cluttered in corners, hidden in drawers or under my bench. And, an empty cord hanging on its nail tells me that something isn't where it should be.

—Don H. Anderson
Sequim, Wash.

Driving with old engine valves

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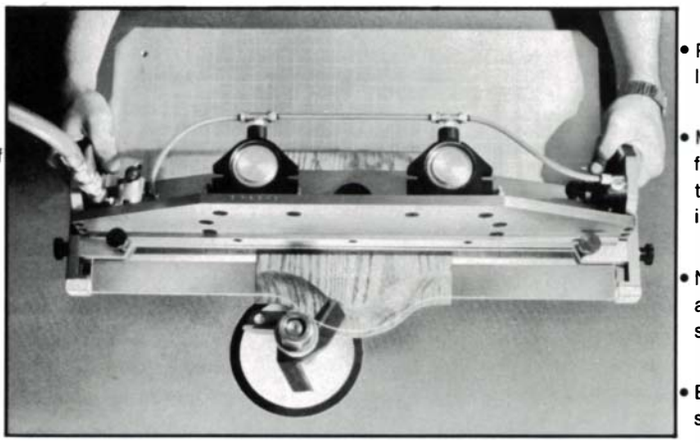

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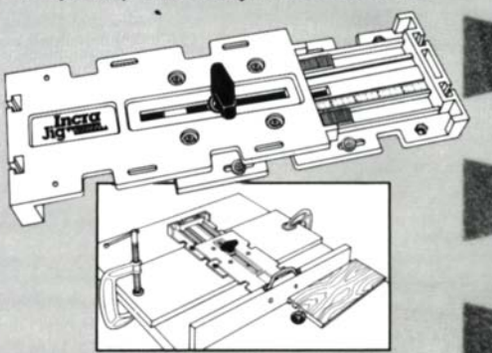

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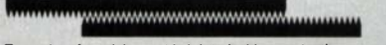

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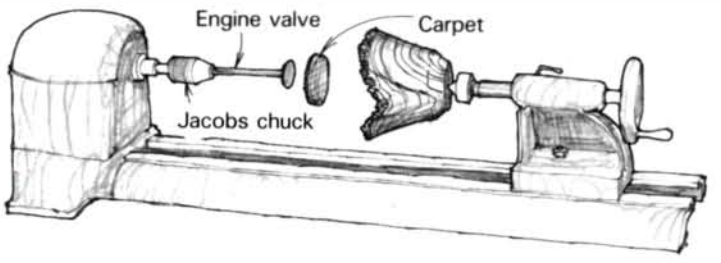
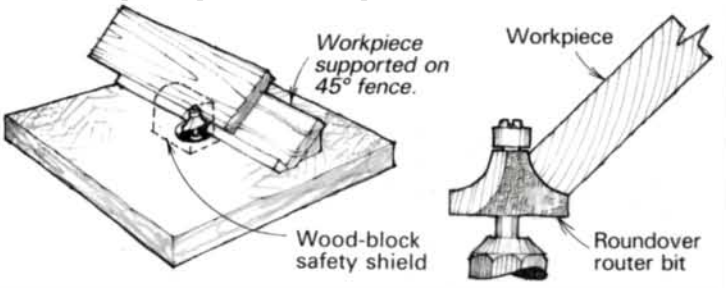


bowls to be turned. The valves are usually free, because service stations that rebuild engines normally throw them out.

First, I fasten the valve in the chuck. Then with a small circle of indoor-outdoor carpeting inside the bowl for padding, I bring the ball-bearing tailstock up to the center of the bowl's bottom, which I've marked with a centerfinder. You need quite a bit of pressure for this technique to work properly, so leave plenty of wood on the bowl's bottom when you are roughing it out; you don't want the tailstock center to punch through the bottom. Things may get out of balance, so wear face protection and keep your lathe at low speed. Be sure to leave enough wood around the tailstock center for safety; this nub will be easy enough to clean up by hand after the bowl is removed from the lathe. *—Robyn Horn, Little Rock, Ark.*

Quick tip: An engine valve makes an excellent spot sander. Chuck the stem in the drill press and attach garnet discs with rubber cement. *—Donald F. Kinnaman, Phoenix, Ariz.*

Routing fingernail edges



Your roundover router bits can do double duty cutting fingernail-shaped edges if you simply change the angle at which the work moves into the bit. I use the bits in a router table with an auxiliary fence that presents the stock to the bit at a 45° angle as illustrated. A ½-in. bit will mold the shape on ⅝-in.-thick stock, and a ¾-in. bit will handle 1-in.-thick stock. Notice that the lip on the fence acts as a track for the work and must have a gap in it so the bit can contact the work. For occasional use, this method beats buying the expensive specialty bit.

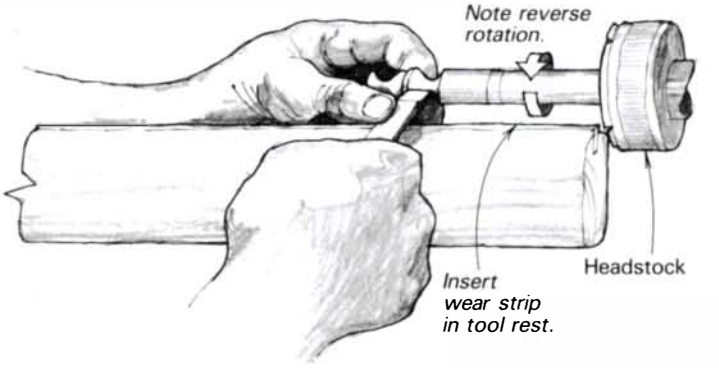
—Jeffrey P. Gyving, Point Arena, Calif.

Mason-jar glue pot

A mason jar makes a good glue pot. Drill a hole through the lid insert to fit the handle of a disposable foam paintbrush. To let the brush hang in the pot, put the insert ring on top of the twist-on cap, as shown in the sketch. You can adjust the height of the brush with a rubber band around the brush handle. The twist-on ring gives a nice scraping edge for wiping excess glue off the brush.

—David L. Pitz Redding, Calif.

Turning from the left



This two-handed lathe technique works well for production turning small pieces. Note that the headstock is to the turner's right. The turner sits sideways, facing the headstock, his left arm over the tool rest with his elbow on the lathe bed. He holds the tool handle in his right hand, and with the left, guides the tool and steadies the spindle to prevent chatter.

A right-handed turner would have to turn his lathe 180° (headstock to the right) and reverse motor direction to use this technique. A left-handed turner would do this backward, with the headstock in its normal position and his right elbow resting on the lathe bed.

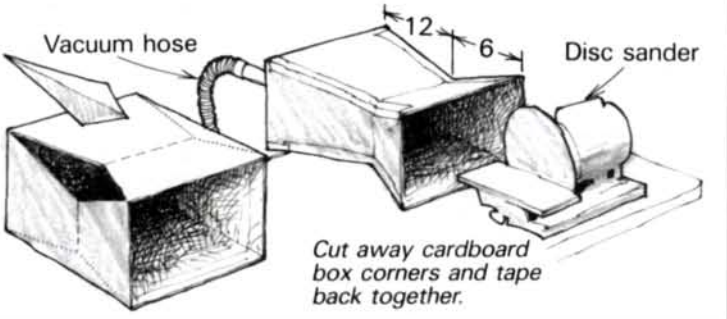
The full-length tool rest is made by inletting a wear strip in a long piece of wood. *—Johannes Volmer, Erzgebirge, G.D.R.*

Makeshift plunge routing

You can adapt a standard router with a screw-lowering mechanism to allow it to make plunge cuts. Fasten a hose clamp around the waist of the motor housing to stop the plunge cut at the desired depth. Loosen the router's tightening cam halfway and spray inside the base with Teflon lubricant.

—James Gentry, Madison, Wis.

Venturi-box dust catcher



My venturi box is an improvement over the standard box-like hoods that are normally used with shop vacuums in dust collection hookups. I use it to catch dust thrown by my bench-mounted disc sander. Try it at various locations behind the sander wheel until you find the most efficient spot. Air drawn through the box speeds up at the constriction, creating a pressure drop in the rear half of the box, effectively increasing the pull from the shop vacuum. Use any heavy, smooth cardboard box, cut away portions of each corner to produce the double taper shown and reassemble the box with duct tape.

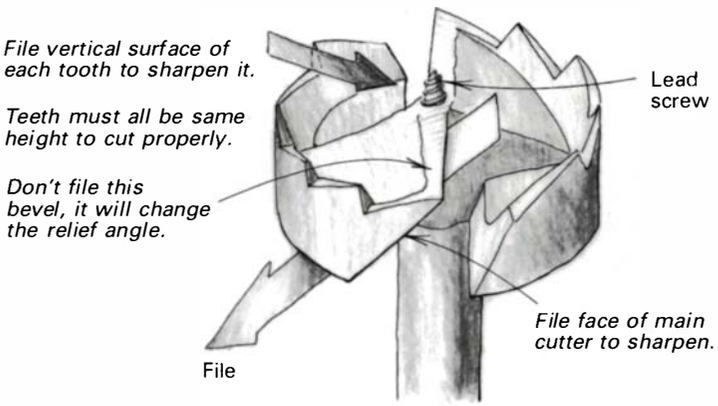
—Gordon Baxter, Beaumont, Tex.

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.*

Sharpening a multi-spur bit

I use multi-spur bits quite often in my shop, but unfortunately, my local sharpening service doesn't do a very good job resharpening them. How should these bits be sharpened? ***–Peter Tourin, Jericho Center, Vt.***

Richard Starr replies: The multi-spur bit is designed to bore a hole with a flat bottom. Like a Forstner bit, it has a small center leadscrew flanked by one or two main cutters, which are at right angles to the axis of the drill. But instead of having a thin, vulnerable outer rim like a Forstner, a multi-spur bit has a series of saw-like teeth. Each tooth is tapered in cross section and widens steeply toward the base for strength. The back surface of each tooth inclines slightly toward the center of the bit. Where the back surface meets the tooth's vertical front surface, a skewed cutting edge, like the tooth of a crosscut saw, is formed. Rather than just scoring the wood, multi-spur bit teeth actually remove wood and leave a shallow groove around the bottom of the hole.



The multi-spur bit is not only more rugged than a Forstner bit, it's also easier to sharpen. As the bit dulls with normal use, you can quickly touch it up. Sharpen the main cutter or cutters first, then sharpen the saw teeth. File the main cutters only on one side, as shown in the drawing above, or you risk changing the relief angle that determines the rate at which the bit advances. With a narrow, flat file, take off no more metal than is needed to restore a keen edge. Try to keep the filed edge of each cutter straight and at a right angle to the axis of the drill. If the bit has two main cutters, file the same amount from both so they'll cut evenly.

Use a triangular file on the vertical surface of each tooth when sharpening it, as shown in the drawing above. Again, take off just enough metal to restore a sharp edge. Just make sure you never file the inclined edge of a tooth. If you do a little careful work on your multi-spur every time it needs it, you may never have to do any major reconditioning on it.

Reconditioning is needed on a bit that's been damaged or is badly worn. If a couple of teeth are shorter than the others, you can probably get along fine, but if the teeth are all of varied lengths, you'll need to joint them, just as you would the teeth on a sawblade. Mount the bit in a three-jaw chuck on a lathe, with the bit's head close to the jaws for rigidity. With the lathe turning at slow speed, clockwise as you face the chuck, use a flat file to joint the teeth. Stop when the file just touches the shortest tooth. Now use your triangular file on the vertical surface of each tooth to sharpen them as described above. Stop filing as soon as the flat that's been jointed on the tooth disappears.

[Richard Starr is a teacher and the author of *Woodworking with Kids*, published by The Taunton Press, 1982.]

Veneering with yellow poplar

I have a supply of yellow poplar lumber with exceptionally beautiful grain pattern and color. Unfortunately, the wood was sawn and planed so that it's only ½ in. thick. Can I veneer these thin poplar boards to a plywood substrate to make an extension tabletop?

–K.M. Autrey, Auburn, Ala.

Seth Stem replies: The ½-in.-thick poplar boards cannot be used as veneer, because, as a rule, face veneers glued to a plywood substrate can't be thicker than ⅛ in. or they will crack from the expansion and contraction due to moisture changes. If you want to use your poplar as a veneer, you'll have to resaw it very thin or plane it down. However, a thickness sander would probably be required to plane the stock so thin, and planing would waste a lot of the precious poplar.

As an alternative to veneering, poplar is a strong enough wood for making the whole extension table. Just glue your figured poplar stock to plainer poplar lumber to increase its thickness. If you're dead set on using your poplar as veneer, I suggest you glue the ½-in. stock over a solid-wood substrate, like oak, ash or maple. Apply the poplar to both sides of the substrate, and run the grain of the poplar and substrate in the same direction so they'll both expand and contract in the same direction.

[Seth Stem teaches furniture design at the Rhode Island School of Design in Providence, R.I.]

Chairmaking without glue

I am constructing a set of dining-room chairs and considering which type of glue to use. I've had success in the past restoring the rigidity of joints in old chairs using a product called "Chair Loc." This liquid causes wood fibers to expand, resulting in very tight joints without any glue. Would using Chair Loc in lieu of glue be advisable in the building of new chairs?

–James A Collins, Hendersonville, N.C.

George Mustoe replies: Loosened joints are difficult to reglue because the wood surfaces are usually heavily contaminated with residues from the old glue. The new adhesive doesn't have a chance to form a solid bond unless it can redissolve the old glue, as is true with hot hide glue. While Chair Loc is undoubtedly superior to a badly glued dowel or mortise-and-tenon joint, glue offers greater strength for new woodwork. I would recommend a yellow polyvinyl acetate adhesive, such as Titebond, but epoxy, urea-formaldehyde plastic resin, hot hide glue, or even ordinary white glue would work just fine. Just be sure the joints fit tightly together before gluing, or in a few years, you may find yourself sitting on the floor—regardless of your choice of adhesive.

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

Domestic woods for guitars

In William Laskin's article on building a steel string guitar,* FWW *#67, he talks about exotic woods used in building fine guitars. In light of the world's dwindling tropical forests, are there any domestic substitutes for these exotics? ***–Gary Brown, Shelbyville, Ind.***

William Laskin replies: I agree that many tropical woods are quickly becoming endangered species. The problem for guitarmakers is that very few wood species deliver superior sound and have the good working properties and stability needed for guitarmaking. There are, however, a number of domestic species suitable for building a good guitar. For the top, Sitka spruce from Alaska or British Columbia is probably the most common musical-instrument soundboard material in use today. Engelmann spruce is also an excellent choice, with qualities very similar to German and Norwegian spruce. Western red cedar is also highly prized: Half of the world's concert-quality classical guitars have tops made from this wood.

Maple, medium-hard to rock, makes an excellent neck and

is used extensively in acoustical steel string guitar and electric guitar manufacturing. Because the fingerboard doesn't play a major role in the sound of the instrument, any wood that's dense and hard will do here. Maple is adequate and boxwood would be ideal, though it's hard to get. Either wood could be stained dark if its light color is undesirable. Also, The Amazing Musical Instrument Company, builders of electric violins, (290 Shuter St., Toronto, Ont., Canada M5A 1W7; 416-368-3462) has patented its own ebony substitute called "Amazinol" that's tougher and more stable than the real thing.

Substitute woods for backs and sides are difficult to find. Although these guitar parts have been successfully built from mahogany, maple, koa and walnut, I think the best-sounding guitars almost always have rosewood bodies. Even among the many species of rosewoods, only a few have the right density, strength, weight and brittleness to create an instrument capable of satisfying a discerning player. Unfortunately, I don't know of domestic substitutes for African, Central American and South American rosewoods.

[William "Grit" Laskin builds custom guitars in Toronto, Ont., Canada.]

Trueing a tablesaw top

I recently acquired a Sears tablesaw, which is about 20 years old. While setting up the saw, I placed a straightedge across the top and found that the top is concave from side to side, with about 1/32 in. of hollow in the middle. Is there anything I can do to correct the problem, or must I get the top milled flat by a machine shop?

–Eric Speth, St. Mary's City, Md.

Rich Preiss replies: Your problem is a common one, but before you take your saw top to a machine shop, check the following points thoroughly and consider your alternatives.

First, make sure you have a reliable straightedge. Check it against another straightedge or a surface you know to be truly flat. Before measuring, make sure the throat plate isn't projecting above the saw top and lifting the straightedge. Also, check to see that the top's wing tables are not canted. If they angle up, they could be contributing to the hollow you detect. Loosen the screws that hold the tables and shim as necessary.

Set the blade square to the table and try both ripping and crosscutting. If the hollow in your top is concentrated near the blade, it will have a negligible impact on all but the narrowest pieces you rip and hardly any effect on crosscutting accuracy.

If you do decide you can't live with the hollowness of your saw top, find a machine shop that has a Blanchard grinder. This type of machine can surface large areas very quickly, and the majority of the cost will be for set-up time. I had my 40-in. by 32-in. bandsaw table reground for $85. Of course, you'll have to remove the table from the saw before taking it to the shop.

[Rich Preiss is head of the woodworking program at the University of North Carolina at Charlotte.]

Cleaning an old finish

I've been asked to refinish a bedroom set that was built in the late 1920s or early 1930s. My client wants the light color of the furniture to remain exactly as it is. The finish on the pieces is in good shape, so I'm guessing it's best to give the pieces a thorough cleaning and then finish them with a light topcoat. What cleaner should I use, and how should I do the topcoating?

–Kenneth E. Simon, Hatboro, Pa.

Dick Boak replies: The best agent you can use to clean old finishes is naptha. It will effectively remove gum, tar, grease and other built-up dirt on a finish. Most solvents will attack or soften the existing finish, whereas naptha will simply clean all foreign matter from the surface. Naptha will remove some of the luster of a gloss finish, but that sheen can be restored by polishing or by spraying a light topcoat.

After the piece is clean, it's best to find out exactly what the old finish is before refinishing or topcoating it. The bedroom set probably has a lacquer or shellac finish. Apply some solvent to an inconspicuous place: Denatured alcohol will dissolve shellac; lacquer thinner is needed to dissolve a lacquer finish.

If it's impossible to determine what the old finish is, your safest bet is to spray a coat of vinyl sealer over the piece before applying the topcoat. This sealer has platelets of vinyl suspended in a lacquer base to prohibit incompatible oils and resins from bleeding up through the layers of the finish and spoiling the new topcoat. Vinyl sealer makes a compatible surface for successive coats of lacquer sealer and satin or gloss lacquer. Regardless of which topcoat you use, play it safe and do a test on a small hidden area before spraying the entire piece.

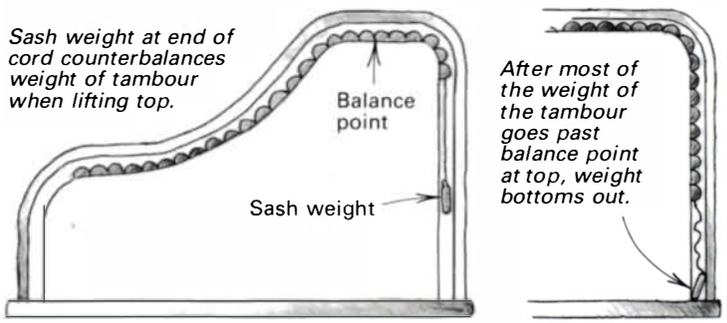
[Dick Boak is a manager at The Martin Guitar Company in Nazareth, Pa.]

Counterbalancing a rolltop tambour

I am in the process of making an oak rolltop desk with a traditionally styled S-curve top. The tambours are made from 5/8-in. oak slats, 58 in. long with nylon end pins riding in a track routed into the desk's sides. Although the pins ride smoothly in the track, the weight of the tambour makes it very difficult to open. Are the slats too thick, or should I counterbalance the top?

–John Plank, Waupun, Wis.

Tim Daulton replies: If the slats could be reduced in thickness to lessen the weight of the top, that would be the easiest solution. However, since this is a large and wide tambour, you probably can't make the individual slats much thinner without making the top too flimsy. Ideally, a tambour top should be designed so that it counterbalances itself, so that the back section lowers as the front section begins to rise. In your case, the addition of a few more slats at the back end of the tambour could improve the balance and make the top easier to open. Too much weight though, and you'll encounter the opposite problem: The top will be hard to pull shut.



The best solution I have to balance an already-built tambour is to add a hanging counterweight that attaches to the back edge of the top. You could use a bar of lead or a section of an old iron sash weight. Hang the bar so that once the counterbalance weight helps you lift the tambour over the "crest" at the top, it bottoms out and won't make the top harder to close. The trick is to find the right length of rope or wire so that the weight bottoms out at just the right point.

[Tim Daulton is a woodworker and a graduate student at James Madison University in Virginia.]

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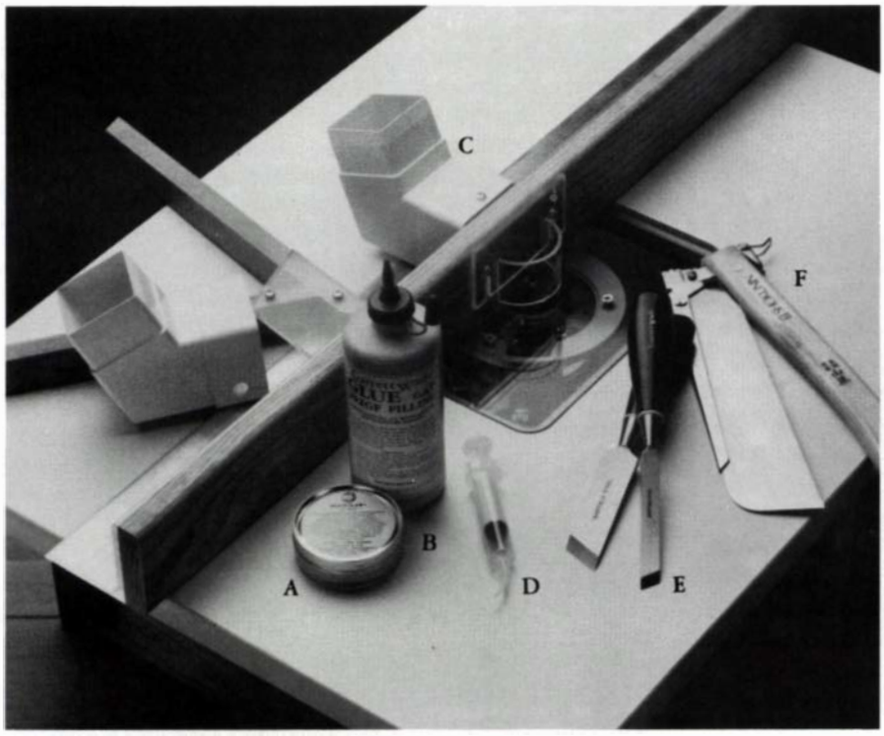

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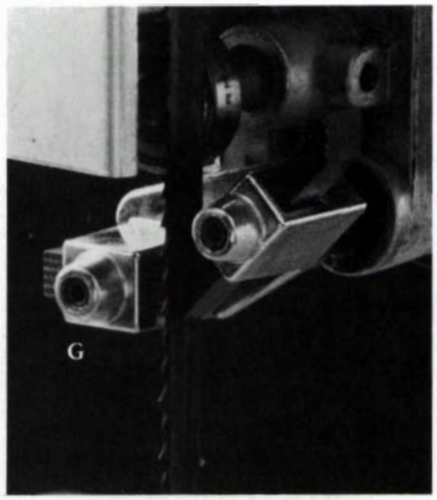

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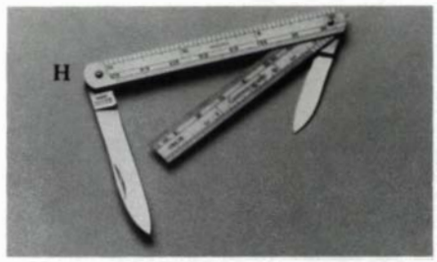

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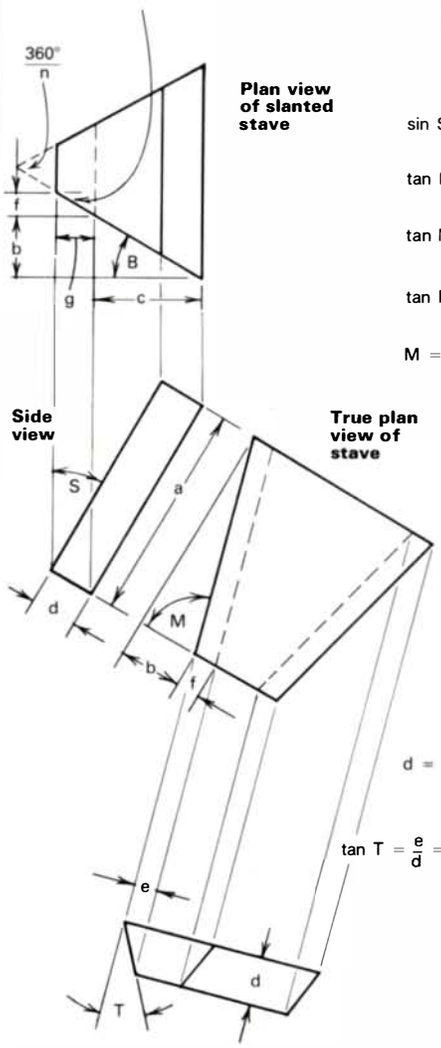
by Jim Cummins

Slant (degrees)	Number of sides 4	5	6	7	8	9	10	11	12	
0	90	90	90	90	90	90	90	90	90	Miter
	45	36	30	25.7	22.5	20	18	16.4	15	Tilt
2	88	88.5	88.8	89	89.2	89.3	89.4	89.4	89.5	Miter
	45	36	30	25.7	22.5	20	18	16.4	15	Tilt
4	86	87.1	87.7	88.1	88.3	88.5	88.7	88.8	88.9	Miter
	44.9	35.9	29.9	25.6	22.4	19.9	18	16.3	15	Tilt
6	84	85.7	86.5	87.1	87.5	87.8	88.1	88.2	88.4	Miter
	44.7	35.8	29.8	25.6	22.4	19.9	17.9	16.3	14.9	Tilt
8	82.1	84.2	85.4	86.2	86.7	87.1	87.4	87.7	87.9	Miter
	44.4	35.6	29.7	25.4	22.3	19.8	17.8	16.2	14.9	Tilt
10	80.1	82.8	84.3	85.2	85.9	86.4	86.8	87.1	87.3	Miter
	44.1	35.4	29.5	25.3	22.1	19.7	17.7	16.1	14.8	Tilt
12	78.3	81.4	83.2	84.3	85.1	85.7	86.1	86.5	86.8	Miter
	43.8	35.1	29.3	25.1	22	19.5	17.6	16	14.7	Tilt
14	76.4	80	82	83.4	84.3	85	85.5	85.9	86.3	Miter
	43.3	34.8	29	24.9	21.8	19.4	17.4	15.9	14.5	Tilt
16	74.6	78.7	81	82.4	83.5	84.3	84.9	85.4	85.8	Miter
	42.8	34.4	28.7	24.7	21.6	19.2	17.3	15.7	14.4	Tilt
18	72.8	77.3	79.9	81.5	82.7	83.6	84.3	84.8	85.3	Miter
	42.3	34	28.4	24.4	21.3	19	17.1	15.5	14.2	Tilt

$\frac{1}{2} \cdot \frac{360°}{n} = \frac{180}{n} = B$

T = tilt of sawblade (0° normally)
M = miter angle (90° normally)
n = number of sides
S = slant of side of object



$\sin S = \frac{c}{a}$; $a = \frac{c}{\sin S}$

$\tan B = \frac{b}{c}$; $b = c \tan B$

$\tan M = \frac{a}{b} = \frac{c}{\sin S} \cdot \frac{1}{c \tan B}$

$\tan M = \frac{1}{\sin S \tan B}$

$M = \tan^{-1}\left(\frac{1}{\sin S \tan \frac{180}{n}}\right)$

$\sin M = \frac{e}{f}$; $e = f \sin M$

$\tan B = \frac{f}{g}$; $g = \frac{f}{\tan B}$

$\cos S = \frac{g}{d}$; $d = \frac{g}{\cos S}$

$d = \frac{\frac{f}{\tan B}}{\cos S} = \frac{f}{\tan B \cos S}$

$\tan T = \frac{e}{d} = \frac{\frac{f \sin M}{f}}{\tan B \cos S} = \sin M \tan B \cos S$

$T = \tan^{-1}\left(\sin M \cos S \tan \frac{180}{n}\right)$

Trivial notes:

$\tan^{-1}$ = arctan
Hand-held calculators will show ERROR if 'S' is set equal to zero.
Angles must be converted to radians and then back to degrees if a computer is used.

Tilt math—In *FWW* #64, we published F.B. Woestemeyer's ingenious no-math method for cutting tapered staves on the tablesaw. The method is useful for setting miter-gauge angles and blade-tilt angles to make compound-angle staves for such projects as wooden wastepaper baskets and garden planters, or for gluing up blanks for turning into bowls. Ever since, we've been receiving a steady trickle of mail from readers who would like to know a mathematical way to do the job.

Here it is, from Richard Soule of Sea Ranch, Calif., in the form of both a table of some useful miter-gauge and blade-tilt angles as well as a mathematical proof and formulas for those wanting to figure out their own combinations of sides and tilts. A hand-held scientific calculator or a home computer with BASIC can be used. Readers like me, who went to school before the microchip revolution, may well remember that such trigonometry can also be worked out using the printed trig tables found in textbooks. Remember interpolation?

Readers whose strengths lie in geometry rather than algebra will enjoy studying the projection lines used to derive the various views of the stave. The projection method relies on using angles and dimensions that are shown true at one orientation of the stave, then projecting these and superimposing other true measurements to get other true views. Soule says engineering students run into this sort of thing in their third year of college. Bright kids in high school will get a kick out of all this as well, and so will their teachers.

Finish vocabulary—Garland L. Popp of Arcata, Calif., a finisher for 25 years, scratched his head over Donald Steinert's article in *FWW* #68. What Steinert calls shading, Popp has always called toning; what Steinert calls toning, Popp has always called antiquing. And instead of using just naptha as a solvent for what they both agree is glazing, Popp recommends adding mineral spirits plus a little boiled linseed oil, which will lengthen working time and allow better grain matching. He advises polishing with steel wool between coats to remove any dust that may have stuck, because "no one works in a dust-free vacuum, except those that work in the space between their ears."

Fire—Bob Jablonski of Milwaukee, Wis., sent us a newspaper clipping about a fire that took place in early November, destroying the old Peter Cooper glue factory, which was featured in the hide glue article in *FWW* #57. *The Milwaukee Journal* reported that about eight fire trucks responded to the early-morning alarm at the 87-year-old factory in Oak Creek. After the factory closed in 1985, the water-sprinkler system was disconnected. The buildings were deserted, and no one was injured. No cause for the fire was reported. There was no insurance coverage. Milligan & Higgins, 333 N. Michigan Ave., Suite 2032, Chicago, Ill. 60601 is the new source for bulk hide glue.

Switch update—Robert Terry, author of the article on the dust collector switch in *FWW* #68, has sent us a number of corrections: 1. Reverse the position of C2; the positive end should face R10. 2. Reverse the order of numbers 5, 6, 7 and 8 on the socket for U1. 3. Drill the board to add C5 electrolytic capacitor, Radio Shack part #271-038, parallel to and above Z2; solder its negative to C1 negative and its positive to BR positive. Terry also suggests doing the following: 1. Change F1 to AGC fuse, ½ amp. 2. Move relay wire nearest mounting hole to junction of R1 and F1. 3. If 120vac board power is frequently turned on and off, add Q3 and R12, which are new parts and available with instructions for S4 from Terry at Teckaid, Box 3272, Palm Beach, Fla. 33480.

One reader, R. Miller of Cincinnati, Ohio, caught the errors and added the recommendation that the unit be powered not by 120vac but by a 12.6v transformer to avoid damaging the

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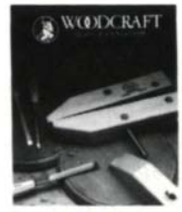

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components if the zener diode opens. Seems like a good idea.

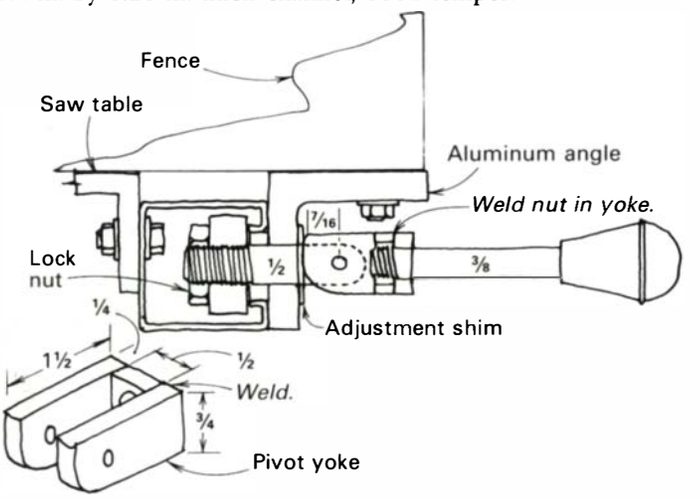
Then Paul N. Graf of Bellingham, Wash., wrote to say that his 10-year-old dust-collection system is based on a 12v doorbell transformer wired to a 12v relay and turned on and off by microswitches that he built into his blast gates. When the slide for any gate is opened, the system turns on; when all gates are closed, the system turns off.

Router danger—"Methods of Work" in *FWW* #68 showed a raised-panel jig that could have been safer, according to Patrick Warner of Escondido, Calif. The first, and obvious, problem is that the router bit should have a guard over it. The second problem is that the work is trapped between the tilted table and the bit. A misfeed could overload the strength of the bit's shank, causing shrapnel to fly. Router bits should be housed within the fence or worktable to contain any breakage.

Killer drill press defanged—Lyle E. Bohrer of Beaumont, Tex., was the first of many readers who wrote with a solution to the problem of needing three hands to work a drill press. His advice is to use a foot switch. Jay Stallman of Massillon, Ohio, suggested writing Linemaster Switch Corp., Box 120, Woodstock, Conn. 06281 for their catalog.

Fifth legs—Jeremiah de Rham's article on extension tables (*FWW* #65) prompted G.H.B. Bretschneider of Shoreham, Vt., to share the method his shop uses to secure the fifth or central leg to the extension slides. An ordinary 6-in.-long bed bolt engages an embedded nut in the leg. One advantage, in addition to strength, is that the leg can be easily removed if the table has to be moved from room to room.

Aluminum channel—A couple of readers mentioned they were having trouble finding aluminum channel for Marshall Young's shopmade rip fence (*FWW* #68). One source is J.T. Ryerson, a Chicago company with 26 distributors nationwide. They sell suitable short lengths. You can call J.T. Ryerson at (312) 762-2121 to find the nearest distributor. Ask for 3-in. by 1¾-in. by 0.26-in.-thick channel, 6061 temper.



Also, Rand Thompson of Palmdale, Calif., suggested a lever-action fence lock rather than Young's screw-action. As shown above, the fence locks in the up position, but could be designed to lock down instead. Shims and washers between the pivot yoke and the aluminum angle can adjust the action. □

Jim Cummins is an associate editor at FWW.

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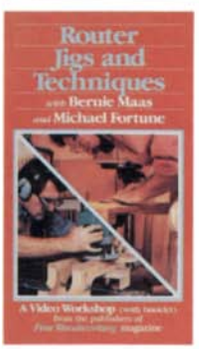

Video

Router Jigs and Techniques
with Bernie Maas and Michael Fortune

Experts Bernie Maas and Michael Fortune show you what your router can really do. Maas focuses on basic router joinery, covering mortise-and-tenon joints, sliding dovetails, and splines. Fortune shows how the router can work with a series of ingenious jigs to create a handsome hand mirror. A booklet is included. *60 minutes, $29.95 (Rental: $14.95)*
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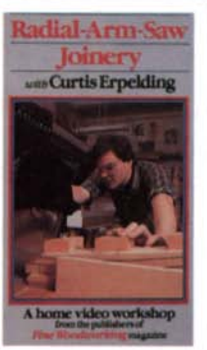

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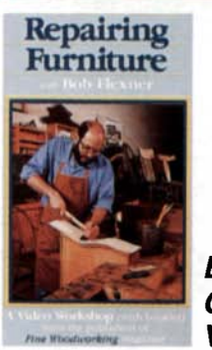

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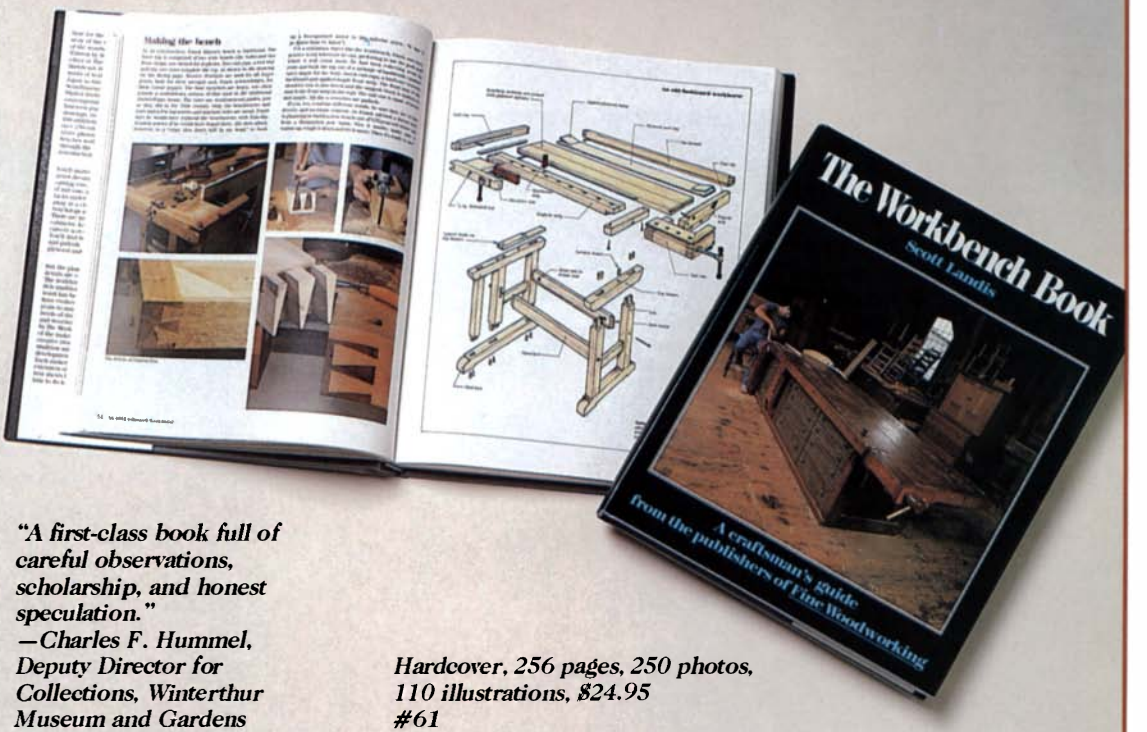

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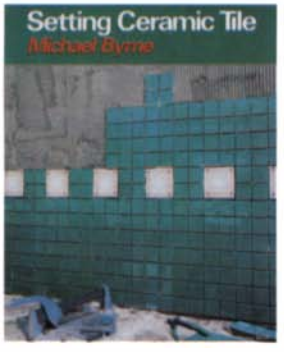

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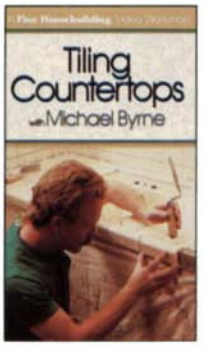

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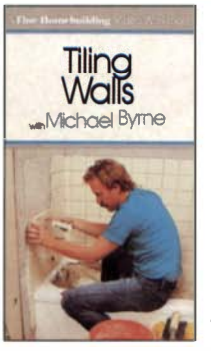

Video

Tiling Walls
with Michael Byrne

Once you learn what Byrne has to show you, you'll be able to tile any wall in your house. Byrne covers all of the techniques you need, from laying out to grouting. Working on a bathroom job site, he shows you how to handle out-of-plumb walls; maneuver around bathtubs, plumbing, and windows; cut tile using biters and a snapcutter; and see the creative possibilities in awkward situations. *75 minutes, $29.95 (Rental: $14.95)*
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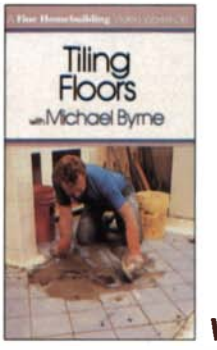

Video

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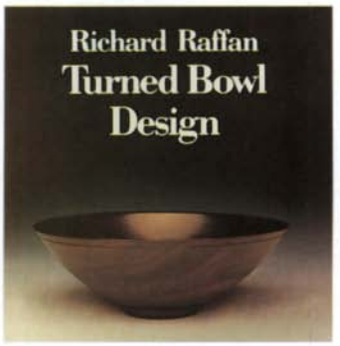
Woodturning



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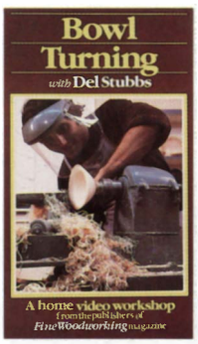

Video

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with Del Stubbs

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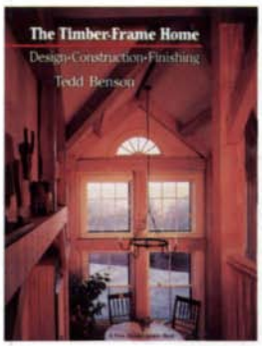
#607 (VHS), #608 (Beta)

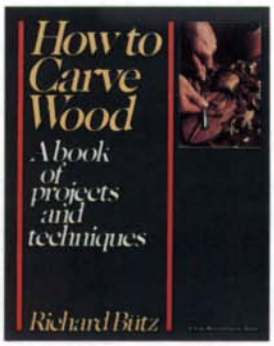
New Book



The Timber-Frame Home
by Tedd Benson

Find out how the age-old elegance of timber-frame construction can be made to meet modern needs. Tedd Benson, world-renowned timber-framer, author, and teacher takes you through strategy, design, engineering, and layout so you can understand the fundamentals of timber framing and the design and structural options available. You'll learn about modern insulation technology; how to choose and install lighting, wiring, and plumbing fixtures compatible with the timber frame; and how to top off your home with some elegant touches, like eave and cornice treatments. With inspiring color photos and technical drawings, this book is the perfect way to join the timber-frame revival. *Hardcover, 240 pages, 97 color photos, 140 drawings, $24.95*
#62

Also of Interest



How to Carve Wood
by Richard Bütz

Covers whittling, chip carving, wildlife carving, relief carving, lettering, and more. *Softcover, 215 pages, 288 photos, $13.95*
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Building a Houseful of Furniture
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Build all types of furniture with plans for 43 of Watts' pieces. *Softcover, 211 pages, 147 photos, 58 measured drawings, $19.95*
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by George Frank

An expert shares the secrets and stories of a lifetime in the trade. *Hardcover, 120 pages, $10.95*
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Video

Dovetail a Drawer
with Frank Klausz

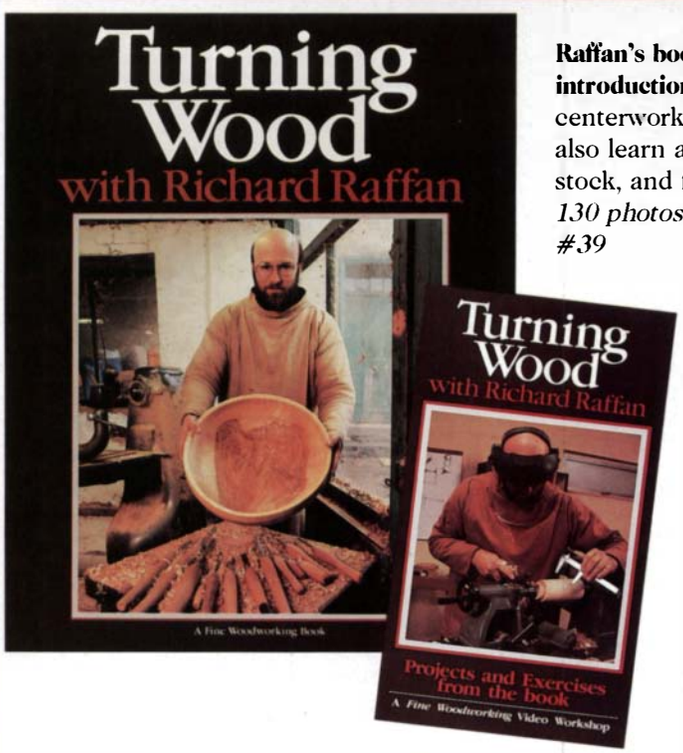
Make crisp, clean, properly fitting drawers by hand. *60 minutes, $29.95 (Rental: $14.95)*
#601 (VHS), #602 (Beta)

New

Fine Woodworking Design Book Four

The best in contemporary woodworking: 320 photos selected from over 10,000 sent to us. *Softcover, color, 149 pages, $16.95*
#65

FINE WOODWORKING CLASSIC—Book and Video



Raffan's book offers you an extensive introduction to woodturning. The focus is on centerwork and facework turning, but you'll also learn about your work area, lathe, tools, stock, and finishes. *Softcover, 165 pages, 130 photos, 15-page color gallery, $17.95*
#39

The video is produced and directed to capture the book's dynamic details. Raffan demonstrates his tool-sharpening techniques and a series of gouge and skew exercises before taking you through six projects. Keyed to the book. *117 minutes, $39.95 (Rental: $14.95)*
#611 (VHS), #612 (Beta)

The Raffan Set
Book and video: $49.95
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Laser Cut Blade Bodies

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The carbide is induction brazed onto Freud's laser produced blade bodies. This process is computer controlled to guarantee uniformity of brazing. A razor edge is then put on the teeth with a 400 grit diamond wheel. This guarantees you of a blade that will provide a maximum of production hours before sharpening is needed.

Item No.	Diameter	Teeth/ Grind	General Purpose	Cross Cut Wood	Plywood	Plastic	Rip Wood	List	Sale
LM72M008	8	24 Rip	NR	NR	NR	NR	E	68.48	51.48
LM72M010	10	24 Rip						77.93	50.68
LM72M012	12	30 Rip						104.03	65.98
LU78M008	8	64 TCG	G	G	E	E	NR	112.57	93.98
LU78M010	10	80 TCG						140.63	104.48
LU78M012	12	96 TCG						169.29	135.68
LU78M014	14	108 TCG						199.80	141.98
LU84M008	8	40 Comb	E	G	G	NR	G	85.96	59.58
LU84M009	9	40 Comb						85.31	59.58
LU84M011	10	50 Comb						89.54	52.18
LU84M012	12	60 Comb						135.31	97.98
LU84M014	14	70 Comb						161.34	116.48
LU85M008	8	64 ATB	NR	E	G	G	NR	112.08	73.98
LU85M009	9	72 ATB						122.56	76.98
LU85M010	10	80 ATB						133.25	85.58
LU85M012	12	96 ATB						161.40	114.98
LU85M014	14	108 ATB						179.06	124.88

E = Excellent G = Good F = Fair NR = Not Recommended
8", 9", and 10" have 5/8" Bore.
12" and 14" saws have 1" Bore.

...ON ADVANCED LASER-CUT DADO SETS!

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DS306	6" set	5/8"	176.54	110.98
DS308	8" set	5/8"	216.18	118.98

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25 x 60	24.95	21.95
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Sliding Table	PRICE
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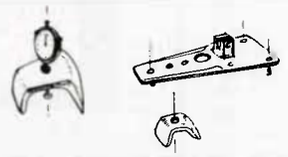
4 PC/SET	8" x 1⅛" x ⅛"	46.95
3 PC/SET	12" x 1⅛" x ⅛"	54.95
4 PC/SET	12" x 1⅛" x ⅛"	72.95
3 PC/SET	13" x 1⅛" x ⅛"	57.95
3 PC/SET	15" x 1" x ⅛"	62.95
3 PC/SET	16" x 1" x ⅛"	65.95
3 PC/SET	20" x 1" x ⅛"	83.95
4 PC/SET	20" x 1" x ⅛"	110.95
3 PC/SET	24" x 1⅛" x ⅛"	112.95
4 PC/SET	24" x 1⅛" x ⅛"	149.95

Carbide Tipped Available — $7 per inch



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MODEL	SWING	CHUCK	TYPE	PRICE
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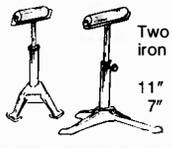
BW-1412B	14"	½"	BENCH	199.00
BW-1458B	14"	⅝"	BENCH	249.00
BW-1758B	17"	⅝"	BENCH	269.00
BW-1412F	14"	½"	FLOOR	269.00
BW-1458F	14"	⅝"	FLOOR	319.00
BW-1758F	17"	⅝"	FLOOR	339.00
BW-2501F	20"	⅝"	FLOOR	569.00

BRIDGEWOOD® ROLLER STANDS



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D1060 CT Cut Off - 60 tooth TCG	$42.95
D1080 TA Trim - 80 tooth ATB	$51.95
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Illustration shows ½" Adapter inserted

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2" x 3"	15.50	3" x 4½"	22.50	½" Adapter	1.50
2½" x 3"	16.00	2½" x 6"	25.50		

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MODEL	H.P.	C.F.M.	TYPE	PRICE
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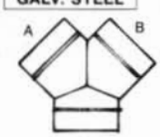
SF-015	1	750	2-BAG	319.00
BW-002A	2	1182	2-BAG	429.00
BW-003A	3	1883	4-BAG	595.00
SF-003	3	1883	4-BAG	795.00

DUST COLLECTOR ACCESSORIES

CREATE THE SYSTEM TO MEET YOUR NEEDS!!!

Y-FITTINGS GALV. STEEL



A	B	C	PRICE	MODEL
5"	5"	8"	$21.50	Y-85
6	6	8	22.00	Y-86
6	6	7	21.00	Y-76
5	5	7	20.00	Y-75
5	5	6	17.00	Y-65
5	5	5	16.50	Y-55
4	4	5	16.00	Y-54
4	4	4	16.00	Y-44
3	3	4	16.00	Y-43

REDUCERS GALV. STEEL

MODEL	PRICE
R-4-3	$ 9.50
R-5-4	9.50
R-6-5	10.50
R-6-4	10.50
R-7-5	11.50
R-7-6	11.50
R-8-5	12.50
R-8-6	12.50

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GA-3	$14.00	$11.50
GA-4	15.00	12.50
GA-5	19.50	15.50
GA-6	24.00	19.50
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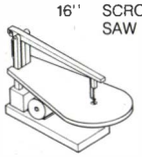

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#890
1.5hp Router
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Mdl#	Description	Cost
100	⅞hp Router	92
830	1hp Router	93
691	1.5hp w/D-Handle	126
536	1.5hp XHD Router	164
537	1.5hp XHD w/D-Handle	196
516	3hp 5-spd Router	323
520	3hp XHD Router	300
895	1.5hp Router w/Table	169
696	Shaper Table	106
309	Trimmer	64
310	Trimmer	114
312	Offset Trimmer	129
319	Tilt-Base Trimmer	136

Circular Saws

#345
Saw Boss 9amp
$95

Mdl#	Description	Cost
	Saw Boss Blades	
12151	6" Combination	4
12152	6" Plywood	4.50
12154	6" Carbide Tipped	6
315-1	7¼" Top Hndl 13amp	99
9315-1	7¼" Top Handle w/case & Carbide Blade	119
617	7¼" Push Hndl 13amp	99
9617	7¼" Push Handle w/case & Carbide Blade	119
587	7¼" Computer Controlled 14.5amp	149
386-1	8¼" Top Hndl 13amp	125
314	4½" Wrm Gr Trim Saw	119
9314	4½" Trim Saw w/case	149
12274	7¼" Crbd tipped Blade	8

Fasteners & Drywall Drivers

#7540
4000rpm vs reversing Drywall 5amp
$109

Mdl#	Description	Cost
7541	XHD rev Teks 5amp	117
7542	XHD vs rev Teks 5amp	119
655	4000rpm vs reversing Drywall 4amp	85
7544	XHD rev Drywall 5amp	114
7545	XHD vs rev Drywll 5amp	105
7523	VS rev positive clutch Screwdriver 5amp	135
7525	Rev positive clutch Screwdriver 5amp	136
7533	VS rev adjst cltch 5amp	159
399	Drywall Cutout	89

Belt & Finish Sanders

#360
3"x24" BS w/bag
$179

#330
Speed Bloc Finish Sander
$52

351	3"x21" BS w/o bag	134
352	3"x21" BS w/bag	123
361	3"x24" BS w/o bag	170
362	4"x24" BS w/bag	189
363	4"x24" BS w/o bag	183
503	3"x24" Wrm Gear w/bg	335
504	3"x24" Wrm Gr w/o bg	325
505	½ Sheet Finish Sander	104

Jig Saws

#7548
Top Handle 4.8amp
$119

7648	Barrel Grip 4.8amp	119
7348	Tp Hndl vs Bayonet Saw	115
548	Worm Gr Bayonet Saw	159
9548	Worm Gear w/case	179

Door Hanging Equipment

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Porta-Plane Kit
$179

513	Lock Mortiser	699
517	Lock Face Template	126
59381	Hinge Butt Template Kit	149
126	Porta-Plane 7amp	167
102	Door Hanging Kit	315

Reciprocating Saws

#9629
Variable Speed w/case 8amp
$135

627	2-spd Tiger Saw 8amp	125
9627	2-spd w/case 8amp	129

Planes

#9852
Versa-Plane Kit
10amp
$275

320	Abrasive Plane	90
367	3¼" Plane 6.5amp	124

Stikit™ Rolls

13608	80 Grit	11
13600	100 Grit	9
13620	120 Grit	9
13616	180 Grit	9
13622	220 Grit	9
13599	Dispenser	8
13597	Stikit Pad for #330	3
13598	Stikit Pad for #505	5

Drills

#7514
½" vs 0-750rpm 5amp
$109

800	Cordless Hammer Drill/ Screwdriver	155
810	Cordless Screwdriver	120
664	¼" T-Handle	115
7501	¼" vs 0-1700rpm 5amp	112
666	⅜" T-Handle	112
621	⅜" vs 0-1000rpm 4amp	84
7511	⅜" vs 0-1000rpm 5amp	109
7557	⅜" vs Rt. Angle 500-2200rpm 5.2amp	184
7558	½" 2-spd Rt. Angle w/case 8amp	178
7554	½" D-Handle 8amp	154
7564	½" Spade Hndl 8amp	154
632	½" D-Handle 6amp	133
635	½" Spade Hndl 6amp	140

Sanders, Polishers, Grinders

#662
7" Angle Disc Sander
$139

303	7" Paint Remover	149
304	7" Disc Sander	114
305	7" Disc Polisher	114
661	7" Angle Disc Polisher	139
7645	5" Angl Grinder 6.6amp	110
7647	7"/9" Sander/Grinder 15amp	145

Plate Joiner

#555
$159
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PRO TOOLS, INC.

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Thousand Oaks, CA 91362
805/497-1610

RYOBI TOOLS

		List	Sale
S500A	3"x5½" Finish Sanders	70	40
AP10	10" Surface Planer	820	399
SU6200	½ Sheet Finish Sander	210	130
B7075K	3"x21" Belt Sand. w/bag/cse.	237	130
B7100	3"x24" Belt Sand. w/bag	281	150
B7200	4"x24" Belt Sand. w/bag	351	182
W640	7¼" 13 amp Circular Saw	210	114
TS380	14" Mitre Box	773	385
RA200	8¼" Radial Saw	515	285
TS251U	10" Mitre Saw	392	188
JSE60	V/Speed Jig Saw	234	128
RA2500	10" Radial Arm Saw	679	392
TR30U	Laminate Trimmer	163	88
R150K	1 H.P. Ping. Router w/cse	206	119
R230	1½ H.P. Router	257	165
R331	2 H.P. D-Handle Router	304	189
R500	2¼ H.P. Plunge Router	326	198
L120UK	3⅝" Planer w/cse	206	119
L580A	6⅛" Planer 10.5 amp	548	298
S600A	¼ Sheet Finish Sander	88	59

YOUR ATTENTION PLEASE!
All Above Ryobi Tool Prices
Take Additional 10% OFF Sale Prices

NEW FROM RYOBI

TS200—8¼" Compound Mitre Saw
List 299 Special Sale 149
RE600—3 H.P. V/Spd. Plunge Router
List 398 Special Sale 209
BE321—3"x21" V/Spd. Belt Sander
List 259 Special Sale 129

MILWAUKEE TOOLS

PRICE BUSTERS

		List	Sale
0224-1	⅜" drill 4.5A magnum	179	109
0234-1	½" drill 4.5A magnum	179	109
0244-1	½" drill 4.5A magnum	179	109
0222-1	⅜" drill 3.3A 0-1000 rpm	165	100
0228-1	⅜" drill 3.3A 0-1000 rpm	145	100
0375-1	⅜" close quarter drill	195	118
0210-1	⅜" cordless drill 2 spd	195	115
0212-1	⅜" cordless drill v/spd.	229	129
6539-1	Cordless screwdriver 190 rpm	103	59
3102-1	Plmbrs rt angle drill kit	295	175
3002-1	Electricians rt angle drill	290	169
5399	½" D-hdle ham drill kit	284	165
1676-1	H.D. Hole Hawg w/cs	375	230
6511	2 sp sazsall w/cs	207	119
6405	8¼" circle saw	199	122
6750-1	Drywall gun 0-4000 4.5A	141	89
6798-1	Tek screwdriver	173	105
6226	2 sp bandsaw w/case	416	250
6234	TSC bandsaw w/case	416	250
6507	TSC sazsall w/case	219	129
6170	14" chop saw	349	209
6012	Orbital sander 3⅝"x7⅜"	179	100
6014	Orbital sander 4½"x9¼"	189	108
6305	6¼" cordless circle saw	239	134
6753-1	Drywall gun 0-4000 3.5A	125	73
8977	Var. temp heat gun	108	70
0214-1	⅜" v. spd. cordless drill	195	125
5397-1	⅜" v. spd. hammer drill kit	227	145
0211-1	⅜" cordless driver drill	205	120
5371-1	½" v. spd. hammer drill kit	313	199
3107-1	½" v. spd. rt angle drill kit	305	189
6754-1	Drywall gun 0-4000 4.5A	173	115
6232	4¾" bandsaw w/case	452	275
6747-1	Drywall driver-0-2500	141	85
0230-1	⅜" drill 0-1700 rpm	165	103
3300-1	½" v. spd. magnum rt angle kit	279	180
5620	Router 1 H.P.—8 amp	289	175
5660	Router 1½ H.P.—10 amp	299	180
5680	Router 2 H.P.—12 amp	350	220
5455	⅞" polisher 1750 rpm	199	130
5535	7" polisher 2800 rmp	209	140
6215	16" chain saw	229	140
8975	Heat gun	81	55
6366	7¼" circular saw	187	106
6368	7¼" circular saw	216	125
0216-1	2 spd cordless drill Hi-torque	215	139
2035-1	½" drill keyless chuck mag	184	125
6016	¼ sheet pad sander	65	40
6147	4½" sander/grinder w/cse	182	110
8950	8 gal wet/dry vac.	189	130
8955	10 gal wet/dry vac	279	189
0239-1	½" drill keyless chuck	174	115
6749-1	Drywall gun 0-2500 4.5A	184	122
6377	7¼" worm drive saw	275	155

FREUD SAW BLADES

⅝" Bore—Industrial Grade
CARBIDE TIPPED SAW BLADES

Item No.	Description	Diam.	Teeth	List	Sale
LU72M010	Gen'l Purp.	10"	40	78.49	36
LU82M010	Cut-off	10"	60	98.89	42
LU84M011	Combination	10"	50	85.25	37
LU85M010	Super Cut-off	10"	80	126.90	62
LM72M010	Ripping	10"	24	74.22	36
LU73M010	Cut off	10"	60	91.16	38
PS203	Gen'l Purp.	7¼"	24	31.42	19
PS303	Plywood	7¼"	40	37.74	22
DS306	6" Dado - Carbide			168.13	92
DS308	8" Dado - Carbide			205.89	108
F0	1¾"x⅝" Biscuits 1000-Qty.				25
F10	2⅛"x¾" Biscuits 1000-Qty.				25
F20	2⅜"x1" Biscuits 1000-Qty.				25
FA	Assorts Biscuits 1000-Qty				28

MAKITA CORDLESS

Model		List	Sale
6070DW	⅜" var. spd. rev. 7.2v	108	61
6071DWK	⅜" var. spd. rev. w/removable batt	180	105
5081DW	3⅜" saw kit	222	130
5600DW	6¼" circular saw	284	167
6010DWK	⅜" cordless drill kit	174	102
6010SDW	⅜" cordless drill	94	55
0A30000W	⅜" angle drill	228	133
6010DL	⅜" drill w/flashlight	188	113
6012HDW	2 spd. driver drill w/clutch & case*	210	113
6710DW	Cordless screwdvr kit	176	103
6092DW	V/spd. & case*	218	115
6093DW	V/spd. w/clutch & case*	232	123
6891DW	Drywall gun 0-1400	204	120
632007-4	9.6 volt battery.	48	33
632002-4	7.2 volt battery	40	30
5007NBA	7¼" saw w/elec. brake	208	127
5008NBA	8¼" saw w/elec. brake	232	145
804510	Sander	92	52
9900B	3"x21" belt sander	234	138
9924DB	3"x24" belt sander w/bag	248	145
9035	⅓ sheet finish sander	96	53
9045B	½ sheet finish sander	194	109
9045N	¼ sht fin. sand. w/bag	196	110
4200N	4⅜" circ. saw 7.5 amp	190	112
5201NA	10¼" circ. saw 12 amp	480	300
4301BV	Orb. v/sp jig saw 3.5 amp	248	145
JR3000WL	2 sp recip saw w/cse	198	122
JR3000V	Vs. recip saw w/case	208	125
LS1020	New 10" mitre saw	396	210
9820-2	Blade sharpener	302	190
410	Dust collection unit	410	269
3705	Offset trimmer	228	125
1900BW	3¼" planer w/case	198	116
1100HD	3¼" planer w/case	344	199
9207SPC	7" sander-polisher	250	139
3601B	1⅜ H.P. router.	216	120
3700B	½ H.P. trimmer	162	90
9501B	4" grinder	146	65
B04530	6" round sander	98	55
B04550	¼" pad sander w/bag	92	46
DA3000R	⅜" angle drill	222	130
DP4700	½" v/sp w/rev. 4.8 amp	178	110
HP1030W	⅜" v.s.r. hammer drilt w/cs	176	102
6300LR	½" angle drill w/rev	302	176
2708W	8¼" table saw	396	250
2711	10" table saw w/brake	698	465
GV5000	Disc sander	108	67
6800DB	2500 rpm 3.5 amp	146	80
6800DBV	0-2500 rpm 3.5 amp	156	88
6801DB	4000 rpm 3.5 amp	146	80
6801DBV	0-4000 rpm 3.5 amp	156	85
2030N	12" planer/jointer	2580	1495
2040	15⅝" planer	2180	1240
1805B	6¼" planer kit w/case	548	340
JV1600	var. speed jig saw	186	125
JV2000	var. speed orb. jig saw	206	135
5005BA	5½" circular saw	192	113
9503BH	4½" sander-grinder kit	166	83
DP3720	⅜" drill rev. 0-1800 rpm	99	55
6510LVR	⅜" drill rev. 0-1500 rpm	144	77
6013BR	½" drill rev. 6 amp	208	125
5402A	16" circular saw - 12 amp	542	325
3612BR	3 H.P. plunge router	338	187
9401	4"x24" belt sander w/bag	288	165
3620	1¼ H.P. plunge router w/case	166	92
4302C	V/spd. orb. jig saw	256	155
5077B	7¼" Hypoid saw.	250	145
LS1430	14" Mitre saw	630	439
2414	14" cut-off saw AC/DC	338	222
5007NB	7¼" circ saw 13 amp	194	114
3612B	3 HP plunge router sq/b	338	187

SKIL SIZZLERS

Model		List	Sale
5510	(551) 5½" circ saw	130	82
5625	(552) 6½" circ saw	164	108
5650	(553) 7¼" circ saw	164	108
5665	(554) 8¼" circ saw	185	118
5750	(807) 7¼" circ - drop foot	175	115
5765	(808) 8¼" circ - drop foot	204	130
5790	(810) 10¼" circ - drop foot	350	225
5825	(367) 6½" worm saw	257	139
5865	(825) 8¼" worm saw	283	149
4575	Vari - orbit jig saw	120	82
3810	10" Mitre saw	349	179
595	3"x21" sander w/bag 5.5A	197	125
7565	¼" palm sander	62	41
2535-04	7.2V drill w/x-tra batt	142	97
2735-04	12V drill w/x-tra batt	210	118
77	7¼" worm drive	261	135
5350	2½ HP circ. saw	90	69
5250	2¼ HP circ. saw	66	49

BOSTITCH PNEUMATIC TOOLS

Model		List	Sale
N80C	Utility coil nailer framing, decking, sheathing - 1½"-3¼" nails	725	470
N80S	Stick Nailer framing, decking, sheathing - 2"-3½" nails	725	470
T36-50	Sheathing and decking stapler	525	340
N12B-1	Coil roofing nailer - ⅞"-1¾" nails	725	470
T35	Roofing staplers applic. of asphalt strip shingles	425	275
T31	Brad nailer and stapler	229	149

DELTA TOOLS

34-410 Saw Complete w/1½ H.P. motor & stand
679.00

33-150 Saw Buck
509.00

28-243S 14" Band Saw w/open stand, light attach. ½ H.P. motor
499.00

28-283F 14" Band Saw w/enclosed stand & ¾ H.P. motor
599.00

43-122 Lt. Duty Shaper w/stand & 1 H.P. motor
499.00

17-900 16½" Floor Drill Press
285.00

23-700 Wet/Dry Grinder
125.00

PIRANHA By Black & Decker

CARBIDE TOOTH SAW BLADE

- Advanced saw blade technology. Exclusive design out-performs regular carbide blades.
- An excellent all-purpose blade.

Model #	Size	# Teeth	List	Sale
73-756	6-1/2	36	27.75	15.20
73-717	7-1/4	18	12.30	7.50
73-737	7-1/4	24	15.68	8.90
73-757	7-1/4	40	28.78	16.20
73-758	8	40	40.70	22.60
73-759	8-1/4	40	41.48	23.00
73-739	9	30	30.40	17.10
73-769	9	60	65.05	35.70
73-740	10	32	31.95	24.20
73-770	10	60	65.55	36.25
73-715	5½	16	13.25	7.30

"NEW" BULLET DRILL BIT SETS

		List	Sale
14347	8 piece 1/16 to ¼ HSS	18.45	11.95
14350	11 piece 1/16 to ¼ HSS	27.18	14.95
14353	14 piece 1/16 to ½ HSS	49.03	28.95
14356	21 piece 1/16 to ⅜ HSS	86.50	49
14359	29 piece 1/16 to ½ HSS	162.75	89

ADJUSTABLE HANDSCREWS

Item No.	Jaw Length	Open Cap	List	Sale	Box of 6
#5/0	4"	2"	12.05	7.75	41.85
#4/0	5"	2½"	12.95	8.80	47.50
#3/0	6"	3"	13.88	9.35	50.50
#2/0	7"	3½"	14.92	9.90	53.50
#0	8"	4½"	16.61	10.95	59.10
#1	10"	6"	18.98	12.60	68.00
#2	12"	8½"	21.78	14.95	80.75
#3	14"	10"	27.62	18.35	99.00
#4	16"	12"	35.93	26.25	141.75

STYLE 37 2½" Throat ¼"x¾"

Item No.	Jaw Length	List	Sale	Box of 6
3706	6"	8.27	5.80	31.35
3712	12"	9.17	6.25	33.75
3718	18"	10.12	7.30	39.45
3724	24"	11.07	7.75	41.85
3730	30"	12.35	8.70	47.00
3736	36"	13.49	9.40	50.75

PONY CLAMP FIXTURES

Model		List	Sale	Lots of 12
50	¾" black pipe clamps	11.68	8.25	90
52	½" black pipe clamps	9.73	6.75	73

STYLE J. ADJUSTABLE HANDSCREW KITS

Model	Open Cap	List	Sale
J04	4	6.47	4.00
J06	6	7.38	4.50
J08	8	8.31	5.10
J10	10	9.69	5.95
J12	12	12	7.40

BOSCH

		List	Sale
1581VS	Top hdle. jig saw	235	129
1582VS	Barrell grip	220	119
1942	Heat gun 650°-900°	99	69
1272D	3"x24" B.S. w/bag	295	195
1273D	4"x24" B.S. w/bag	315	219
11-212	Bulldog ¾" SDS rotary	339	189
1196VSRK	⅜" vs hammer drill	205	119
1198VSR	½" vs hammer drill	219	129
1608	5.6 amp lam trimmer	135	75
1608L	Same as above w/trimguide	139	79
1608T	5.6 amp tilt base trim	155	89
1609	5.6 amp offset base trim	199	119
1609K	Lam installers kit w/1609	285	169

Offset base, trimmer tilt base, trimguide, ¼" collet, collet nut, wrenches, hex keys and case

1601	1 H.P. 790 watt motor 25,500 rpm	159	95
1602	1½ H.P. 1000 watt motor 25,000 rpm	195	109
1603	1½ H.P. D handle 1000 watt	219	119
1604	1¾ H.P. 10 amp 25,000 rpm	219	119
1606	1¾ H.P. D handle 1120 watt	243	129
3258	3¼" planer w/blade guard 5.7 amp	205	139
3270D	3"x21" dustless belt sander 5 amp	219	145
1273DVS	Var spd. 4"x24" 6 speed range sander 10.5 amp	339	219
1611	3 H.P. trigger hdle, plunge base slo start	339	219

HITACHI 15" MITRE SAW

#C-15FB List 630.00 Sale 389.00

FREUD 15" CARBIDE BLADE

108 Tooth LU85M015
List 181.00 Sale 118.00

BLACK & DECKER!!!

Black & Decker Cordless

Model		List	Sale
1950	Hi-torque drill kit w/case	190	115
1980	Clutch scrudrill kit w/case	193	115
1987	V/spd. scrudrill kit w/case	209	125
1947	V/spd. hi-torque kit w/case	201	117

Black & Decker Deals

Model		List	Sale
2054	Versa clutch screwgun - teks & wd screws	232	140
2037	0-4000 5 amp drywall gun	160	92
1175	⅜" 0-2000 3.5 amp drill	96	54
2034	0-4000 4.5 amp drywall gun	138	87
4015	½ sheet sander 3 amp	190	109
2600	⅜" 0-1200 4.5 amp drill	119	73
4018	½ sheet sander 2.3 amp	122	74

Black & Decker Saw-A-Thon

Model		List	Sale
3051	7¼" worm drive 13 amp	246	142
3103	2 spd recip w/case	190	127
3028	7¼" circ w/18 tooth carb blade	125	78
1703	10" mitre w/60 tooth carb blade	313	186
3047-09	7¼" super saw cat w/brake	270	164
3048-09	8¼" super saw cat w/brake	285	174
3157	Orb v/spd. jig saw	212	126
3153	V/spd. jig saw	205	123

NEW FROM BLACK & DECKER

1707 8½" Compound Crosscut Saw automatic brake—cuts 2x10 at 90° 2x6 at 45°
List 770.00 Sale 469.00

PORTER CABLE

Model		List	Sale
630	1 H.P. router 6.8 amp	165	115
690	1½ H.P. router 8 amp	205	125
691	1½ H.P. router D hdle	225	156
536	1½ H.P. speedmatic router	300	207
518	3 H.P. 5 speed router	520	357
520	3 H.P. 15 amp router	490	340
309	3.8 amp lam trimmer	135	93
310	3.8 amp H.D. lam trimmer	190	132
312	Offset base lam trimmer	205	142
319	Tilt base lam trimmer	221	152
695	1½ H.P. router/shaper	283	197
696	H.D. shaper table	155	108
351	3"x21" belt sander w/o bag	202	140
352	3"x21" belt sander w/bag	212	148
360	3"x24" belt sander w/bag	297	205
361	3"x24" belt sander w/o bag	277	192
362	4"x24" belt sander w/bag	312	215
363	4"x24" belt sander w/o bag	297	205
587	7¼" speedtronic 14.5 amp circ saw	220	152
315-1	7¼" top handle 13 amp circ saw	178	109
617	7¼" pushhandle 13 amp	178	109
346-1	6½" top handle 12 amp	166.50	115
368-1	8¼" top handle 13 amp	188	131
314	4½" trim saw 4.5 amp	185	128
548	X HD bayonet saw	245	170
9548	X HD bayonet saw w/case	265	185
9629	Recip saw v/sp 8 amp	225	139
9627	Recip saw 2 speed 8 amp	215	133
666	⅜" H.D. vsp drill - Hdl	176	122
620	⅜" H.D. 4 amp 1000 rpm	132	92
621	⅜" H.D. v spd. 0-1000 rpm	140	98
320	Abrasive plane 3 amp	140	98
126	Porta plane 7 amp	280	193
9118	Porta plane 7 amp kit	315	218
653	Versa plane 10 amp	399	278
9652	Versa plane 10 amp kit	419	288
7545	0-2500 v spd. drywall gun 5.2 amp	163	114
505	½ sheet pad sander	187	116
7511	⅜" v spd. drill 5.2 amp	175	122
7514	½" v spd. drill 0-750	180	125
303	Paint remover	220	150
304	7" disc sander 4000 rpm	187	130
305	7" disc polisher 2000 rpm	187	130
367	3¼" planer 6.5 amp	210	145
537	1½ H.P. D hdle router	315	220
7548	Top hdl jig saw 4.8 amp	205	137
7648	Barrel grip jig saw 4.8 amp	205	137
330	Speed block sander ¼ sheet	97	56
555	Plate biscuit joiner 5 amp w/case	269.95	162
345	6" saw boss 9 amp	154.50	107
5060	"Stair Ease" stair templet	194	135
5061	"Stair Ease" hard wood stair templet	204	142
655	0-4000 drywall gun 4 amp	125	87
7540	0-4000 5.2 amp gun	158	110
100	⅞ H.P. router.	155	107
59381	Door hanging kit	219	152
399	Drywall cutout unit	104.50	69
43218	Drywall cutout unit replacement bit	6.75	5.50
5008	Dovetail template kit	95	69
97650	½" v/spd hammer drill w/case	211	149
5009	Mortise & Tenon jig	49.95	38

STICK IT PAPER

13599	Dispenser	21.95	13
	80 grit paper 10 yd roll	13	10
	100, 120, 180, 220 10 yd roll	11.50	9

Now You Can Solve All Your Feet-Inch Problems Quickly & Simply!

Now for a limited time Only $79.95— You Save $10.00!

Now you can save time and cut costly errors by solving all your woodworking problems right in feet, inches and fractions—with the new *Construction Master™* feet-inch calculator.

The perfect tool for cabinet making, design, framing, estimating, stairs, masonry, concrete, square footage, lineal footage, stringers, roof rafters [inc. hips and valleys], squaring-up rooms and much, much more.

Adds, subtracts, multiplies and divides right in feet, inches and any fraction—*1/2's, 1/4's, 1/8's, 1/16's, 1/32's, up to 1/64's*—or no fraction at all. And you can mix fractions.

Converts between all dimension formats— *feet-inch-fraction, decimal (10th's, 100ths), yards, inches and meters*—including square and cubic. All with just one button.

Solves diagonals and right triangle instantly *and* directly in feet and inches. You just enter the two known sides, and press one button to solve for the third. With rafters you can also use "pitch" and 1 side. Solves hips and valleys too!

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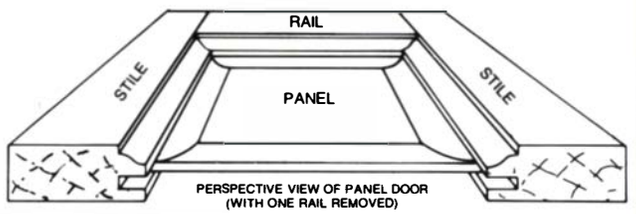

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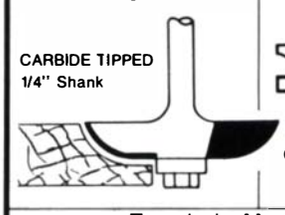

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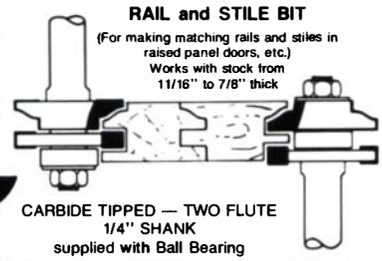

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9900B, 3x21 Sander w/Bag 145
9924DB, 3x24 Sander w/Bag 145
9401, 4x24 Sander w/Bag 165
JR3000V, V.S. Cutsaw w/Case 124
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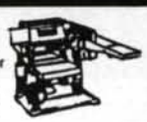

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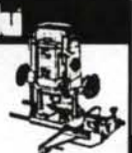

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1609K, 3in1 Trimmer Kit 159
1581VS, Top Handle vs Jigsaw 124
1582VS, Barrel Grip vs Jigsaw 117
11212VSR, ¾" Bulldog Rtry Hammer 199
920VSRK, 9.6V, 3/8 VSR Drill Kit 129
921VSRK, 9.6V, 3/8VSR DrKt/Clutch 139
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1654, 7¼" Saw w/ct blade 109

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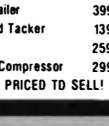

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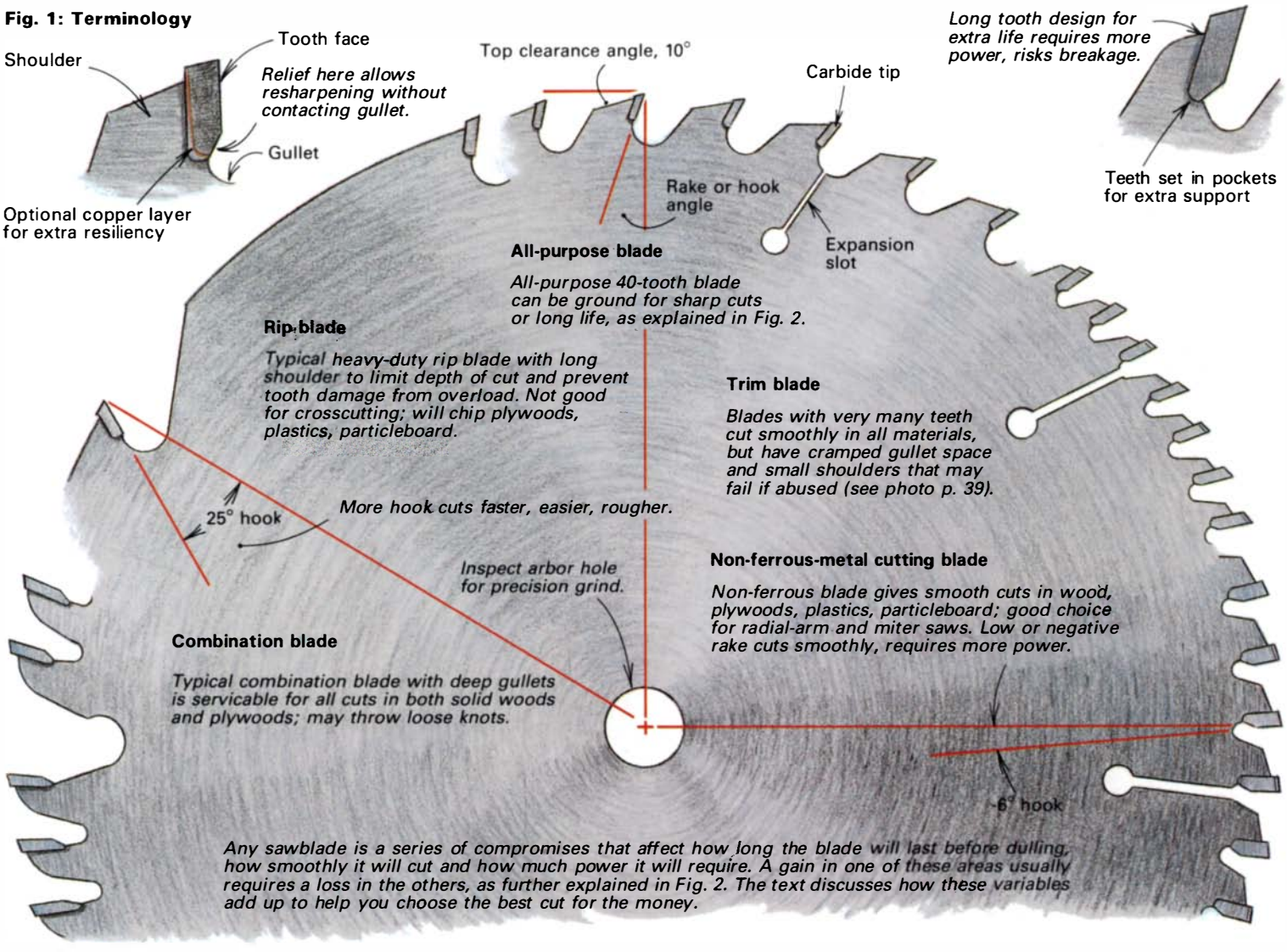
Carbide Sawblades

Compromises in quality make for affordable cuts

by Jim Cummins

Fig. 1: Terminology



Any sawblade is a series of compromises that affect how long the blade will last before dulling, how smoothly it will cut and how much power it will require. A gain in one of these areas usually requires a loss in the others, as further explained in Fig. 2. The text discusses how these variables add up to help you choose the best cut for the money.

A top-of-the-line carbide tablesaw blade costs more than some motorized 10-in. tablesaws. Does it make sense for a woodworker to shell out $100-plus for such a blade? There's no single answer, but after researching this article, I formulated a two-part rule of thumb: First, don't spend more than 15% of the cost of your tablesaw on any one blade; second, figure on spending from 25% to 50% of the saw's cost on three or four special-purpose blades that will let you cut just about anything. While this may sound arbitrary, it's based on careful observations.

No sawblade can be better than the tablesaw powering it. In fact, I spent about $900 on sawblades for my Sears saw in the first five years I ran my shop, ignorantly buying toothier blades each time in hopes of finding one that would cut both smoothly and at an economical rate. It wasn't until I bought a Rockwell/Delta Contractors Saw with about 50% more horsepower that I found out I had some real winners. Four of these are in constant use today, while the rest of my investment mostly hangs on the wall.

I'll tell you what my old favorites are, but I'm convinced that the most significant part of my list is the *type* of blade, not the manufacturer: a 10-tooth ripping blade (Winchester), which can slog through full-depth cuts on anything I've ever fed it; a 40-tooth combination blade (Freud) that's on the saw 95% of the

time; an 80-tooth, thin-kerf plywood blade (Freud); and a 120-tooth no-set steel blade (Simonds), which I use for cutting aluminum picture-frame molding, but which can give me a glassy surface on wood on the few days a year I want it. At one time, all my blades were steel. I switched to carbide because my steel blades dulled too quickly, especially in abrasive, man-made materials. One sawblade manufacturer I talked with mentioned an informal test his company had done comparing two types of carbide blades with a steel blade. One carbide blade cut 12,000 linear ft. of particleboard; the other cut 9,000 ft.; the steel blade was hopelessly dull after 300 ft.

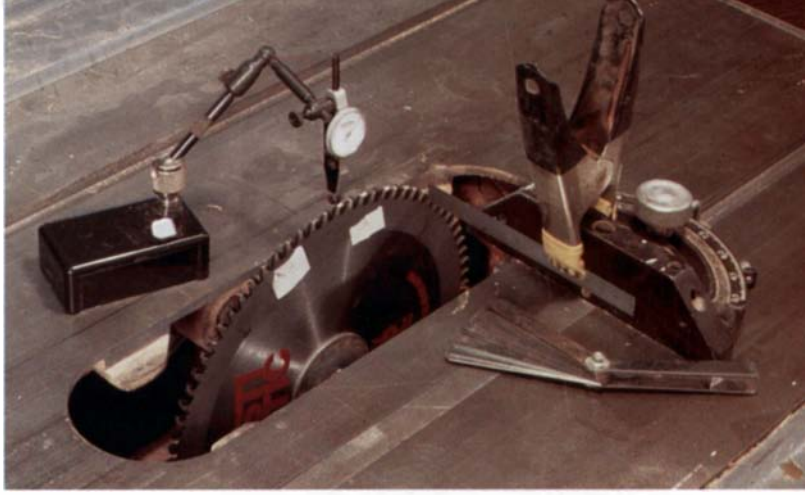
My saw is now about 10 years old, and while it's in pretty good tune and a darn nice machine for the money, it's incapable of showing up noticeable differences in blades that cost more than about $55. But when I tried the same expensive sawblades on a new, fine-tuned, General tablesaw, their special qualities became apparent. The owner of the saw, Jim Van Etten of Perkasie, N.J., had recently spent three hours getting the blade perfectly parallel with the miter slots, aligning his Biesemeyer fence and adjusting his shopmade sliding tables. This attention is critical for smooth, splinter-free cuts. One easy day-to-day test for proper fence alignment is that both sides of the cut should show an X-pattern resulting from the front teeth cutting down and the back teeth cutting up. For some applications, the back of the fence can be canted a hair away from the blade. This will give a smoother cut on the fence side of the blade, but on the offcut, the teeth at the back of the blade will cause a rough cut and surface tearout.

For this article, I interviewed major sawblade manufacturers, as well as some small saw shops. I called woodworkers around the country for their opinions. I bought, and borrowed, about four dozen blades, tried them in my shop and persuaded other woodworkers to try them in theirs. Taking a look at this assortment is by no means a "test." That would require subjecting perhaps three dozen blades of each design from each manufacturer to test cuts until they were dull. Without such rigor, results are bound to be subjective, although some clear patterns did emerge: Sawblades do work best cutting the materials the manufacturers say they should cut and, yes, you get what you pay for. When I counted last, I owned 28 sawblades; the ones that I prefer to use are the most expensive in each category. This doesn't mean, however, that you have to pay big bucks for good cuts.

Grades and tolerances—Most manufacturers make several grades of blades, aimed at three broad markets. The top line is for industrial use. The middle line is for contractors. The bottom line is for "consumers."

Industry needs sawblades so uniform they can be ganged up 10 or more at a time on an arbor, then run at high horsepower and feed rates. Ten-inch industrial blades sell in the range from $75 to $200, depending on the number of teeth. Even so, a large part of the blade's cost is the plate—the alloy-steel disc the teeth are brazed to. Both the initial cost of the plate and the cost of the manufacturing steps to bring it to close tolerances can make an expensive blade even more costly.

Contractors don't need industrial-quality blades and are more likely to be concerned with the most cut for the dollar. By relaxing tolerances a little and automating, manufacturers can sell very good blades between $35 and $60. Special promotions can yield incredible values—Freud's new version of my old combination blade, for example, costs less than half, from today's discounters, of what I paid retail. Similar values from U.S. Saw, DML, SystiMatic, Delta, Amana, FS Tool, Forrest and all the others competing for your dollar make carbide blades real bargains.



Two setups for checking blade/arbor runout. If you don't have a dial indicator, you can make do with an engineers' rule clamped to the miter gauge and an automotive feeler gauge to check the gaps. The masking tape on this blade indicates high spots—initial runout was 0.007 in.—yet by reorienting the blade on the arbor, it was made to run true.

Industry thinks "consumers" just want to get the job done as cheaply as possible. Tolerances are so loose in this part of the market that it's safe to generalize: Good blades don't come in blister packs; the flashier the packaging, the cheaper the blade.

The technology to make the best sawblade in the world is available to anyone who wants to use it. The few proprietary patents and new tooth designs don't amount to all that much. In fact, any carbide sawblade you pick up is likely to be worth the money, provided you buy it on sale. There are many ways to get sawblades into an attractive price range for contractors and homeowners. It's a benefit, when making up your mind to buy, to be able to discern where the cost cutting was done. First, let's consider the saw plate.

The plate—The plate should be alloy steel that's tempered to an appropriate hardness. Standards range anywhere from 30Rc (Rockwell C scale) to 46Rc or even 48Rc. Most plates on industrial blades range from 38Rc to 44Rc. The higher the plate hardness, the more the blade can be deflected and twisted without permanent deformation. Some manufacturers talk about plate hardness in their ads, and you can always ask the ones who don't. For the average woodworker feeding the saw by hand, plate hardness is not as important as it is in industry, where feed rates can approach 300 ft. per minute.

What is important is that the plate is the reference for all sharpening. The arbor hole in the plate should be as snug as possible on the arbor. It is the reference for the concentricity of the teeth; the plate surface just below the teeth is the reference for top, face and side grinding. Two ways of checking plate flatness, or runout, are shown in the photo above. Holding a backlit straightedge against the plate will also show runout. A plate that is not flat will be forced flat as each tooth is sharpened, then will spring back, leaving the teeth out of line. A blade that is not concentric because of a loose-fitting arbor hole, or that has teeth out of line, will not only be less efficient and less smooth cutting, but will require more frequent sharpenings, at $10 to $20 a shot.

Cheap plates are merely punched out—as if using a cookie cutter—then polished to look good in the store. The dividing line seems to be about $25, discount price. Such a blade might be an excellent value if you plan to rough-cut cheap stock and discard the blade after a sharpening or two.

Better plates are flattened by sanding or grinding. A sanded plate will show grind marks that spiral out noticeably toward the rim; ground plates, which can be made more precisely, will show

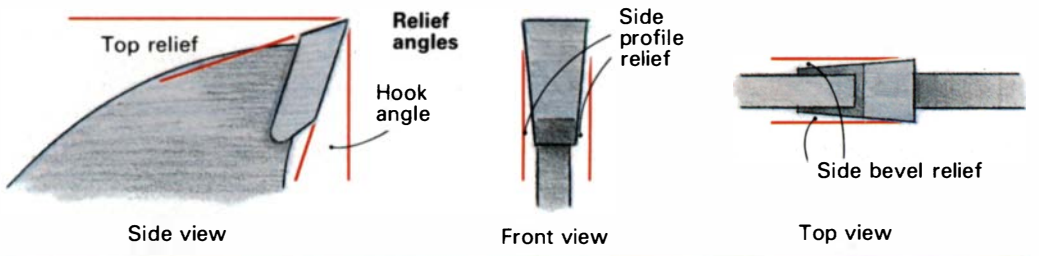
marks that are concentric. The finer the grind marks, generally, the more careful the manufacturer was. A plate can lose its flatness through abuse. Sticking a screwdriver in an expansion slot to loosen the arbor nut is not wise—as little as 0.001-in. abrupt runout makes for a noticeably scratchy cut. Heat buildup from hard running or forcing an overdull blade can also distort the plate.

Manufacturers go to great lengths to make sawblades look good, but one thing that hasn't occurred to them yet is that you can look into the arbor hole and tell a lot about how carefully a blade was made. Cheap arbor holes are simply punched to size, and this is obvious to the eye. The edges of the hole will be bent in, and there will be a fracture line within the hole showing where the center popped loose. Better arbor holes are at first cut or punched to a rough diameter, then brought to true round by reaming or grinding. Reaming is fast and leaves a smooth surface with minor, intermittent scoring and chatter marks. Grinding is better, but bad grinding is done fast, leaving slag and rough score marks. Manufacturers who skimp on arbor-hole machining tend to make the hole oversize, on the theory that if a blade fits loosely, it's better than if it doesn't fit at all. But if a blade fits loosely, it's only by luck that you'll ever get it to run true.

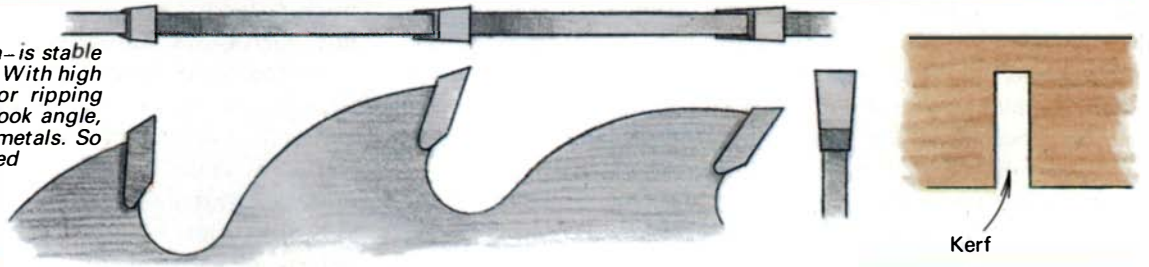
The other quality affecting the plate is its tensioning. Tension-

Fig. 2: Grinds

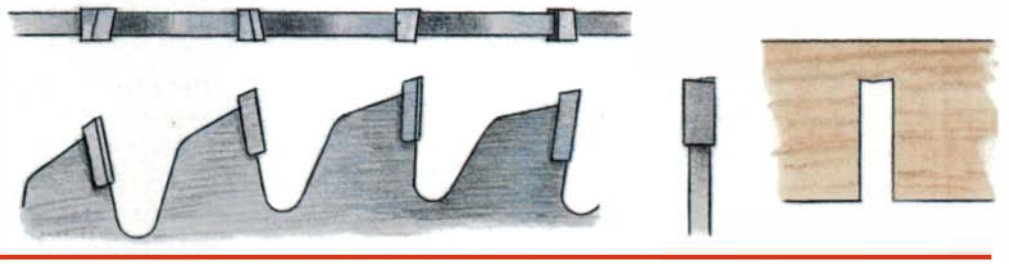
Blades can be designed to work best in particular materials by choosing the appropriate combination of hook angle, grind type, grind angles and number of teeth. Some of the necessary compromises are noted below.



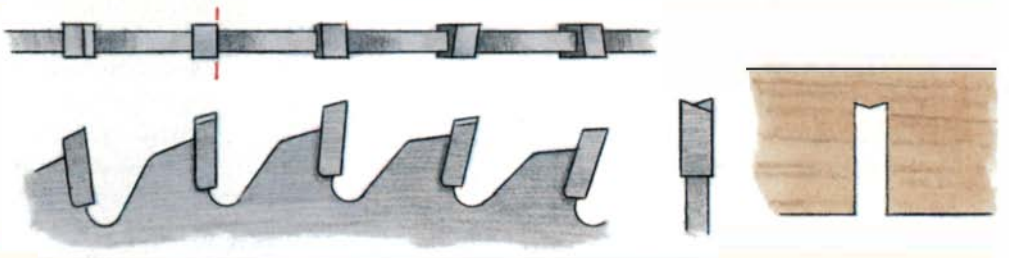
Flat or rip grind chops into endgrain—is stable in cut, long lasting, but takes power. With high hook angle, this profile is good for ripping solid wood. With low or negative hook angle, this profile is good for non-ferrous metals. So called 'glue line' blades have reduced side profile relief and cut slower.



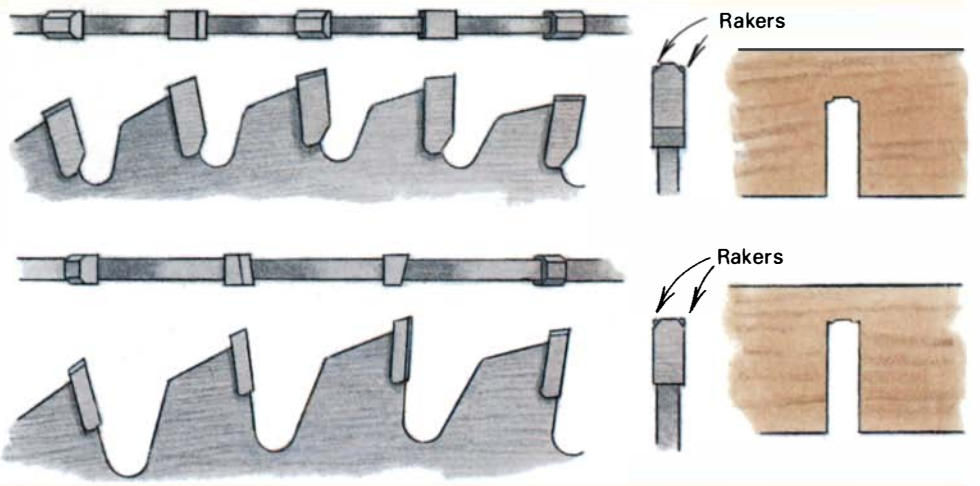
Alternate face bevel imparts slight top bevel. Face bevels are most often, but not always, seen on teeth that have top bevels as well. Face bevels tend to clear sawdust well, producing longer life and requiring less power for fast feed in all materials.



Alternate top bevels slice, and may be from 5° to 40°. Mild bevels with high hook angles reduce power demands for ripping; moderate bevels of 10° to 20°, usually seen in combination with moderate hook angles of from 6° to 15°, cut clean for all-purpose work in solid woods, most plywoods; high bevels, 25° and up, usually with low or negative hook angle, minimize surface tearout in delicate plywoods and melamine.



Triple-chip tooth gouges out initial groove, limiting surface tearout to center of kerf; rakers then clean-cut edges of kerf. Rakers may be flat grind for long life (top), alternate-top-bevel or alternate-face-bevel for less surface tearout (bottom). Hook angles have same effects noted above: High hook angles result in longer life with less power required, but cut rougher; low or negative hook angles cut smoother, require higher feed pressure.



ing is pre-distorting the saw plate by means of hammering or roller pressure. This leaves stresses in the steel that tend to push the blade's rim out when the blade is at rest. When the blade is running, centrifugal force at the rim balances the tensioning and lets the plate run true. Tensioning also allows for some rim expansion from heat buildup. To a major extent, the blade's expansion slots leave room for this, and I believe that tensioning of a 10-in. blade in average use is less important than its flatness. Runout, or blade wobble, should be no more than 0.004 in., and a gradual runout affecting many teeth is better than an abrupt one.

Plates can be made in various thicknesses. Some Japanese plates are so thin that they cut kerfs barely more than 1/16 in. wide, while some rip blades clear a kerf of almost 3/16 in., and a number of blades have thin-rim designs that feature a heavy plate in the center with a thinner edge. Standard plate thickness is about 0.085 in., which seems good for most work. My favorite rip blade's plate is 0.095 in. thick. I like the heavy plate on this blade for several reasons: Its mass keeps it turning when a thin plate might bind and helps damp out shock from hitting knots or contrary grain. And it's also almost deflection-free.

A good case can be made for thin-kerf blades, provided they are not misused. On tablesaws that bog down frequently, a blade with a narrower kerf has the advantage of needing less power because it is removing less wood. The main problem with thin-kerf blades is vibration in the cut, causing deep gouging that has to be planed or sanded away. It is a good idea not to force thin-kerf blades so that they slow down from normal speed range—the blade's natural vibration frequency will become excited and amplified by vibrations generated in cutting, causing the blade to flutter. Also, don't feed too slowly, as heat buildup may distort the plate. I have not found that stiffeners or dampeners are necessary to get good cuts on my saw, but on a more powerful saw allowing faster feed rates, they may prove beneficial. It is a good idea to save thin-kerf blades for cutting top-grade stock that's not likely to warp or twist. As one woodworker I talked with put it; "When you're cutting a $200 claro walnut board or a $100 sheet of plywood, a thin-kerf blade can mean the difference between a usable offcut and a piece of scrap." Smaller diameters of the thin-kerf family make admirable blades for hand-held circular saws, because their free-cutting action greatly reduces fatigue.

Here's a tip from the experts: After you tighten the arbor nut, give the saw a short power bump, then watch for runout as the blade winds down. If there's any runout visible, change the blade's orientation on the arbor and try again until it runs true. If using stabilizers or a dampener, rotate these to various orientations as well. While checking one sawblade with a dial indicator, I was able to reduce a runout of 0.007 in. to nothing—a freak occurrence where my arbor and plate runout exactly cancelled each other.

The carbide—Carbide is composed of fine grains of extremely hard tungsten-carbon particles cemented together with cobalt as a binder in a process called sintering, which involves pressing powders together, while applying heat below melting temperature, to produce a coherent mass. Carbide is usually rated on a hardness scale from C1 (soft and tough, with up to 8% cobalt) to C4 (hard and brittle, with as little as 2% cobalt). I would not make a big deal about which carbide grade the manufacturer uses, because C1 carbide is about 89Rc, and C4 is about 94Rc (diamond is 100Rc). Also, the "C" rating does not define the material—carbide grains may be coarse, fine or mixed; binder alloys vary; homogeneity within each tooth can vary. Cheap carbide may be so full of voids that the cutting edge simply flakes away, but good carbide is pretty much all good. I found no bad carbide

Blades with a lot of teeth don't have much room for shoulders. Here are a few that failed—most likely while cutting aluminum—and were returned as 'defective' to the dealer.

on any blade except a Sears 20-tooth all-purpose ($25), which had seven teeth chipped or pitted, as shown in the photo on p. 41.

To make a tooth, the mixture of carbon and cobalt is pressed together in a mold and sintered into solid form in an oven. Teeth can be molded so close to final size that, on cheap blades, the tops alone are ground, with the faces and sides retaining the dull gray, matte finish from the mold. Avoid these. Some design approaches to shape are shown in the drawings, but I feel normal, moderate-sized teeth up to about 1/4 in. long are the best bet. The photos on p. 41 show nearly 20 years of grinding on my first carbide blade from Sears ($35 then, $55 now), and there's a little more life in it yet. Big teeth may promise a few more sharpenings, but you'll use a lot of power and time over the life of the blade, dragging them through the cut.

The carbide chunks are brazed into pockets on the plate's shoulders, which were cut, along with the gullets, when the plate was made. Teeth brazed directly to the front of a blade without being pocketed used to be the sign of a really cheap blade, but I found none of these. Also, I did not find bad brazing on any of the sawblades I considered for this article, so I will not dwell on the things that can go wrong—shoulders losing temper and being softened by too much heat, lack of adhesion from too little heat, serious voids, etc. It seems these are problems of the past, but that's not to say you shouldn't keep your eyes open.

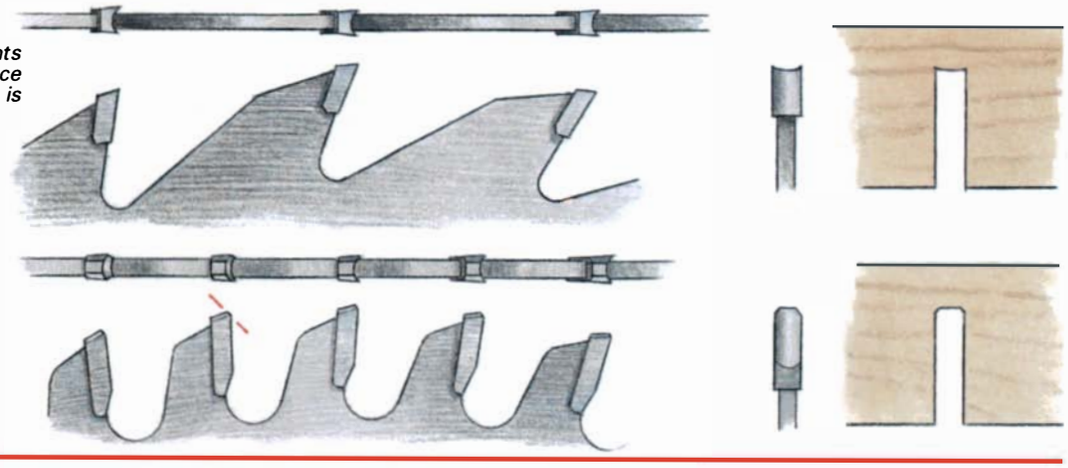
The number of teeth—There's something immediately appealing about a blade with a lot of teeth. The truth is, however, that you are best off with the *fewest* teeth you can get away with for the job. The rule is that there should be at least two, but not more than four, teeth in the cut at any one time. For extended blade life, it pays to raise your sawblade high when smoothness is not important. Use the guard, of course. Lower the blade to get more teeth in the material for smoother cuts.

The more teeth, the faster the blade dulls, for three reasons: First, when there are a lot of teeth, each tooth takes small chips, which gives a smooth surface with little breakout and chipping, but each tooth hits the wood more often and the initial impact against the wood is a serious dulling factor. Second, when there are a lot of teeth, blades tend to recut the chips, in effect doing much more work than is necessary. A third factor is chip size. Good-sized chips carry away much of the heat from cutting; small chips don't. Blades with a lot of teeth run hot and cut slow.

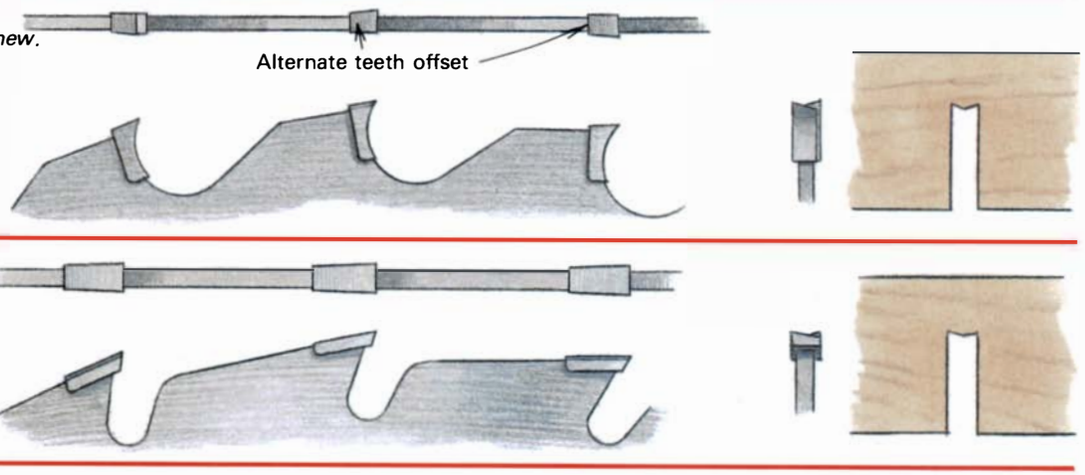
Another factor working against high tooth numbers is geometry. There's only about 30 in. around the rim of a 10-in. sawblade, and each tooth needs room for the carbide chunk, for the gullet and for the shoulder. An 80-tooth blade needs three times 80 divisions, or approximately 1/8 in. for carbide, 1/8 in. for gullet, and 1/8 in. for shoulder. Take a look at the damaged high-tooth blades shown in the photo above. If such a blade flutters a little,

Fig. 3: New faces

V-face or hollow face produces two points when top is ground flat–minimizes surface tearout. With triple-chip grind, hook angle is reduced at tip, for smoother-cut edge.



Hook-face tooth has high rake angle when new. Thin-kerf design cuts fast and rough.



Low-profile or horizontal tooth cuts fast and rough.

or catches an offcut or a loose knot, a tooth can find itself taking three times the impact load for which it was designed, which will break either the braze, the tooth or the shoulder. This is a particularly serious problem if you are trying to cut aluminum in a miter saw. Don't do it.

Hook angles, as shown in figure 1, are built into a blade when the plate is cut. The higher the hook angle, the more aggressive, and rougher, the cut. The lower the hook angle, the more the tooth acts as a scraper. Let's say a "normal" hook angle is 10°. A higher hook angle makes a blade act as if it had fewer teeth–it will cut faster and require less power. A lower hook angle, particularly a negative hook angle, makes a blade act as if it had more teeth. Blades with lots of teeth and low hook angles may excel on a miter saw or a radial-arm saw, where cuts are relatively short and feed pressure not too important. But if they are used on the tablesaw, they may require objectionally high feed pressure and may heat up too much on long cuts, burning the work and possibly warping the plate.

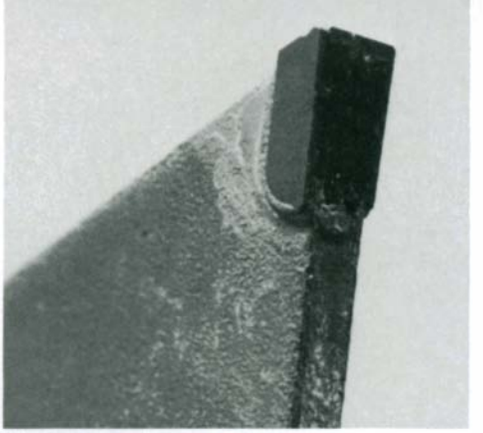
The advice to use as few teeth as possible depends on the cutting job. All else being equal, the more teeth, the smoother the cut. Rip blades usually run from 10 teeth to 40 teeth. If you have to surface the sawn edge anyway, it makes little sense to choose a rip blade with more than 20 teeth. Blades with more than 50 teeth are usually designed to crosscut wood or to saw plywoods, non-ferrous metals, particleboard and plastics, where smoothness of the cut is more important than speed and blade life.

The grind–Every cutting edge needs some elementary clearances, or relief angles, which are shown in figure 2. These allow the cutting edge to bite into the work without friction from the top and sides of the tooth. Top and side clearances are fairly standard, and there's not much to be said about them except that blades should be cleaned when pitch starts to build up in these areas. Typical cleaners include kerosene, alcohol, ammonia or oven cleaner.

Clearance between the sides of the plate and the work being cut is provided by making the teeth wider than the plate. In addition, there is usually a radial (or side-profile) clearance of typically 0.007 in. to 0.010 in. from the tip of the tooth down to the bottom of the tooth. Some planer-type blades have radial clearances of 0.001 in. and less for an especially smooth cut, rivaling hollow-ground steel blades. The two best-known contenders for an ultimately smooth cut, Forrest's Woodworker I and Freud's LU85M, take different approaches toward the goal. Forrest grinds little or no radial clearance and uses a thin plate machined to very precise tolerances to provide sufficient plate clearance. Freud's LU85M is designed to have as little plate clearance as possible, on the theory that if a tooth doesn't stick out far, it can't scratch much. The blade is therefore coated with Teflon, because in most cutting, the plate will rub. Freud includes special sharpening instructions, because if this blade is sharpened normally, all plate clearance can be lost and the blade may start to smoke. While this design approach may have its drawbacks, it makes the blade particularly appropriate for vibration-prone machinery–miter saws, radial-arm saws and tablesaws with lumpy belts, arbor run-out, out-of-round pulleys, unbalanced motors or other flaws–provided there's enough power to keep it turning.

With these obligatory clearances in mind, the simplest grind is a flat-top, flat-face rip tooth. It works like a chisel with the grain, chopping in, then popping out hefty chips. The whole edge cuts, so the blade requires considerable power, but wear is slow because it's spread across the whole cutting edge. Square teeth have a stable cutting geometry. This is offset somewhat by typically high hook angles that follow changes in grain direction, leading

This old Sears blade (left) has been resharpened many times. Although there's hardly any carbide left, the blade cuts smoother than the new one at right because it was sharpened more carefully. It also cuts easier, because the teeth have become smaller and thinner, so less carbide has to be dragged through the cut.



It's worth inspecting blades before you buy. On this Sears combination blade (about $25), seven of the 20 teeth were chipped or had pitting and inclusions. Even on costly blades, magnification may show similar sharpening damage.

to rough cuts. Like a chisel, a rip tooth cuts poorly cross-grain.

A cure for the rough cut, while keeping balance, is the triple-chip design. A leading tooth has its corners ground off so it plows a center groove, which is then cleaned up by one or more rip teeth, called rakers, that follow it. These blades are effective in particleboard or other materials that have uniform tough structure. A triple-chip blade with square rakers and a low or negative hook angle is good for non-ferrous metals, but not for cross-grain cutting in splintery plywoods. Where surface splintering is a problem, you need teeth with sharp corners to sever the work.

There are a few ways to grind points onto teeth. If a rip tooth's face is beveled, a mild point on one corner of the tooth will result because of the way the face bevel intersects the top clearance angle. Points can be put onto teeth by such exotic grinds as V-top grinds, hollow faces or concave faces, but by far, the most common tactic is to alternately bevel the tops of the teeth. This bevel can be as mild as 5° or as steep as 40°. The higher the bevel angle, the sharper and more fragile the tooth.

For cutting splintery plywoods, a triple-chip tooth may be followed by two or more alternate-top-bevel teeth. Such a blade with mild top bevels will be more stable in the cut than one with high top bevels. The tradeoff in triple-chip blades is that one with square rakers may splinter the veneer, but will produce a smoother-cut edge. One with high alternate top bevels will produce a scratchier-cut edge but with no tearout, and is best for veneer, laminate or melamine. If the tearout problem is paramount, you want a blade with top bevels of between 30° and 40°. Such a blade will dull fast, but the long point will still give a splinter-free cut for a longer time than a shallow-bevel blade that is in fact sharper.

Triple-chip blades are designed for man-made materials, but if they have moderate alternate-top-bevel rakers, they can be used on solid woods as well, making them something of a jack-of-all-trades. Another good all-around blade would be a 40-tooth with alternate top bevels between 15° and 20°. Spokesmen throughout the industry recommend this type of blade for general-purpose cutting in the average shop. It can smoothy crosscut solid woods, plywoods, particleboard and laminates, and if not pushed too hard, can rip up to 2-in.-thick hardwoods.

The last candidate for all-purpose work is a combination blade like my old Freud, with groups of teeth consisting of four alternate-top-bevel teeth followed by a flat-top raker ground a little lower. The usual number of teeth is 50, ten groups separated by deep gullets. Because of their popularity, everybody makes a blade of this design—I tried half a dozen and thought they were all excellent—but the consensus is that you are better off buying separate blades more specifically designed for the work at hand.

Figure 3 shows a few new tooth shapes. The V-top and hollow-face grinds can be found on some very good sawblades indeed, and produce chip-free cuts in difficult plywoods and melamine. But fancy teeth on cheap blades seem aimed for the consumer market, and the generally loose tolerances necessitated by this price range mean you might get a very good blade for the money, but you might also not. A V-tooth gives a smoother cut than the number of teeth would suggest, but requires high feed pressure. The hook tooth and the horizontal tooth both cut very fast, but I wouldn't call either cut smooth.

The polish—With the grind geometry established, the next consideration is how well the carbide has been sharpened. Carbide must be ground with diamond wheels. Some shops use as coarse as 180-grit wheels, but the best shops finish with up to 600 grit. Diamond of 400 grit leaves a finish on carbide comparable to what an 80-grit aluminum-oxide grinding wheel leaves on steel. The surface depends not only on the grit size, but on the slowness of the pass, the lubricant used and the condition of the wheel. Contrary to general opinion, silicon-carbide "green wheels" do not sharpen carbide, but merely remove the cobalt binder material. They can be used to rough-shape carbide, but will not leave a true sharp edge.

A rough grind on the face, sides and top indicates that the cutting edge is ragged, and there is a good chance that the points of many teeth will be missing. Any manufacturer can have a bad day in this regard and it doesn't necessarily mean that the blade is inferior. Provided the plate is good, you'll get many years' work from it, and a good sharpening service can make the blade better than new indefinitely. A highly polished carbide surface, on the other hand, does not necessarily indicate a sharp cutting edge. It may be the result of a glazed, clogged and worn diamond wheel that has overheated the cutting edge, leaving it weak and fractured—you'll be more likely to see this on a resharpening rather than on the original grind, and I'd worry about it. The true test of a good grind is to inspect the cutting edge under magnification. You can verify this yourself very easily. Take a carbide blade that has seen some service and look for a tooth that has picked up more than its share of pitch on the top or face. I'll bet that even under low magnification, you will find the tooth's corners chipped off. By examining teeth under higher magnification, say 20X or 30X, you can tell a lot about how a blade will cut even before you mount it on the saw. □

Jim Cummins is an associate editor of Fine Woodworking

The author builds period reproduction mantels, such as the one shown here, using antebellum mantels as inspiration. This blockfront mantel incorporates grooved pilasters, raised panels and a variety of moldings made with simple milling procedures.

Building Fireplace Mantels

Antebellum designs provide inspiration

by Ben Erickson

Fireplace mantels of the antebellum South range from rigid interpretations of classical architectural styles to more homely examples shaped by the whim of the homeowner and his builder's skills. To arrive at mantel designs for the houses I restore, I've studied 25 antebellum mantels in central-western Alabama, where I live. Built in the Greek Revival style that swept the young republic between 1825 and 1860, these designs have been a good source of inspiration, and when altered to suit modern building codes, they're perfectly suitable for new homes as well.

Even though Greek Revival is associated with strict rules of proportioning and detail, I haven't been able to develop universal design rules based on mantels I've seen. I suspect the local builders lacked formal architectural training and copied high-style pieces they had seen or heard about. I'm not the first designer to have problems determining proportions. Even Asher Benjamin, 19th-century housewright, author and architectural authority, was reluctant to formulate precise guidelines. "The proportions of chimney pieces," he wrote, "I am obliged to leave to the judgement of the workman, as no exact rule can be laid down that will answer for every room." Still, the following construction guidelines enable you to design and build a mantel to suit any fireplace.

Mantel anatomy—Mantels are embellishments meant to frame the fireplace, the focal point of the room in the days before central heating. The word mantel itself defines the entire ornamental structure surrounding the fireplace, not just the shelf above it. Figure 1 illustrates one type of mantel popular in the antebellum South, an elaborate design I call a blockfront. Figure 2 shows two more common styles. Although they have markedly different appearances, all of these mantels consist of four major elements: a field, a shelf, pilasters and applied moldings. Some designs incorporate a fifth element: a decorative entablature board.

The field is appropriately named, for it serves as the foundation to which the other parts are fastened. Basically, the field is an inverted U-shaped assembly made of three pieces—two vertical boards on either side of the fireplace opening and a horizontal board that spans the two. The field is made as a single unit, thus the mantel can be built on the bench and then attached to the wall. Field boards are traditionally solid wood, 1 in. to 1½ in. thick, with the horizontal piece tenoned into the verticals. In new work to be painted, you could just as easily use cabinet-grade plywood whose dimensional stability will reduce warping.

Figure 1 shows typical dimensions for fields in period work. But

Drawings: Lee Hov

Fig. 1: Blockfront mantel

Shelf applied to field first, then pilasters and plinth applied, then moldings wrap around pilasters.

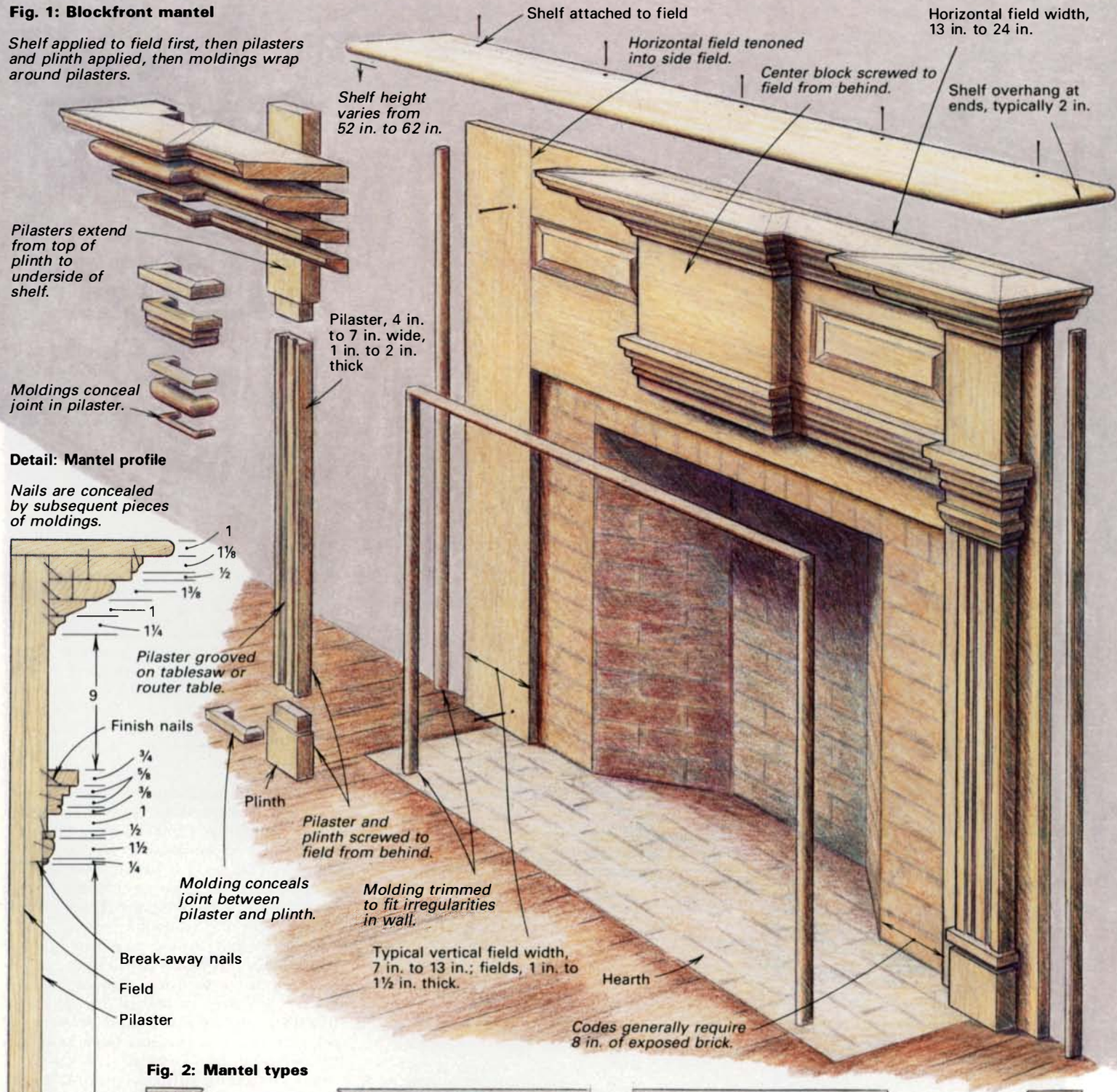
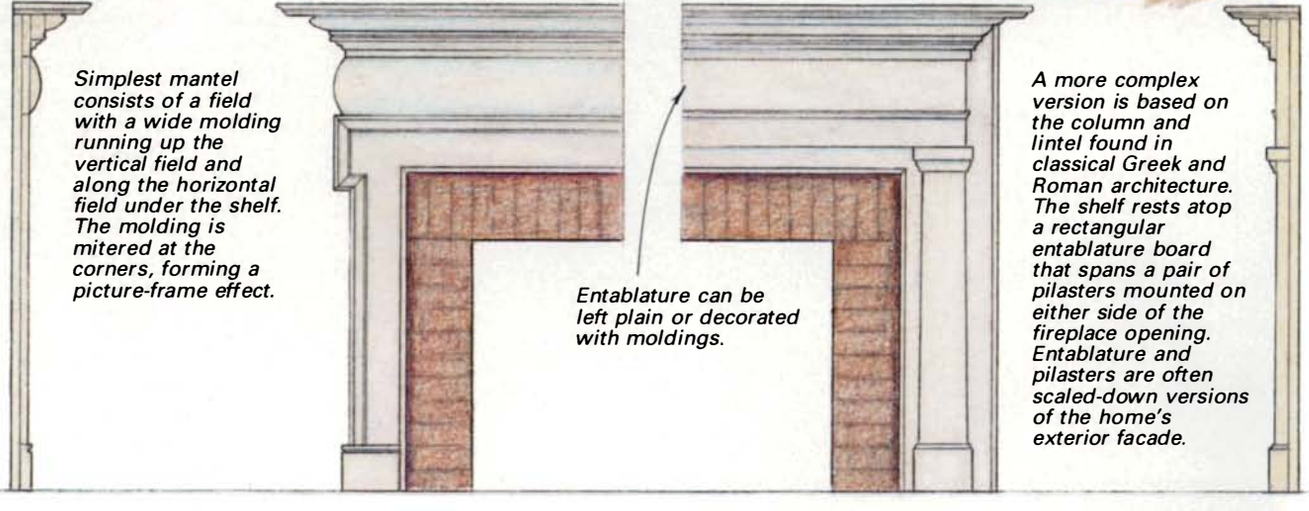


Fig. 2: Mantel types



Simplest mantel consists of a field with a wide molding running up the vertical field and along the horizontal field under the shelf. The molding is mitered at the corners, forming a picture-frame effect.

Entablature can be left plain or decorated with moldings.

A more complex version is based on the column and lintel found in classical Greek and Roman architecture. The shelf rests atop a rectangular entablature board that spans a pair of pilasters mounted on either side of the fireplace opening. Entablature and pilasters are often scaled-down versions of the home's exterior facade.

in designing a mantel around existing brickwork, the fireplace opening's size, building code requirements and the need to have the shelf at a convenient height above the floor may severely limit variation in field dimension, particularly the horizontal field. Ideally, the horizontal field should be one-and-a-half times to twice as wide as the verticals to allow space to accommodate the graduated bands of moldings beneath the shelf. If a field this wide isn't workable, use less molding or no molding at all, otherwise the design will appear too crowded. Consider building the horizontal as a frame-and-panel construction if it must be very wide.

The shelf is glued and nailed or screwed to the top edge of the horizontal field and to the ends of the vertical fields. Shelves I've examined vary in thickness from 1 in. to 2 in. and in width from 8 in. to 12 in. I've found that the average thickness and width, about 1½ in. by 9½ in., looks right for the majority of mantels I build. The shelf should be long enough to extend about 2 in. to 4 in. past the outermost moldings applied beneath the shelf. In some period mantels, the vertical fields extend above the horizontal field by the thickness of the shelf. The shelf is notched around the verticals and nailed or screwed into place. This gives additional support to the shelf, but it's not a necessity, as the moldings, pilasters and entablature add additional support. If you decide on a plywood field, reinforce the shelf joint with dowels or plates.

Pilasters are the tall, rectangular projections that, along with

Making mantel moldings

With a little ingenuity, you don't need a shop full of expensive machinery to make mantel moldings. I make most of the profiles I need with a molding head on my tablesaw and with standard and shop-modified bits on my router table. Remember, a mantel doesn't require hundreds of lineal feet of molding, just two or three yards of each profile.

I shape the large nosing beneath the mantel shelf with a set of matched cutters in a molding head. (Mine is a Sears model 9HT3218 with a 1-in. radius cutter.) With the cutter head set up (see figure 3), I tilt the arbor to get the radius I want and take several shallow passes with each cutter until I reach the necessary depth. I finish the cut with a regular sawblade tilted at an angle and then smooth to the final shape with a handplane and 120-grit sandpaper. If you don't have a molding head, this profile, along with many large convex shapes, can be rough-shaped on the tablesaw with multiple passes, then finished by hand. For all edge-shaping and sawing operations, use a featherboard to hold the work firmly against the fence.

The large cove moldings applied beneath the shelf are also made on the tablesaw by feeding the wood diagonally across a regular sawblade. Varying the fence's angle and/or tilting the blade controls the cove's shape. For a nearly circular cove, feed the stock at close to a right angle; a deep, elliptical cove will result if the fence is more parallel to the blade. Tilting the arbor will make one side of the curve steeper, and a smaller blade will give a tighter curve. I make shallow, slow passes, increasing the blade height about 1/16 in. per pass. A small cove can be milled into a large board and then sawn off, or a larger cove can be ripped down the center to produce two separate moldings, as shown in the photo at right. For more on tablesawn moldings, see *FWW* #35 or *FWW on Woodshop Specialties.*

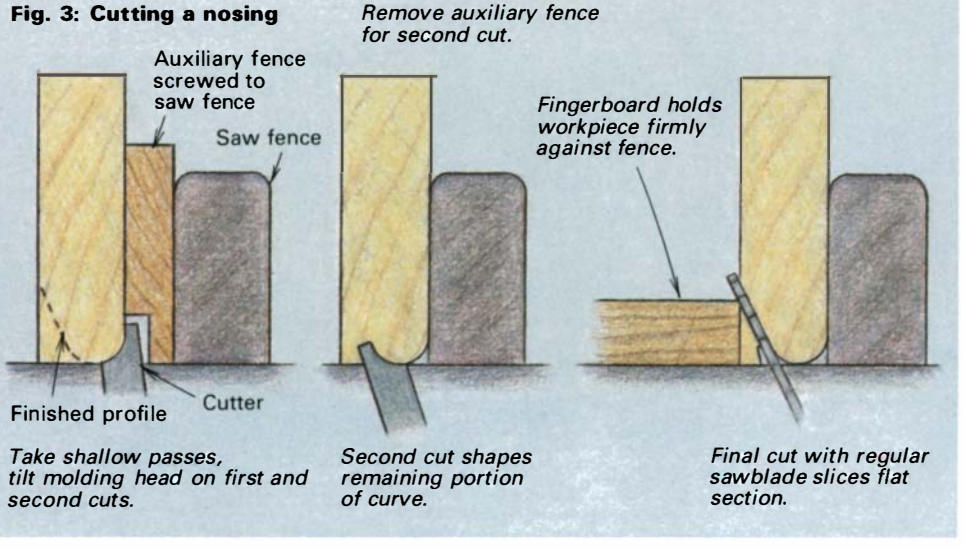
Through and stopped flutes for pilasters are made quickly on the router table. Stopped flutes are blind-cut by plunging the wood down onto the bit while holding one edge of the pilaster firmly against the router-table fence. To keep track of where to start and stop the cut, I mark reference lines on the back of the pilaster and align these with marks on the fence showing the bit's precise position. The centers of the flutes are marked lightly on the workpiece's face, then the fence is set an appropriate distance from the bit's center. If your pilaster stock is warped or bowed, press it down firmly over the bit, otherwise the flutes will be too shallow and uneven.

To cut a cove molding, run the workpiece along a fence angled to the blade. Make several shallow cuts, then rip the workpiece in half. Hold the work against the fence with a featherboard, using a push stick to finish the cut.

For through flutes, pass the pilaster over the bit along its full length, allowing the flutes to enter and exit at the ends. This may sound like a shortcut, but it's perfectly acceptable. Many period mantels I've studied have pilasters decorated in this fashion.

For matching unusual period moldings, I regrind high-speed steel router bits to the shape I need. First, I regrind a 1/4-in.- or 3/8-in.-wide, 60-grit grinding wheel to a curve. I shape the wheel using a star wheel or diamond-tip dresser, then coat a rabbet bit with layout die and mark the desired shape on the bit with a carbide-tip machinist scribe (Sears 9HT4078). Next, I slowly grind to the line, holding the bit with locking pliers and quenching often to prevent softening the steel. Finally, I hone the bit with a slip stone. The entire process takes about an hour and is a good way to press old high-speed steel bits back into service. For more on grinding router bits, see *FWW on Making and Modifying Tools*. —B.E.

Fig. 3: Cutting a nosing



moldings, give a mantel its architectural presence. Pilasters are usually solid boards, 1 in. to 2 in. thick, glued and screwed onto the vertical field from the rear before the mantel is installed. Depending on how elaborate the mantel is to be, pilasters can be straight or tapered in width toward the top at a ¼-in. to ⅜-in. taper per foot of length. Pilasters can be left plain, reeded or fluted, as shown in the photo on p. 42, and can extend directly to the floor or be mounted atop a plinth block, as shown in figure 1.

Tiers of moldings usually extend beneath the shelf in step-like bands. Note in the photo on p. 42 that the moldings are mitered and return back to the wall or the field. The moldings, combinations of coves, rounds and ogees, are usually built up, but you could install a single-piece molding, such as a wide crown, instead. Although it's more work to fasten many individual pieces, it's easier to cut tight miters on them rather than fitting one large piece. For a less ornate mantel, you can skip the molding entirely, applying a rectangle of molding to the field that visually suggests a panel, as shown in the photo at right.

Erickson built this mantel for a fireplace on a raised hearth. The fireplace mantel extends away from the wall approximately 4 in. to accommodate the fireplace's facing bricks, which were laid proud of the wall.

Building a mantel—Armed with the average dimensions of mantels I've studied, I begin with a scale drawing of the fireplace and hearth, roughing in the shape of the mantel around it. I alter the dimensions of the mantel's components until they look right. Check your local building codes before settling on a design. Most require a minimum of 8 in. of exposed brick between the mantel and the fireplace opening, and some require that the shelf be at least 12 in. above the opening. This is usually not a problem, but it's better to know it ahead of construction.

The overall width of the mantel should be such that the vertical fields extend to the outer edge of the hearth, though in hearths set flush with the floor, the fields can run past the hearth, onto the flooring. With a raised hearth, the fields must stop flush with or slightly inside the outer edge of the hearth. The height of the shelf above the floor can vary from 52 in. to 62 in., with 58 in. about average. In a floor-level fireplace with a low opening, 52 in. is about right; if the shelf is much higher than this, the horizontal field will be too wide and look awkward. Just the opposite is true for a fireplace with a raised hearth; a shelf height of 62 in. (above the floor) works well, otherwise the field will be too narrow.

Usually the facing bricks on the front of the fireplace are laid flush with the surrounding wall so the mantel can simply bridge the gap. Occasionally, facing bricks are laid with their full width standing proud of the wall, so the mantel must box them in. In these cases, side pieces must be glued to the back face of the vertical fields and the shelf must be wide enough to accommodate the thickness of the bricks. For this reason, it's best to do final measuring after the brickwork and hearth are completed. This avoids the unpleasant surprise of a beautifully built mantel that won't fit the wall. If the wall protrudes slightly past the bricks, take up the gap with molding applied around the inside of the mantel opening.

I assemble a mantel in the following sequence. First the field is glued and the shelf is glued, nailed or screwed on. Next, the pilasters and plinth blocks are butted under the shelf and screwed to the field from the back. If the mantel has an entablature board, it is screwed into place from behind and then the pilasters and plinth block are mounted below it. Finally, the moldings are mitered around the pilasters (and the entablature, if there is one). As shown in figure 1, the nails that fasten moldings under the shelf are hidden by subsequent moldings. I nail small mitered moldings with break-away nails (available from HGH Hardware Supply, Inc., 3912 2nd Ave. S., Box 31192, Birmingham, Ala., 35222) that are of very small diameters and extremely brittle. Driven in and left standing proud of the molding face, they can be snapped off about 1/16 in. beneath the surface of the molding with a sideways hammer tap.

The mantel is centered on the fireplace opening and nailed to the wall studs through the field at top and bottom with 16d casing nails countersunk and filled. If the filled holes will detract from the appearance of a natural finish, leave off one of the moldings beneath the shelf, attach the mantel to the wall where the molding will go and apply the molding to cover your tracks. The small finish nails fastening the molding will be less visible. To fasten the bottom of the mantel, leave off the plinth blocks at construction, then use them to hide your nail holes after installation.

After the mantel is attached to the wall, a ½-in.- to ¾-in.-thick molding, usually with a bead cut on the edge, is applied to the inner and outer edges of the field. I normally make two sets of moldings, one the exact size and one slightly wider than it needs to be. If the mantel fits snugly to the wall with few irregularities, I use the narrow molding. To accommodate a bumpy wall, I plane the wider molding to fit using a block plane. Unless there is a major irregularity, I don't scribe these moldings but plane them by eye until I get a perfect fit.

Mantels can be painted, stained or clear-finished. I generally use poplar for painted or stained mantels and walnut or mahogany for clear-finished work. Many antebellum mantels were painted black to resemble marble and to make them less likely to show soot, which was more of a problem in those days when fires were burned around the clock than today when they are used only occassionally. □

Ben Erickson builds furniture and millwork in Eutaw, Ala., and wrote about antebellum shutters in FWW *#53.*

Further reading

The Classical Orders of Architecture by Robert Chitham. Rizzoli International Publications, Inc., 597 Fifth Ave., New York, NY 10017; 1985.

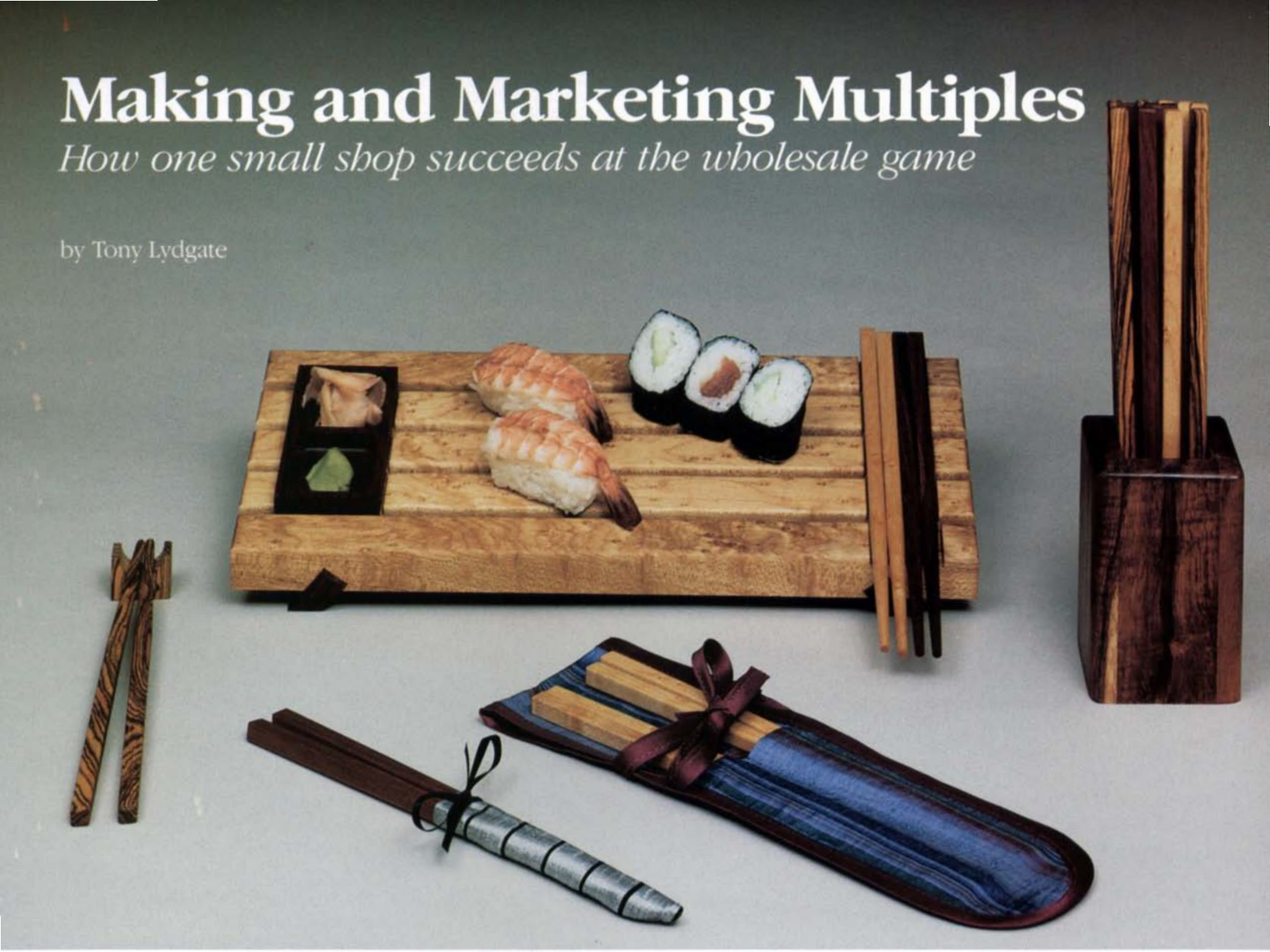
The Gentleman and Cabinet-maker's Director by Thomas Chippendale. Dover Publications Inc., (reprint third edition), 180 Varick St., New York, NY 10014; 1966.

The American Builder's Companion by Asher Benjamin. Dover Publications Inc., (reprint sixth edition), see address above; 1969.

Making and Marketing Multiples

How one small shop succeeds at the wholesale game

by Tony Lydgate



After he grew tired of unprofitable furniture commissions, Lydgate turned his energies to mass producing small boxes, sushi sets and chopsticks. The sushi sets retail for $70; a pair of chopsticks range in price from $8 to $10.

I operate a woodworking business that produces multiple-edition jewelry boxes, chopsticks and sushi sets. I started out by myself nine years ago in a small garage; the first year I grossed $12,000. Today, I have six employees, a 3,000-sq.-ft. commercial workshop and gross sales in the low six figures. The multiples market makes the most sense for me, and I want to explain what led me to this business decision.

By way of background, my career as a designer-craftsman grew out of my assembling a harpsichord kit for my wife while in graduate school. I decided to veneer rather than paint the case, and the results were so spectacular that I became interested in the two-dimensional possibilities of wood veneer. I began producing wall plaques, place mats and eventually backgammon sets, which I sold to a local craft gallery. By the end of graduate school, I'd logged enough hours in the shop and earned enough money to consider making a living at my craft. Moreover, I was ready for a change from academics and felt confident about focusing on work uniquely expressive of my tastes.

From crafts to furniture—I continued selling my veneer work to galleries and at craft fairs, and added a line of cutting boards, chopsticks and small boxes. But these sales wouldn't keep me afloat for long. When one gallery asked me to build a set of bookcases, I jumped at it. A dozen commissions later, I'd became skillful at selling my work, but was spending more time negotiating than working in my shop, where I preferred to be. Within a few months, several events soured me on commission furniture work. One client who had commissioned a wall system and conference table suddenly hedged on the agreed price. Then a major desk commission, completed a year earlier, was damaged by movers when the clients relocated; and, the clients expected me to repair it free of charge. Finally, a rosewood rolltop I'd slaved over for months was returned because the husband (who signed the checks) didn't like the drawer handles I had carefully made to his wife's specifications. He insisted I replace them, even over her objections.

Multiples to the rescue—My ego bruised, time wasted and proletarian leanings thoroughly aroused, I was ready to abandon the furniture business altogether. But how would I replace the earnings furniture had been producing? Fortunately, the demand for my production items was about to exceed my capacity to make them, so production pieces made more sense than ever. They were fun to make, there was a ready market and I had the processes down. In addition to being predictable and profitable, multiples were more manageable than furniture—simpler to make, more conservative of raw materials and easier to handle and sell. No single item ever cost that much, so there was less to worry about—if one didn't pass quality control, it wasn't the end of the world.

In a shop of some 3,000 sq. ft., Lydgate, above, has relatively few machine tools, but he has designed fixtures for virtually all of the redundant operations multiples require.

These readily marketable boxes can be made in large enough quantities to be sold profitably, retail or wholesale.

Once you decide, as I did, to concentrate on multiples, three problems must be solved: what products to make; who will make them and how; and how and where will they be marketed.

If you're starting from scratch, as I did, my best advice is to produce something—anything—you enjoy making that has sales appeal. It's essential to take advantage of the materials, equipment and technical skill you already possess. Your product may not be as perfect as you'd like, but keep on cranking it out. This is the only way I know to get better. Above all, avoid the mental roadblock that plagues so many talented people—the impossibility of producing work as good as the ideal vision in your mind.

My early veneer pieces arose naturally from work I was already doing. Likewise, my cutting boards evolved as a profitable way to utilize scraps from furniture jobs. More often than I like to admit, a wildly successful product has originated in a suggestion, even an offhand remark someone else made. One gallery owner told me chopsticks in exotic woods would be fun—now, nine years later, chopsticks and accessories account for a third of my business. Once, a friend visiting my shop remarked, as tactfully as he could, that one of my boxes had a lovely design, but that it was too small to be practical. He suggested I add an inch to each dimension, along with a removable tray and a velvet lining. That box has become so popular I have buyers for all I can possibly make far into the future.

Setting the price—Making multiples inevitably leads to wholesale, rather than retail, selling. This means all your costs and profits must be reflected in the wholesale price, which a retailer typically will double to arrive at the retail price. Doubling the wholesale price may seem excessive, but remember, the shop or gallery owner is also running a small business. As far as I'm concerned, after I sell a retailer my work, it's none of my business how the retail price is set.

The trick is to set a wholesale price that's both low enough to maximize sales and high enough to maximize your profit. Production cost, overhead and profit are the principal components of the wholesale price. The following is a summary of some (but not necessarily all) of the items you should consider. Production costs include raw materials (lumber, hardware, fabric, fittings), production supplies (glue, sandpaper, oil, wax) and labor. In calculating labor, pay yourself a realistic wage. It's self-defeating to lower the cost of your products by grossly underpaying your most-valued worker.

Overhead includes electricity, shop rent, shop and tool maintenance and repair, interest on business indebtedness, legal matters, accounting, insurance, payroll taxes, office expenses, automobiles, packaging supplies and marketing. I tack on 15% of the production cost to cover marketing expenses. I then add between 15% and 30% for profit, capital improvements and contingencies. The resulting figure is the wholesale price.

However, there is a shortcut you can use. I call it "the rule of four." You total your costs for materials, production, labor and overhead; double this number to produce the wholesale price; and double that total (or multiply the original total by four) to produce the retail price. Both methods are general guidelines, not hard-and-fast formulas. Experience will tell which formula works best for you.

To give a concrete example, my pencil box, pictured at left, sells at wholesale for $30. This breaks down as follows:

Lumber	$3.50
Production supplies	$.50
Overhead	$2.00
Labor—milling @ $50/hr.	$6.50
Labor—assembly & finish $10/hr	$5.00
Marketing	$2.50
Profit	$10.00
Total	$30.00

If I had followed the rule of four, this product should sell $35 wholesale and $70 retail, but I felt the box would sell better at $60 retail.

How to make it—Craftspeople vary widely in their ability to enjoy, or at least tolerate, having employees. A work force requires someone, usually you, to spend considerable time and money managing it. But if you want your business to grow, sooner or later you'll have to hire. If you're skillful, you can create an environment where shared responsibility, camaraderie and dedication to a common goal give you back far more than the employees ever take out of you.

I believe, however, that a multiples business must start out as a solo enterprise. Once you're familiar with all the production steps and what can go wrong at each one, you can consider whether an assistant could do some of the tasks. For example, I personally mill all the parts for every piece my shop produces. First of all, I really enjoy turning huge piles of raw lumber into neat stacks of precisely milled parts. Second, because I primarily use highly figured, extremely expensive exotic lumber, I'm the

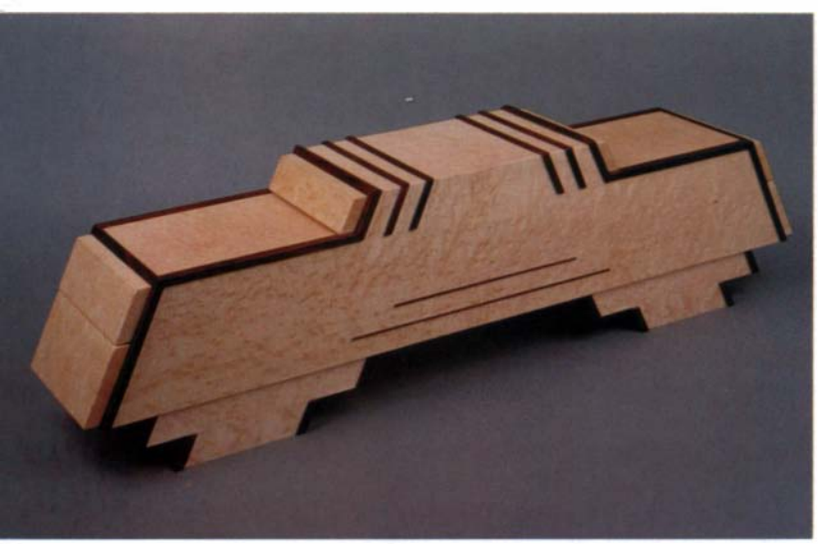
only one I trust to get the maximum quality and yield out of the raw materials. And finally, this is the only way I can be sure each piece reflects my sense of design.

Once I've prepared the parts, however, my assistants do the gluing, assembly and finish work. I perform some of the more delicate milling operations and supervise the process along the way, but I mostly try to stay out of the way until the end, when I inspect the pieces, sign them and package them for shipping.

How and where to market—Let's assume you've had the persistence to develop a product you enjoy making—the bugs are out of the production process and you have an inventory of finished pieces piling up on the shelves. It's time to shift some of your energies from the shop to the marketplace. If you can find someone to market your work, all well and good, but it's been my experience that the craftsperson is the best choice to market the work.

Craftspeople today have a great luxury that was not available 20 years ago—a large, well-organized and growing wholesale market for fine crafts, both through galleries and established craft shows. One of your first priorities should be to exhibit at one of the wholesale shows that take place at least a dozen times a year throughout the country. (Contact the American Craft Enterprises, P.O. Box 10, New Paltz, N.Y. 12561 for more information.) The application process, cost and logistics of these shows can be intimidating, but, as with your products, start where you feel comfortable and keep at it until you find which shows are best for you.

My marketing approach involves two general concerns: how my work is presented to potential buyers and what market segments are most promising for me. How your product looks to customers ultimately determines whether they buy it. If you only sell at retail craft shows, you can rely on appearance alone to get your message across. This means you should have a well-designed, professional booth that shows your products to best advantage. For wholesale, your aim should be to show the retailer how appealing your work might look in his or her store. As your market grows, you'll need sophisticated ways to present your work. These include a brochure with photos, preferably in color, a price list/order form, background information on you and your craft, invoices, shipping labels, stationary and product-care tags. Be kind to yourself and your cash flow while starting out, and make do with the simplest printed forms available.



As an antidote to the repetitiveness of multiples, Lydgate builds one-of-a-kind pieces like this maple and rosewood jewelry case, which sold for $1,200.

Initially, a good-quality rubber stamp will suffice for graphics, stationery, labels and such. For background information and artist's biography, I relied on my typewriter and a photocopy machine until last year, when I finally switched to a handsome—but very expensive—printed brochure. The only thing you can't afford to shortcut is good photography. Fortunately, many trade shows offer the services of a professional craft photographer at reasonable rates. And you can make arrangements by telephone to have some of the most experienced craft photographers, such as George Post, who took the shots illustrating this article, photograph your work in their own studios, if you're willing to send the objects through the mail. Nothing sells like color, and for under $600 you can get a one-page, 8½-in. by 11-in. color product sheet, including layout, color separations and typesetting, from any of several volume printers who advertise in *Crafts Report* (P.O. Box 1992, Wilmington, Del. 19899) and similar trade journals. What's important is not a slick, packaged look, but rather an approach that captures what you feel is important to convey about your work.

What's my market segment?—My first market was local retail craft shows, usually held outdoors on weekends. As my products developed, however, I found the cost of outdoor shows outweighed the economic return reflected in the Sunday-evening receipts count. As a result, I cut back on the outdoor shows and sharpened my efforts at selling indoors, in a professionally displayed gallery setting surrounded by other high-quality work. Now I've stopped doing retail shows altogether.

Galleries, located through show contacts or from mail lists, are another good outlet. When I was just starting out, I was so eager to sell my work that I'd offer galleries very favorable terms—say net payment within 30 days, with no minimum order. As my business grew, I shipped to galleries on consignment; this generated lots of goodwill and many long-standing customers. Now that I'm more established, I no longer consign. Now, I'm more interested in developing accounts with good track records than in finding increased numbers of new outlets.

Additional markets can be reached through magazine advertising, your own mail-order catalog or participation in joint craft catalogs. I've had very good luck with my own direct-mail campaign. Around Christmas, I always mail out 2,500 brochures to past customers whose names I've collected at shows, plus a list of 500 galleries. Only 1% or 2% of these generate orders, but often, these turn into reliable accounts. Overall, I've calculated it costs me about $40 to find a new account by mail versus $50 to $100 through a show. And mail order is a lot less wearing than a show. Incidentally, if you want to try mail order, I strongly recommend you engage a mail-order service to sort your list and produce labels. It's more than worth the small cost.

Succeeding as a craftsperson requires faith in yourself, persistence, common sense, the willingness to learn from your mistakes and a bit of luck. In my experience, the single, most important among these is persistence. Although my business is multiples, I'm now at the point where I can return to unique, one-of-a-kind or limited-edition pieces. I've recently done a series of sculptural containers, loosely presented as jewelry boxes or silver chests, one of which is shown at left. Most important, I've found a way to pursue my own aesthetic vision, develop a life-style I am in control of, at least much of the time, and finally do better economically than merely making a living. □

Tony Lydgate operates Master Designs in Wood. He lives in Palo Alto, Calif.

Multiples on a router table

by Robin Cosman

My father was a woodworker in heavily forested New Brunswick, so I grew up around wood and tools. As far back as I can remember, I have worked with wood, whether it was making paddleboats or carving handgrips for an air pistol. As a result, I've developed an affinity for small, well-crafted objects like the boxes I now produce.

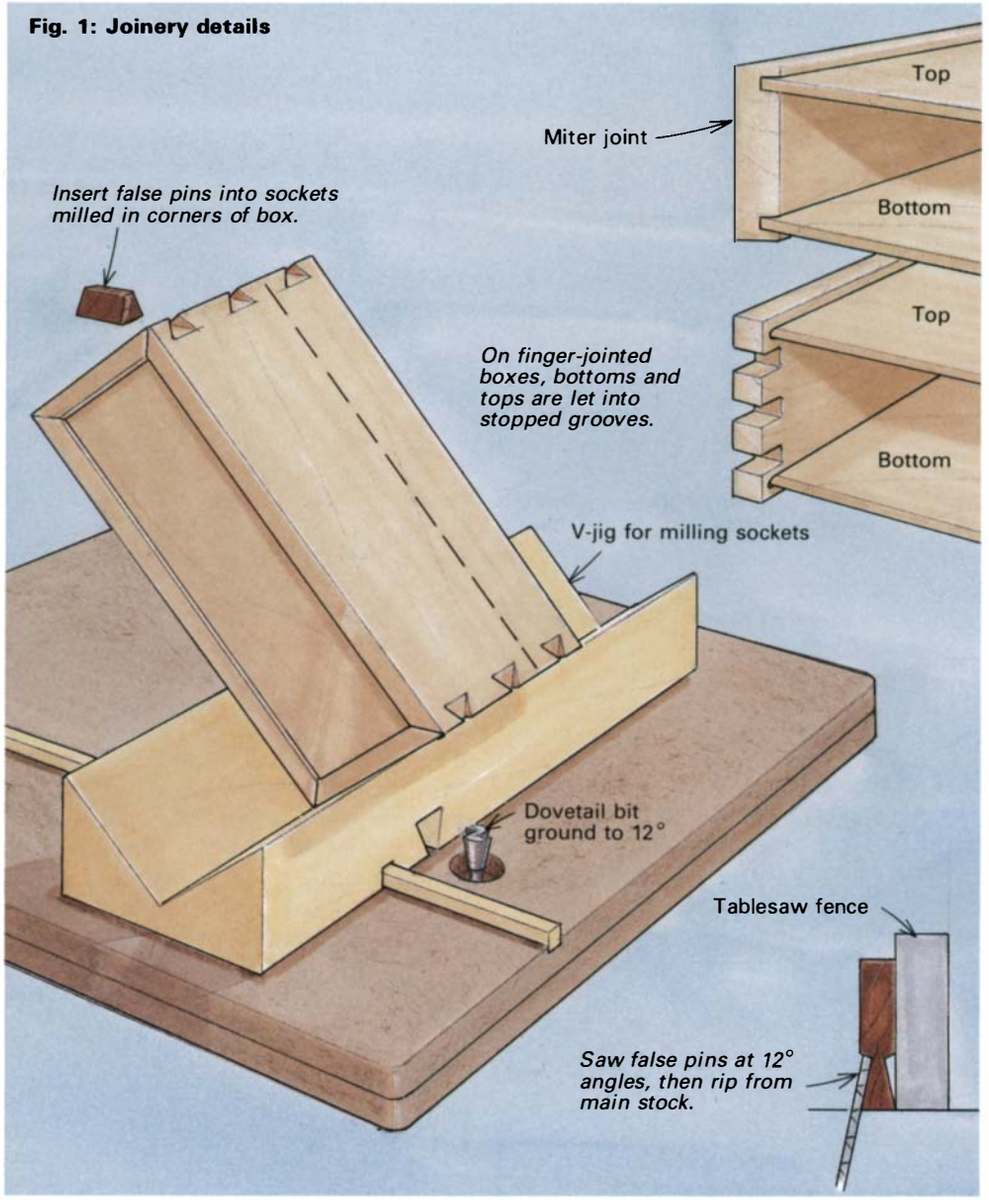
I make these boxes in my spare time and earn a good profit selling them through local galleries. The boxes shown here sell for $65 retail, $32.50 wholesale. My boxes are very labor intensive, but I keep my overhead low because I don't need many power tools. Much of the work is done on a small, portable router table I built for cutting joints, grooving the sides and setting hinges on the boxes. Made in runs of 12, each box requires about two hours of labor. Building a dozen boxes at a time makes my part-time production profitable, without leaving me bored with the repetition.

Finger joints or miters decorated with the mock dovetail shown in figure 1 join the box corners. The lids pivot on a wooden hinge made from a dowel—a nice feature I learned about from Dale Nish at Brigham Young University. I've since learned this same hinge was used by 18th-century box makers in Scotland. (*Editor's note:* Despite their apparent ancient lineage, some wooden hinges may be protected by patents. Spider Johnson of Mason, Tex., has notified us that he has applied for such a patent.) The drawings and photos show the steps for making a box. One secret of efficient production work is to make consistently accurate parts. After I've surface-planed enough lumber for 12 boxes, I set up the tablesaw with a miter gauge and stop block to cut sides and ends precisely square. Before machining the sides and ends, I cut the box lids and bottoms, sand them smooth and oil them. For sanding, three orbital sanders with 150-, 220- and 320-grit paper are well worth the extra cost.

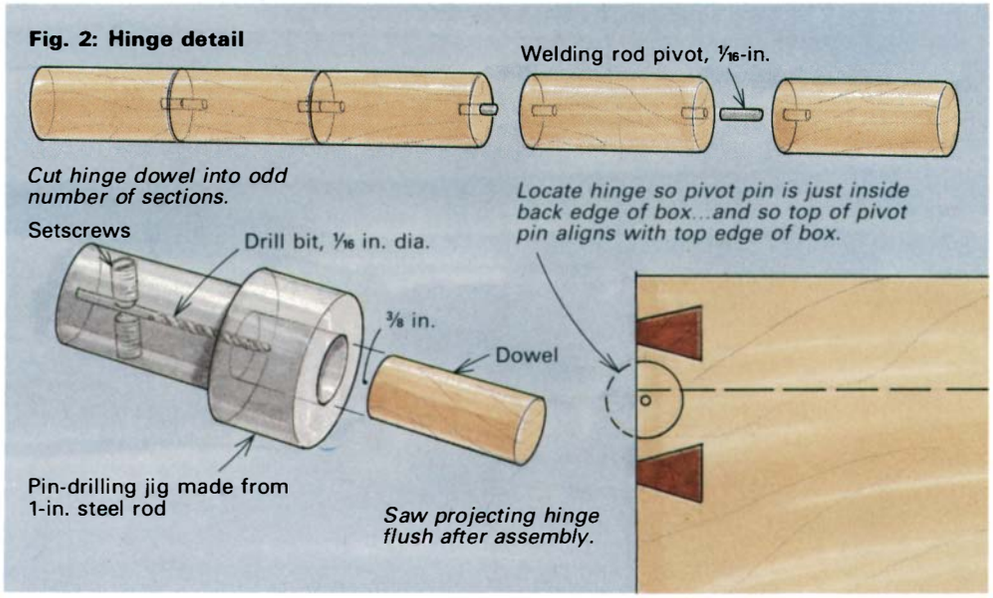
While the oil is drying on the tops, I set up my router table to cut the stopped grooves in the sides to house the box lid and bottom. There's less tearout if this step is done before the finger joints are cut. On boxes with sides that are 5/16 in. thick, a 3/16-in. bit makes an aesthetically pleasing finger. Although I cut my finger joints on the router table, they can be cut on the tablesaw, as described in *FWW* #69. After

With corner joints suited for quick construction on a router table, the author's small wooden boxes are a practical, profitable craft item.

Fig. 1: Joinery details



The hinges are made from a dowel turned from the same species of wood used for the box body. A shopmade caliper assures consistent diameter. A semi-circular rabbet houses the hinge. It's cut on the router table with a core-box bit.



the fingers are cut, the box is dry-assembled with the lid and bottom in place. If everything fits, I square up the box and apply Hot Stuff cyanoacrylate glue on the corners. The water-thin glue can be seeped into an already-assembled joint and then set with a shot of accelerator catalyst.

For the mock dovetails, I first miter the parts, then lay them end for end, outside face up. I run lengths of strapping tape along the parts, letting a few inches overhang the ends. After yellow glue is applied to the miters, I fold the pieces into a box, using the overhanging tape as a clamp. Once the glue is dry, I cut the sockets for the mock dovetails. Because commercially available bits don't produce a distinct enough dovetail, I ground a bit to about 12°.

After I have glued up all the boxes, I'm ready to slice off the lid on the tablesaw. I decide where the box should be cut apart and then, if the box is finger-jointed, center the cut in the middle of a finger. Removing a 1/8-in. kerf down the middle of a 5/16-in. finger leaves 1/32 in. on each half of the box. Working on a stationary belt sander, I use the remaining fingers as a guide—once they are sanded flush, the lid mates perfectly to the box.

The wooden hinge is next. As figure 2 shows, the hinge itself consists of a lathe-turned dowel made of the same wood species as the box. You could, however, use a standard hardware-store dowel. The dowel is sawn into an odd number of sections (odd numbers look better than even), which are let into a semi-circular rabbet routed into the back edge of both the box body and the lid with a core-box bit. The hinge pivots on 1/4-in. lengths of a 1/16-in.-dia. welding rod and, once assembled, the hinge sections are glued alternately to the lid and box body.

To turn the dowels safely and accurately, I use a mini drive center on my lathe, checking for consistent diameter with a shopmade caliper consisting of a small scrap block with a groove milled in it by the same core-box bit that cuts the semi-circular rabbet. The dowels are initially turned 1 in. longer than the box, sawn into sections and then trimmed to final length. One of the biggest problems I've encountered is drilling perfectly centered holes in the dowels for the pivot pins. I solved the problem by having a machinist make the jig shown in figure 2. If you don't want to go to this trouble for just a few boxes, you could probably make the jig of wood and epoxy the 1/16-in.-dia. hinge-pin bit in place. (See *FWW* #62, p. 10 for another dowel-drilling method.)

The semi-circular rabbets for the hinge are cut on the router table, beginning with the box body. The rabbet depth is critical; if it isn't correct, a sprung hinge might keep the box from closing or, worse, it will open too wide and jam. I cut the rabbet in the box body first. This rabbet must be positioned so the pivot points will be just inside the back edge of the box and tangent to the box's top edge. It's best to use a scrap piece to get the depth just right. To cut the lid rabbet, I lower the bit and move the fence forward, then using a scrap piece, I readjust the cutting depth and fence position until the lid fits with a tiny gap near the hinge end. This will prevent a sprung hinge.

The outermost hinge sections are glued to the box body and then alternate sections are glued to the lid. To avoid confusion, I pencil a "g" at points where the hinge is to be glued. A piece of cellophane tape stretched across the back of the box along the narrow edge of the rabbet prevents glue squeeze-out from seizing the lid. Apply a small bead of glue at the marked points—yellow glue or cyanoacrylate—and once everything is lined up, apply just enough clamp pressure to hold the box together. After the glue dries, I remove the projecting back of the hinge on the tablesaw, then sand everything flush, using the same sequential procedure as with the lids. A couple of coats of Minwax Antique Oil followed by two coats of Liberon Black Bison furniture wax leaves a satin-smooth finish. □

Robin Cosman is a student at Brigham Young University. He plans to open a furniture shop in New Brunswick upon graduation. Hot Stuff glue, mini-spur drive centers and Black Bison furniture wax are available from Craft Supplies U.S.A., 1287 E. 1120 S., Provo, Utah 84601; (801) 373-0917. Brass rod is available from Small Parts Inc., 6891 N.E. Third Ave., Miami, Fla. 33138; (305) 751 0856.

A cheap saw kit the author encountered at a 1950s industrial-arts show inspired the design for this shopmade parallel-arm scroll saw. Powered by an old dryer motor, the saw's 2-in. stroke makes for an aggressive cut.

Shopmade Scroll Saw

Eccentric drive simplifies construction

by Mark White

I was a high-school student in the mid-1950s when I attended my first industrial-arts conference in Oswego, N.Y. One of the displays there featured a cheap kit for a motorized version of the wooden scroll saw my great uncles had used to cut fretwork for fancy houses they built at the turn of the century. The saw was made almost entirely of unfinished, ¾-in. ash. It was simple and homely, but boy could it cut. For years, I've tried to lay my hands on one, but the manufacturer has disappeared without a trace.

Since I had already built a large walking-beam saw (see *FWW* #24 or *FWW on Making and Modifying Machines*), I finally decided to design my own scroll saw. I ended up with a saw that performs as well as any of the factory-made machines I've tried and will saw very tight curves in wood up to 2 in. thick, leaving a smooth surface that requires no sanding. For inside cuts on fretwork, the blade can be removed, threaded through a hole in the wood and reinstalled in less than 30 seconds.

Inspired by the homely kit I'd seen years earlier, I made my saw as simple as possible. Basically, it consists of two parallel wooden arms mounted on a rigid wooden frame and kept in tension by the blade at one end and a stout nylon cord at the other end. The blade is driven by the reciprocating motion generated by a pair of eccentric, rotating weights attached to the lower arm with a shaft and pillow block. An old clothes-dryer motor drives a section of rubber hose that acts as a flexible shaft to spin the weights. Because the weights are eccentrically mounted, they actually unbalance the pillow-block shaft, causing it to oscillate one cycle for every revolution of the motor. Although the stroke can be varied by changing the length of the weights, I've found that weights made from 2-in. bar stock, 3½ in. long, work best with the 6-in. coping sawblades I use in the saw. These longer blades produce a more aggressive cut than the 4-in. blades most scroll saws use. As shown here, the saw has a 24-in. throat, but if you need a smaller or larger throat, you can scale the dimensions up or down without affecting performance.

Building the frame and arms—When choosing wood for the frame, pick a stable and warp-resistant material. For this saw, I used two Sitka-spruce 2x12s about 32 in. long, because that's what I had. White pine or fir would work as well, or if you want a nicer-looking saw, use walnut, beech or maple. To ensure precise alignment of the arm pivot holes, screw the boards for the frame together and machine both parts at once. The pivot holes—½ in. dia. for the top arm and ¾ in. dia. for the bottom arm—should be bored on a drill press. Bore the large access holes for the rotating weights with a Forstner bit or a hole saw, or saw them out with a jigsaw and much patience. After bandsawing the frames to shape, I separate the two sections and rout a radius on all the edges except those that mate to the base and the saw table.

I also used spruce for the arms, but ash, cherry and pine are good choices, too. Whatever wood you pick, keep the weight of the arms as low as possible near the blade end. If the arms are too heavy, excess vibration and poor reciprocating action will result. One advantage of spruce is that it has sound knots hard enough to serve as bearings for the bolts or rods on which each arm pivots. On one of the saws I've built, a 1¼-in. knot drilled for the pivot shaft and regularly lubricated with gear oil has lasted four years as a bearing. The lower pivot on the saw shown here is a ¾-in.-dia. steel rod in an Oilite bearing of the equivalent inside diameter. Oilite bearings—self-lubricating, sintered bronze sleeves—are available in a range of sizes. Refer to the supplies box for a source.

As the drawing shows, the distance from the pivot point to the blade mount is ¼ in. longer on the top arm than it is on the

Photos: Marion Stirrup

bottom arm. This causes the blade to back out of the cut on the upstroke and advance into the material on the downstroke, increasing blade life and improving performance. Reducing the blade rake (angle) to ⅛ in. will make the blade less aggressive and the cut more precise.

The eccentric drive—For the drive, you'll need some ¼-in. by 2-in. mild steel bar stock, a 3½-in. to 3¾-in. bolt to serve as a shaft and a ¾-in. ID pillow block. As shown in detail C, the weights are fashioned from the bar stock, then mounted on either side of the pillow-block bearing by the shaft. The threads on the bolt's excess length are filed or ground off to give the rubber-hose coupler good purchase. To make the weights, I first bored the bar stock, then cut them to final size. It's tough boring large holes in heavy steel, so I started by boring a ¼-in. hole, which I then enlarged to ¾ in. Do this boring on a drill press and be sure to clamp the steel firmly and keep your hands well clear of the work.

I assembled the drive mechanism by holding the bolt head tightly in a vise while the nut was drawn up very lightly. Washers, or a ⅞-in. nut, can be used as spacers to keep the weights from striking the arm as they rotate. As you tighten the nut, make sure the weights are aligned so they'll rotate in unison, otherwise the reciprocating action will be uneven. Once it's assembled, position the pillow block on the lower arm, as shown in the drawing. Before bolting the pillow block down, make sure the weights rotate through their full arc without striking the arm. If they strike the arm, add a thicker spacer. By the way, the drive can be positioned so the motor is on either side of the saw.

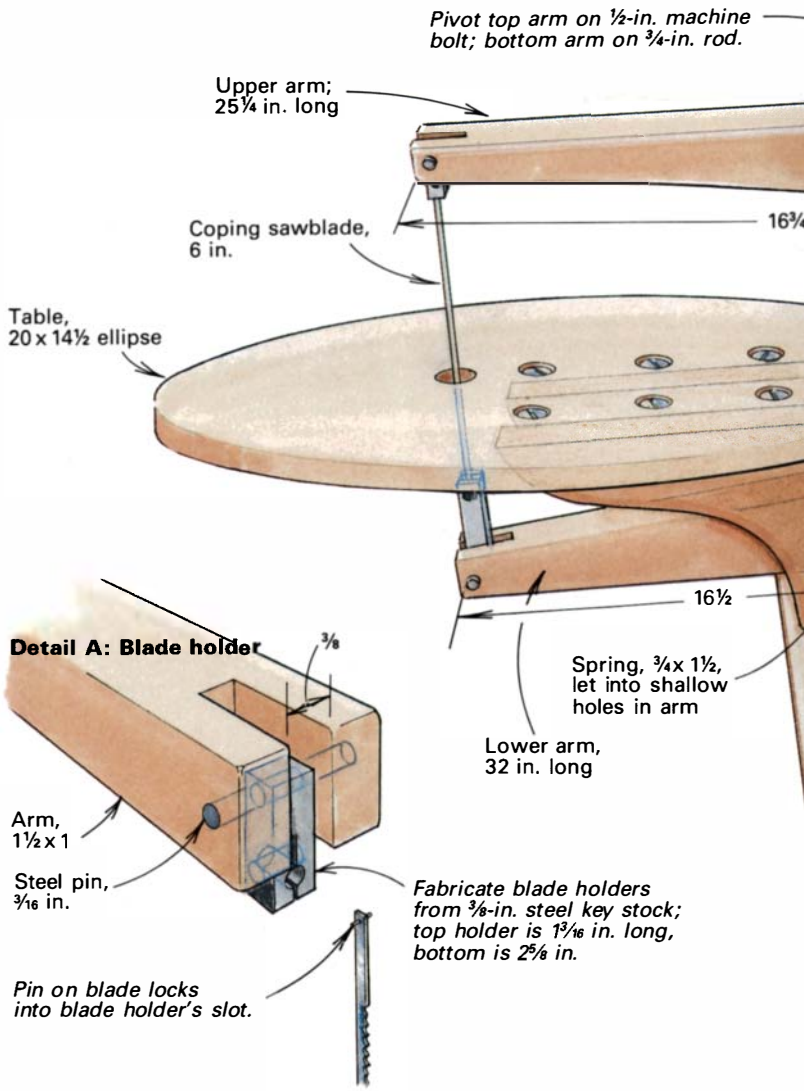
Assembling the saw—Begin assembly by inserting the arm pivot bolts in their holes and positioning the upper and lower arms on the frame. Rotate the eccentric weights by hand, and on the inside of the frame, mark the path they describe. With a large Forstner bit and/or a chisel, chop clearance cavities in both frame pieces to accommodate the rotating weights. Remember, the arm's travel is at least 1 in. in both directions, so be sure you've provided enough clearance. Although the spinning weights are well protected by the saw's frames, it's probably not a bad idea to fashion some sort of a removable guard for the back of the saw as an added safety feature. Before proceeding with final assembly, the blade holders and tensioner must be made.

I made the blade holders from ⅜-in. key stock, as shown in the drawing. Each blade holder fits into a slot cut into the end of the arm and is held in place by a 3/16-in. steel pin. If you can find them, pins that are hardened and ground will work best with the softer key stock, but in a pinch, a small bolt could also suffice. The blade itself is inserted through the holder's slot and held in place by pins on the ends of the blade.

To cut well, the blade must be under considerable tension; and on commercial saws, this is usually done with a threaded rod. But in keeping with my saw's low-tech design, my tensioner is simply a loop of nylon cord that passes around a ¼-in. pin in the lower arm and through a hole in the upper arm, where it wraps around a dowel. Twisting the loop tensions the blade, as with a bowsaw. This setup may sound crude, but it's effective, and because it's flexible, the saw won't shake itself apart when a blade breaks. Sometimes, vibration will tend to unwind the tensioner, a problem that can be remedied by carving a detent notch for the dowel where it seats against its mounting knob.

To minimize warping, I finish both sides of the frames with varnish or shellac before assembling the saw. Once the finish is dry, I test assemble the parts, tightening the fasteners fingertight.

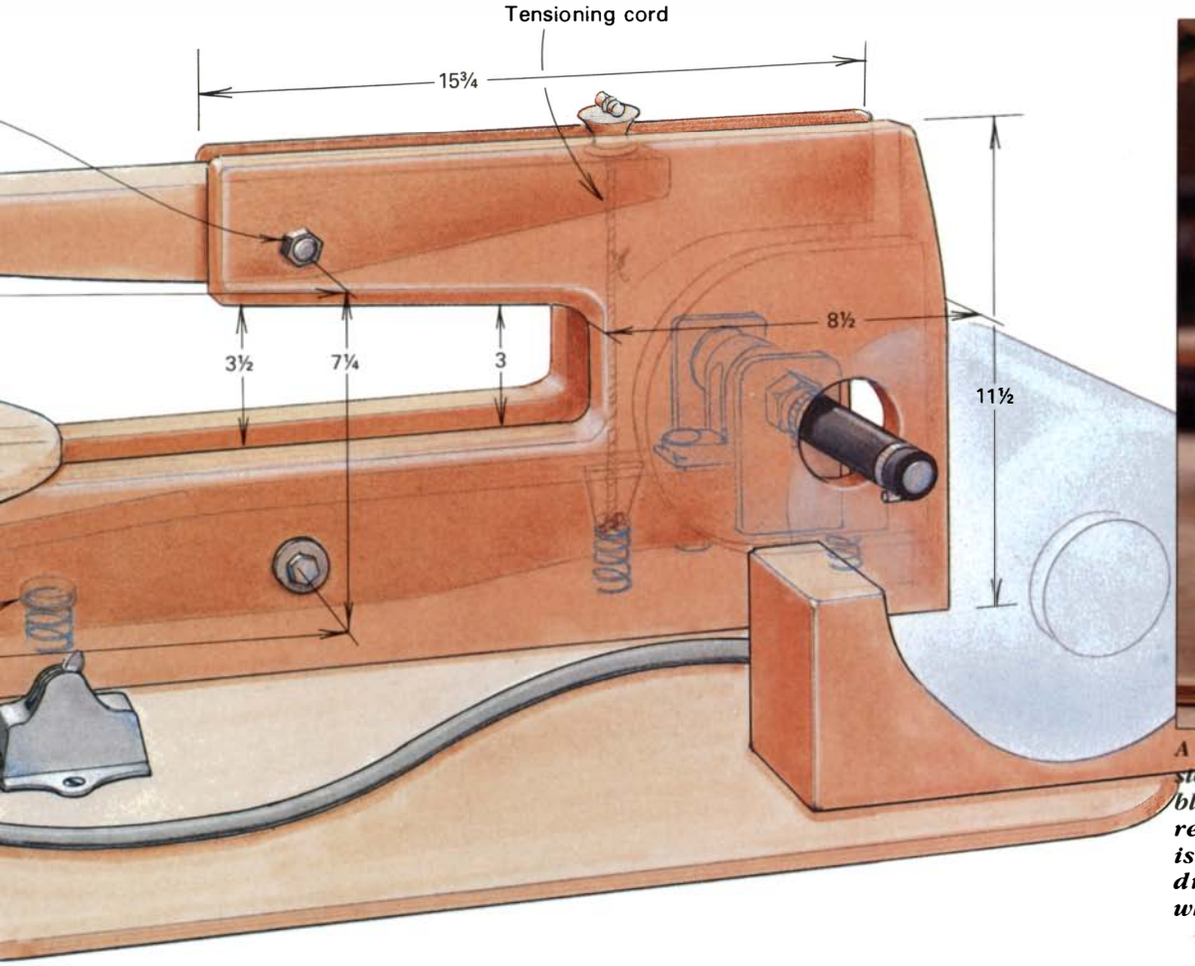
Fig. 1: Scroll saw plan



With a blade installed and lightly tensioned, I move the arms by hand. They should slide lightly against the sides of the frame. If there's binding, trim as needed with a handplane. To keep the lower arm roughly centered in its swing and to give the rotating weights some resistance to work against, I mounted three coil springs between the lower arm and the saw's base. The springs—straight from the hardware store—are 1½ in. long, ¾ in. in diameter. To hold each spring fast against vibration, I bent one end of the coil down and threaded it into a small hole bored in the base. Long finishing nails will temporarily hold the coil springs in place while the saw is attached to its plywood base.

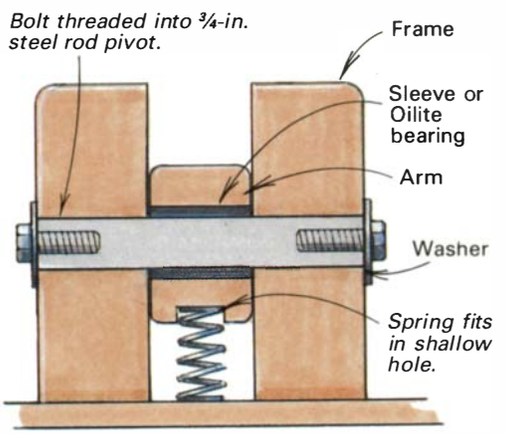
Trial run—To test the saw, I chuck a bolt into a variable-speed drill and connect this through a section of rubber hose to the eccentric drive shaft. I run the machine for a few minutes at slow speed to check everything out. Both arms should reciprocate freely with minimal vibration. If the front or back of the bottom arm strikes the base, adjust the position of the springs or install stiffer ones. Once this test is done, I connect a permanent motor and switch. The saw doesn't require much power—⅓ HP to ¼ HP should be plenty at 1,720 RPM. Do not, under any circumstances, use a 3,450-RPM motor. Unless you reduce its speed through pulleys, a motor this fast will cause dangerous vibration.

To finish up the saw, I make a 20-in.-dia. elliptical saw table out of ¾-in. plywood and screw it to the frames with drywall

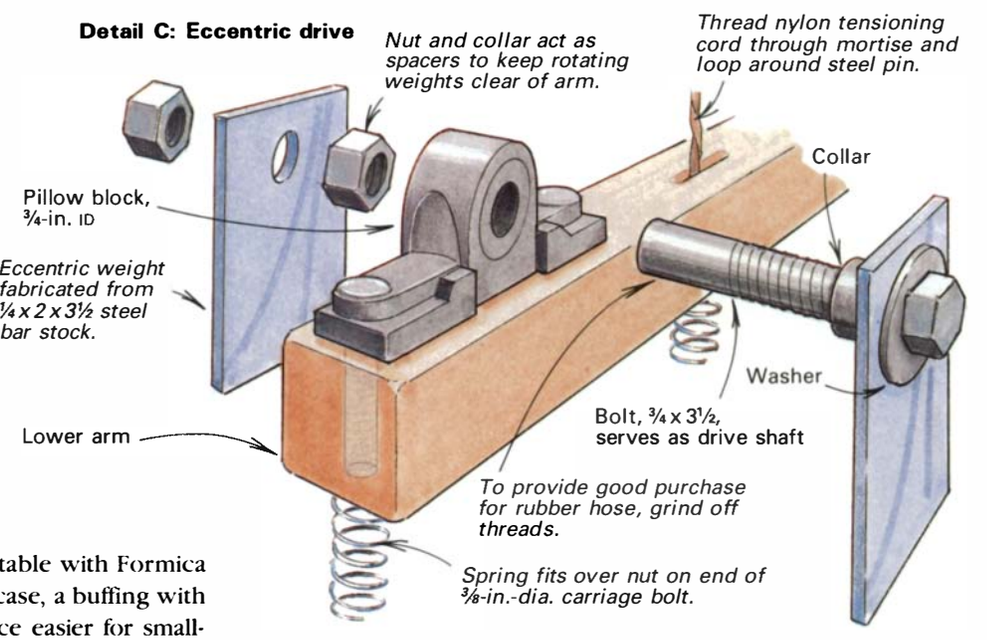


A pair of eccentrically mounted steel weights bolted to a pillow-block bearing generate the saw's reciprocating action. The motor is connected to the reciprocal drive through a rubber hose, which acts as a flexible shaft.

Detail B: Bottom pivot



Detail C: Eccentric drive



screws. For a really smooth surface, cover the table with Formica or make it out of an old sink cutout. In either case, a buffing with paste wax will make maneuvering the workpiece easier for small-radius scroll work. I've come up with solutions for the two aspects of using a scroll saw that I find most unpleasant: vibration and dust. A 3-in.-thick foam-rubber pad placed under the saw's base dampens noise and vibration considerably and keeps the saw from walking across the table. On a few of the machines I've built, I tapped into the airstream coming off the motor's cooling fan and diverted it through a ½-in. copper tube to a point just in front of the blade. If you do this, make sure to orient the tube so it blows dust toward the back of the saw and not toward the operator. □

Mark White teaches woodworking, welding and house construction at the University of Alaska outpost on Kodiak Island.

Sources of supply

Pillow blocks and motors are available locally from Grainger's. For a catalog and list of distributors, write W.W. Grainger, Inc., 5959 W. Howard St., Niles, IL 60648; (312) 647-8900.

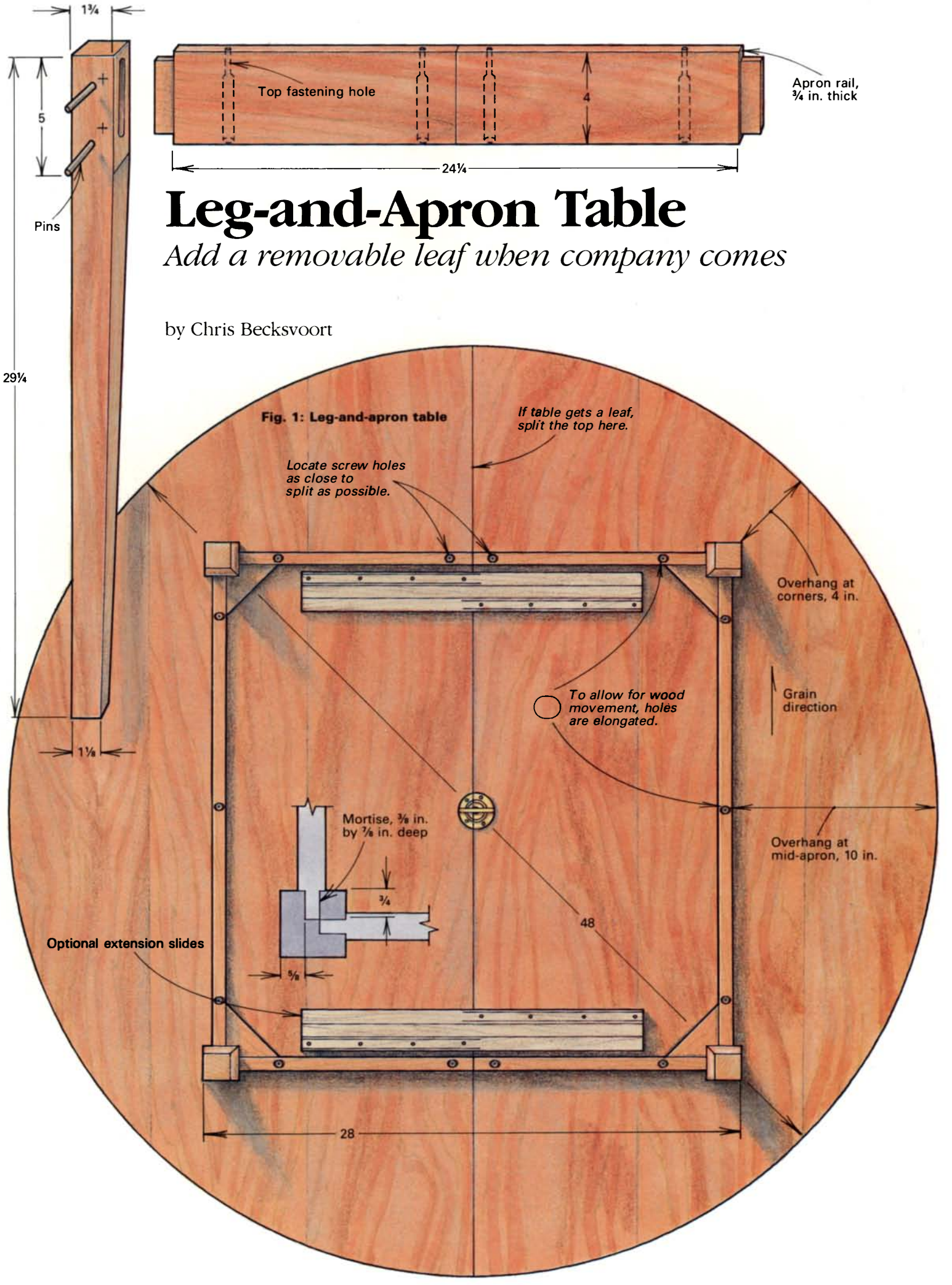
Bar stock, Oilite bearings and hardware are available from Small Parts, 6901 N.E. Third Ave., Miami, FL 33238; (305) 751-0856.

Key and bar stock is available from Metal by Mail, 18170 W. Davidson Road, Brookfield, WI 53005; (414) 786-4276.

Leg-and-Apron Table

Add a removable leaf when company comes

by Chris Becksvoort



I designed this round table to solve a space problem in a tiny apartment my wife and I once shared. Our dining room was a niche surrounded by three walls, leaving far too little space for a rectangular table. A round tabletop on a square leg-and-apron base promised the most usable surface area in the least floor space. I've since built about 30 of these tables, some with up to three removable leaves that expand the top to accommodate more people. Over the years, I've refined the details a little, but the table remains a straightforward piece you can build with minimal tools in a couple days.

The tabletop is 48 in. in diameter, which will seat four comfortably or six in a pinch if you don't wish to add a leaf. You can scale the top and base up or down slightly, but wholesale departure from the dimensions given isn't advisable. The plans call for a 24-in. space between the legs—plenty of room for knees and legs. For a smaller top, you could move the legs a little closer together, but if you scale the top up and widen the leg stance accordingly, spacing greater than about 26 in. will look awkward. Leg spacing is complicated by the fact that a round top overhangs a square base unevenly. As a result, when the apron is viewed from straight on, the table appears to be all overhang; when viewed diagonally, it appears to have too little overhang. By experimenting with a mock-up, I arrived at a visual compromise represented by the dimensions in figure 1. If you need a larger table, I suggest you add one or two leaves instead of gluing up a bigger single-piece top.

Getting started—There are any number of ways to build a leg-and-apron table, but for expediency, I follow a definite order of events, regardless of the method. First of all, I glue up one or more tabletops several days before beginning construction. When I do my weekly errands in Portland, I drop off the tops at a local millwork house where they're sanded to 150 grit on an abrasive planer. This machine sanding is well worth the $20 or so it costs: The tops emerge perfectly flat and ready to finish after a final sanding to 220 grit.

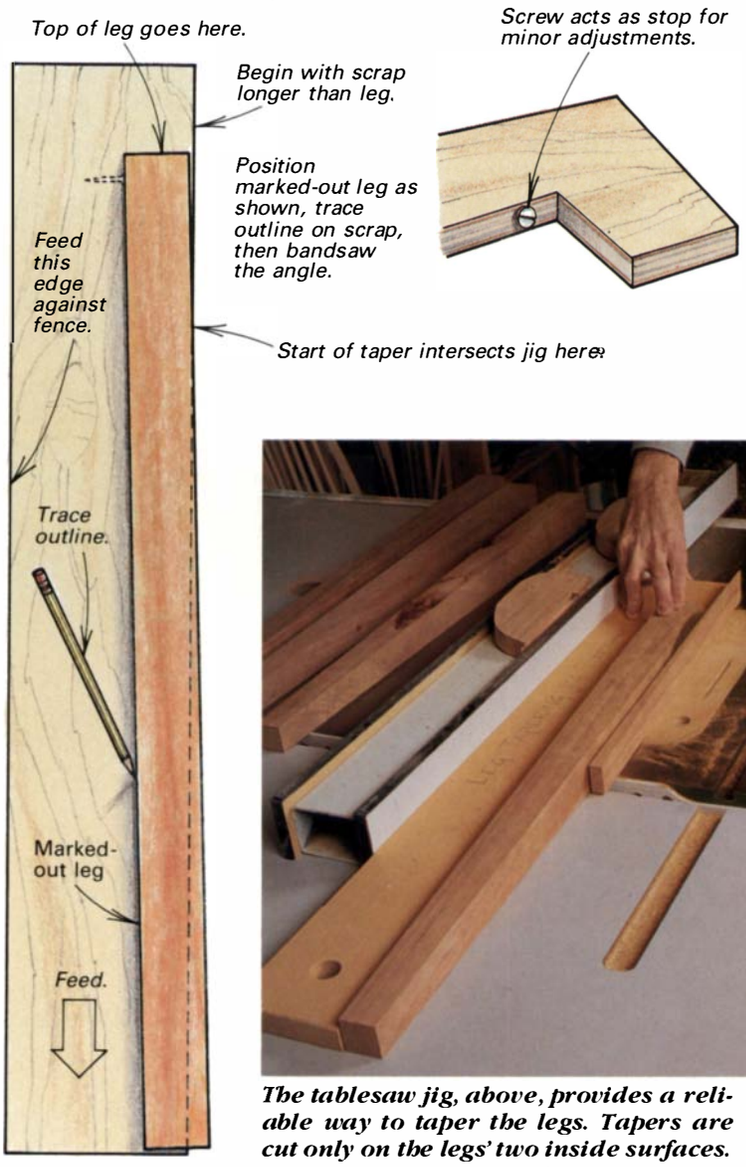
Some woodworkers argue that it's best to glue up a tabletop so the boards' growth rings are either all up or all down, reasoning that any cupping will be easier to restrain if it occurs in the same direction. Others alternate the growth rings, claiming it's better to have several small warps than one big one. Frankly, I don't accept either point of view. I'm most interested in a nice-looking top, so I orient the boards for best color and grain match and let the growth rings fall where they may. So far, I've had no problems with warping. Whether the table will have a leaf or not, I glue up the top in two sections that can fit through the mill's 36-in. capacity sander. For a top without a leaf, I glue the two sections together before marking the circle with a trammel and bandsawing it. Leafed tabletops are clamped for marking, then bandsawn as two halves.

I begin construction of the base by making the legs. Over the years, I've experimented with various sizes and tapers and have finally decided there's no good argument for making the legs thicker than the minimum dimensions needed to support the table. Even the thinnest legs will support vertical loads imposed on a table, so the chief design concern is balancing the legs' visual weight with their ability to resist wobble. On the table illustrated here, the legs taper from 1¾ in. to 1⅛ in. This proportion looks just right with a 48-in.-dia. top, ¾ in. thick, and it results in a rigid base. For visual balance, a thicker or larger top might look nice with a heavier leg, but I think the table would look awkward with a 2-in.-thick leg.

To save the trouble of crosscutting them individually, I rip all the legs from a single 1¾-in.-thick board cut to the exact

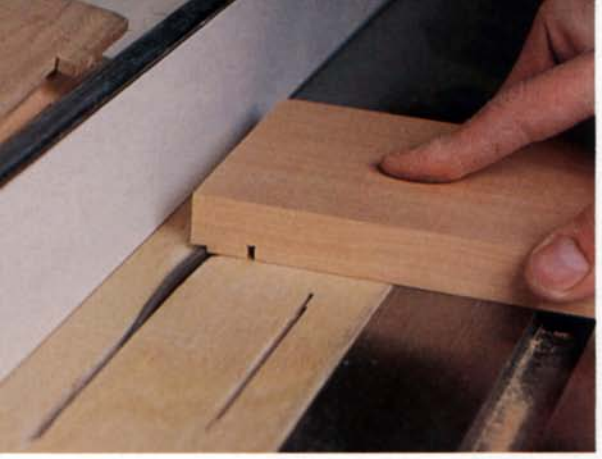
With a 48-in. round top on a square, leg-and-apron base, the author's table will accommodate four people. Built with three removable leaves, there's room for eight to 10 people.

Fig. 2: Tablesaw taper jig

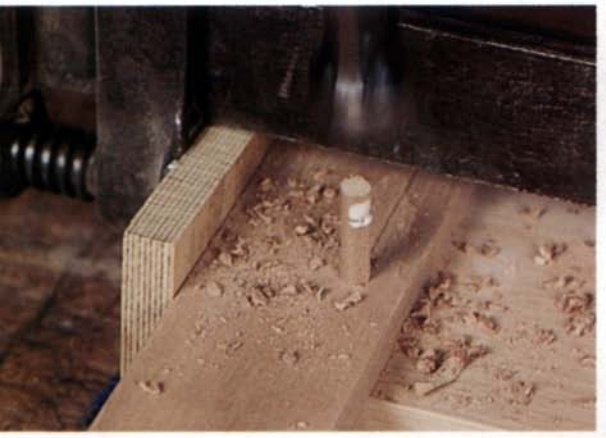


The tablesaw jig, above, provides a reliable way to taper the legs. Tapers are cut only on the legs' two inside surfaces.

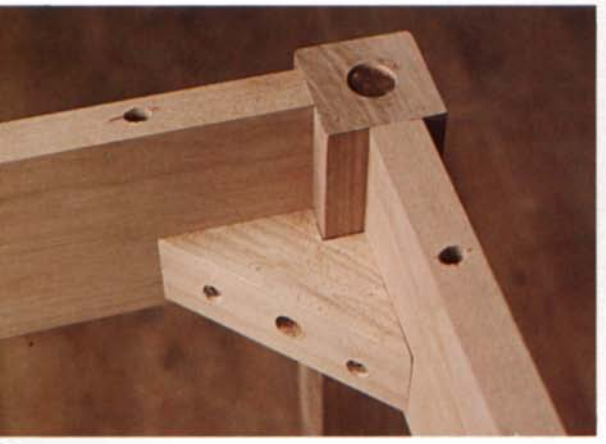
Drawings: David Dann

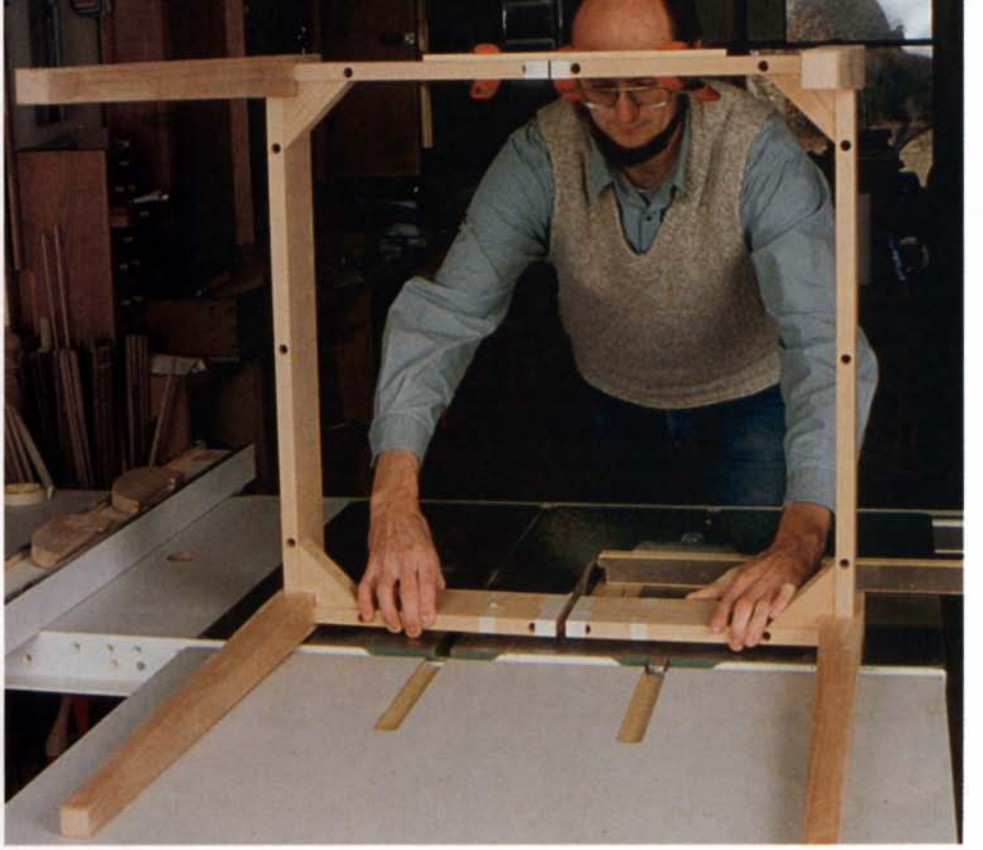


For tenoning with a single setup, above, the tablesaw's cutting depth is set to the shoulder depth, the fence (or a stop block) to the shoulder length. With the stock held firmly against the miter gauge, multiple passes form the cheek.



Glue blocks, above, glued and screwed at the bottom edge of the apron bolster the joint against damage from an accidental kick. The author's trademark, a penny let into the leg, dates the piece for posterity. Pulled home with clamps, the tenons, below, are pinned with ¼-in. dowels.





Wooden extension slides convert an ordinary table into one that expands. To install the slides, the top is attached to the base and the slides are screwed to the underside of the top. Then the base is removed so the apron rails can be tablesawn, above, using a miter gauge. A scrap taped to the apron acts as a shim, preventing binding during the cut. A brass latch, below, locks the leaves together.

length of the legs. Each leg is then tapered on the tablesaw with the jig shown in figure 2. If you prefer, you can mark the taper on the leg and bandsaw to the line or use the jointer tapering setup described in *FWW* #54, p. 54. Keep in mind, though, the tapers are cut only on the legs' two inside surfaces. Position the legs to expose the nicest figure and color on the two outside surfaces. Also, note that the taper starts about 5 in. below the top of the leg, leaving a flat for the apron to bear against.

The apron—As with the legs, the table apron's width is a trade-off between ergonomics and aesthetics. A 4-in. apron is wide enough to provide substantial tenon shoulders, but not so wide that you bang your knees on it. The few tables I've made with 3-in. aprons look fine, but aprons 5 in. or larger give the table a low-slung, bottom-heavy look. In leg-and-apron tables, the aprons are usually joined to the legs by a mortise and tenon. On older tables, you'll often see a haunched tenon. Even though a haunch will help keep the apron from twisting, I don't think it's worth the extra time required to cut it. Also, the apron is screwed to the tabletop near the corners, which are further braced against twisting with stout glue blocks. Besides, the apron twisting doesn't threaten the joint as much as a swift kick to the end of

the leg does. The glue blocks, positioned at the bottom edge of the apron and screwed into the leg, are good insurance against such a broken joint.

The detail in figure 1 shows the joint dimensions. I cut the mortises on a slot mortiser equipped with a fence and a series of stops. This means I have to mark out only one of the legs, then use it to set the fence and stops for cutting the rest of the pieces. If you plan to chop the mortises by hand (see *FWW* #66) or by some other method that's not jigable, you'll need to mark each joint individually. In either case, take care to cut the mortise in the right place, that is, on the sides with the tapers. And, don't forget to offset the mortises toward the outside of the leg, as shown in figure 1. Mortises ⅞ in. deep will just meet inside a 1¾-in.-thick leg, and there's really no need to make them any deeper. If you've cut mortises with a router or slot mortiser, you'll need to either square the mortise with a chisel or round the tenon. I've found that rounding the tenon with a knife is a quick, rather pleasant job.

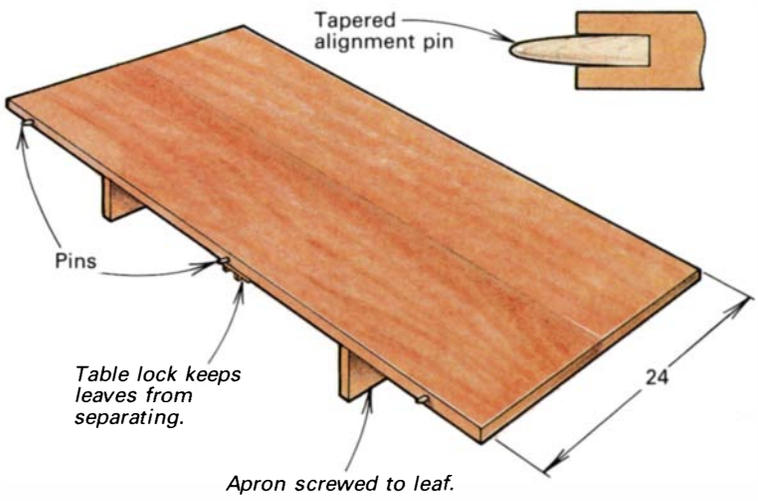
Cutting short tenons—Tenons are easy and quick to cut on the tablesaw. To set up for tenoning, I take a long scrap cut from the stock used for aprons and center it over one of the leg mortises. With a knife, I mark the mortise width on my scrap, then set the tablesaw's depth of cut just shy of the knife marks. Next, I position the fence (or a stop block clamped to it) so it's as far from the *inside* edge of the blade as the shoulder is long, in this case, ¾ in. Allowing for a ⅛-in. kerf, this produces a ⅞-in.-long tenon. The shoulders are cut first by firmly holding the scrap in the miter gauge and feeding its squared end against the fence or stop block. To form the cheeks of the tenons, I nibble away the waste in multiple passes, starting at the squared end and working toward the shoulder cut. With both cheeks wasted, I try the fit. If the tenon's too loose, I reduce the depth of cut and try again with another scrap. If it's too tight, I increase the depth until the fit is just right. Because increasing the depth removes material from both sides, make minute adjustments and try the fit as you go.

Assembly—With all the parts cut out, the base goes together in about 10 minutes. I first bore holes in the aprons for the top mounting screws and sand everything to 220 grit. I don't usually dry-assemble a simple piece like this table, but I do check that all the tenons fit snugly into their mortises and that the shoulders seat correctly. At final assembly, I pull the tenons home with clamps and bore ¼-in.-dia. holes through the joint into which 1¼-in. hardwood dowels are driven, pinning the tenon. The dowels are later pared flush with the leg surface. You can turn your own dowels or buy them in hardwood species from Midwest Dowel Works, 4631 Hutchinson Road, Cincinatti, Ohio, 45248. At assembly, check two critical things: Make sure the aprons go into the correct mortises, or the holes you bored for the top will be upside down; check the base for square by measuring diagonally across the inside edges of the legs. If everything looks right, I make up glue blocks, then screw and glue them at the corners.

All that remains is to screw the top to the base. Before I do this, however, I elongate the screw holes with a rasp to give the screws room to move as the tabletop shrinks and swells with the seasons. When drilling the mounting holes, it's a good idea to use a depth stop on the bit. Nothing is more embarrassing—or harder to repair—than an accidental hole through a tabletop.

Adding a leaf—If the table is to get a leaf, I screw the two separate tabletop sections to the base, just as I would a single-piece top. Then, after the table extension mechanism is installed on the underside of the top, I remove the base and simply crosscut the aprons on the tablesaw, using a scrapwood shim under the apron so it won't pinch the sawblade. Once the base is reinstalled, the kerf space remaining between the two halves of the apron allows for wood movement. You can make your own table-extension slides (see *FWW* #65) or buy one of the many commercial models available. I prefer a commercially made wooden slide made by Walter of Wabash and available from the Woodworkers' Store (see sources of supply). For a single leaf, 24 in. wide, use a slide with a 26-in. opening. Two leaves will require a 50-in. opening slide, but the table will then expand to a racetrack shape 8 ft. long, with room for eight or 10 people. The table could accommodate up to three leaves, providing seating for 10 to 12 people, but I wouldn't recommend making it any bigger without a center leg to support the additional leaves.

Fig. 3: Typical leaf detail



The leaves should be about 24 in. wide and their length should equal the diameter of the top. To keep the apron from warping and to hide the extension mechanism, fasten short sections of apron rail to the underside of the leaves. To align the leaves, table pins made from tapered dowels should be let into the edges of each leaf. Pin spacing isn't critical, but a 4-ft. leaf should have at least three table pins. To keep the leaves from separating, install table latches under the top and position them so each leaf can be latched to its neighbor.

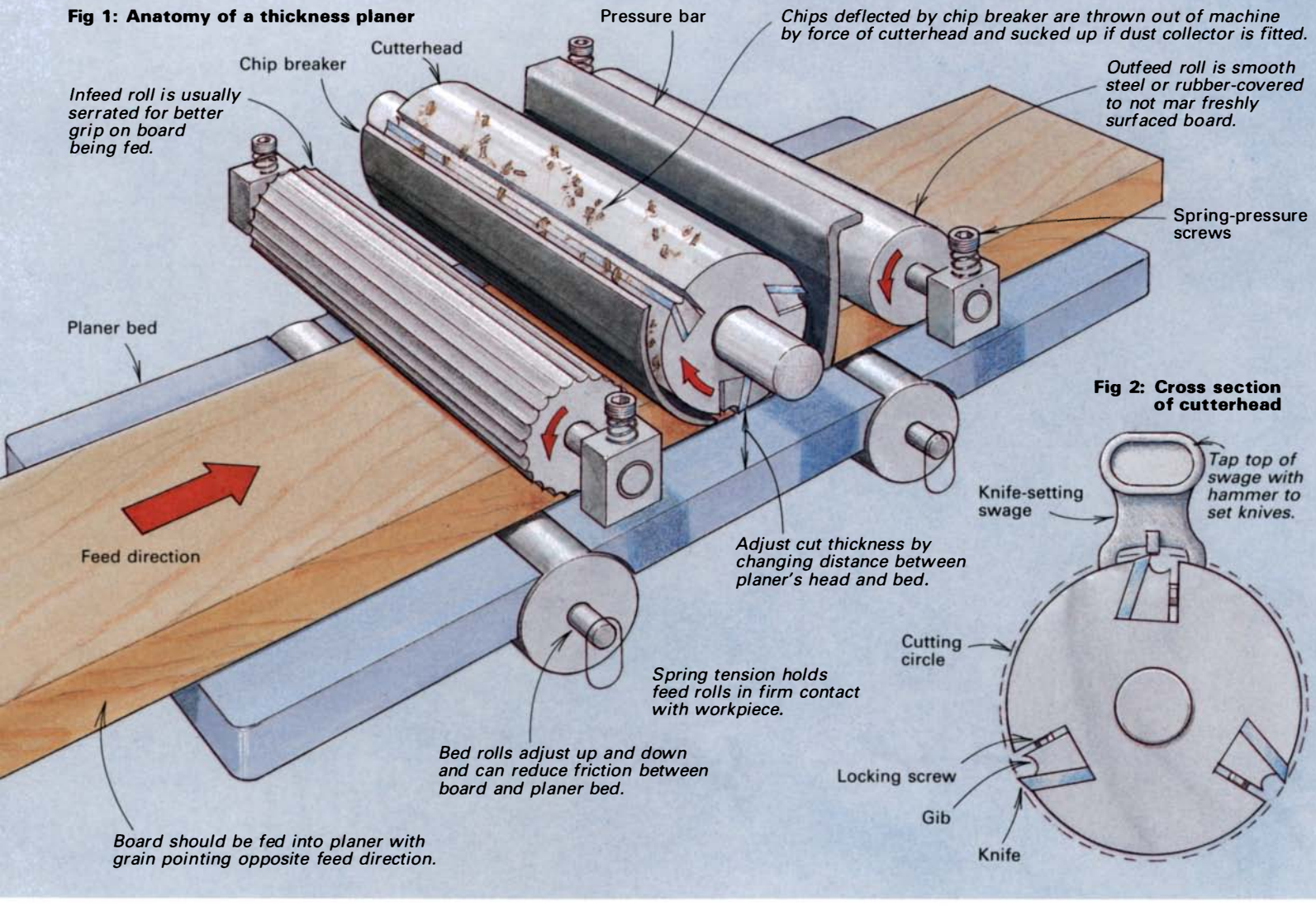
A final sanding followed by the finish of your choice completes the table. I normally use Watco oil, but if the top will see hard, daily use, lacquer or varnish would be more appropriate because of its durability. □

Chris Becksvoort makes furniture in New Gloucester, Me. He wrote about fastening tabletops in FWW *#62.*

Sources of supply

Table slides, tapered alignment pins and table locks are available from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374, (612) 428-4101.

Table locks and slides are available from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013, (800) 221-2942 or (212) 807-1757 (in NY), and in Canada from Lee Valley Tools Ltd., P.O. Box 6295, Station J, Ottawa, Ont. K2A1T4, (613) 596-0350.



Thickness-Planer Primer

Fine-tuning is the key to smooth planing

by Alfred E. Holland, Jr. and David Kinter

There are many types of planers on the market, ranging from small hand-fed 4-in. to 6-in. models to large production machines with multiple cutterheads capable of surfacing a million feet a week. Despite differences in size and features, all planers operate on the same principles. If you understand these principles, you can adjust your planer properly to obtain consistently flat lumber that's smooth as silk. The planers we'll discuss in this article are those most commonly found in the home shop or small woodworking business–the single-cutterhead surface planer with a maximum width of 12 in. to 18 in., often called a "cabinet" or "pony" planer.

A typical planer consists of a flat bed supported by a frame, usually cast iron. The frame supports a 1½-HP to 3-HP motor that drives a multi-knife cutterhead suspended above the bed. The motor also powers a series of rolls above the bed that push wood through the machine. A board placed on the bed is grabbed by the infeed roll, which presses it flat and drives it into the spinning cutterhead. Just ahead of the cutterhead, a metal bar called the chip breaker helps break off chips raised by the cutterhead and clear shavings out of the planer. Behind the cutterhead is another bar, called the pressure bar, which also holds the wood flat against the bed. An outfeed roll behind the pressure bar pulls the wood out of the planer. Depth of cut is determined by the distance between the bed and the cutterhead arc and is controlled

by turning a crank wheel that either moves the head (containing the cutterhead and feed-roll assembly) or the bed up and down.

Unlike a handplane blade, which slices a single shaving at a pass, the multiple knives in a planer's cutterhead each take many small shavings as the board is fed past. The cylindrical cutterhead has slots in it that hold two, three or four knives. The knives are held in place by locking screws, which let the knives be adjusted or removed. These screws don't bear directly against the knives, but contact knife-length bars called gibs, which distribute the pressure of the screws evenly and help curl over the wood chips sliced off by the knife.

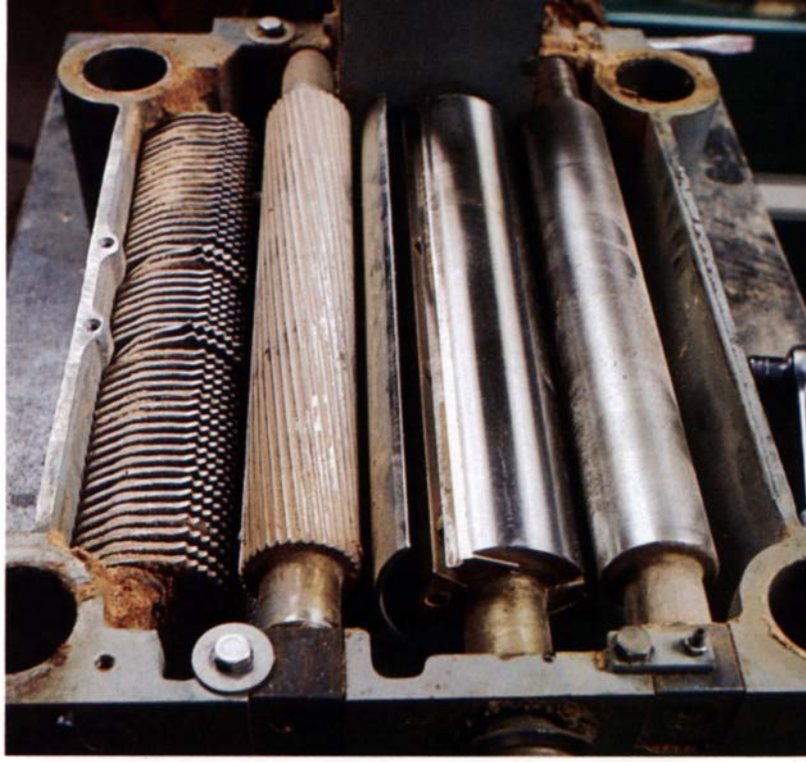
The infeed and outfeed rolls on small planers are driven by chains or belts connected via a gear-reduction box to the cutterhead. The rotational speed of these rolls determines how fast the lumber passes through the planer. The infeed roll is typically a serrated steel cylinder that grips the top surface of the rough stock fed into the planer. The outfeed roll is usually either smooth or rubber-covered steel, so it won't mar the freshly milled surface of the wood. Both feed rolls must press the stock flat against the bed to ensure a straight cut, but must also accommodate the irregular thickness of rough lumber. To achieve this, the rolls are spring-loaded and travel vertically to allow for thickness variations. Bed rolls are not usually powered and are positioned in openings in the bed directly below the feed rolls. They reduce feed friction by lifting the board off the bed slightly.

For a smooth cut, the wood must remain flat on the bed during the cut, so the chip breaker and pressure bar are very important. Besides holding the work down, the chip breaker also directs the chips out of the machine (and into the dust collector, if one is fitted) and minimizes tearout by breaking off chips lifted by the cutterhead's cutting action. The pressure bar is a rigid steel plate adjusted to align with the lowest swing of the rotating knives, and therefore, to the thickness of the just-planed lumber. Some of the smaller machines get along without a pressure bar, but these planers usually have slower feed rates and can't remove as much material in a single pass as those with pressure bars.

More sophisticated planers employ a segmented infeed roll that can accommodate greater surface irregularities than a single serrated roll. This prevents slipping when boards of varying thicknesses are run simultaneously through the planer. The feed speed on some planers can be adjusted either by flipping a lever or changing a belt. This is a critical feature if you surface both hardwoods and softwoods, because hardwoods usually require a slower feed speed than softwoods.

Some planers are also equipped with anti-kickback fingers or pawls to prevent the cutterhead from throwing a board back at the operator. Knife-setting devices that can knock the drudgery out of changing knives are also common on more elaborate planers. These devices include jacking screws built into the cutterhead to raise or lower knife height or separate jigs that clamp the knives in the proper position while they're being locked into the cutterhead. Production-model planers usually offer a knife-grinding attachment that allows the knives to be jointed, ground and honed while they're still in the cutterhead. Most small shops, however, send their knives out for professional sharpening.

Tuning up a planer—Start by leveling the planer—both side to side and front to back. A spinning cutterhead works like a gyroscope and runs smoothest when level. When out of level, it strains against its bearings and causes excessive wear. If the floor you place the planer on is fairly level, it should be heavy enough to stay put, but we've always bolted our planers down to ensure they don't move and that each foot assumes its share of the load.

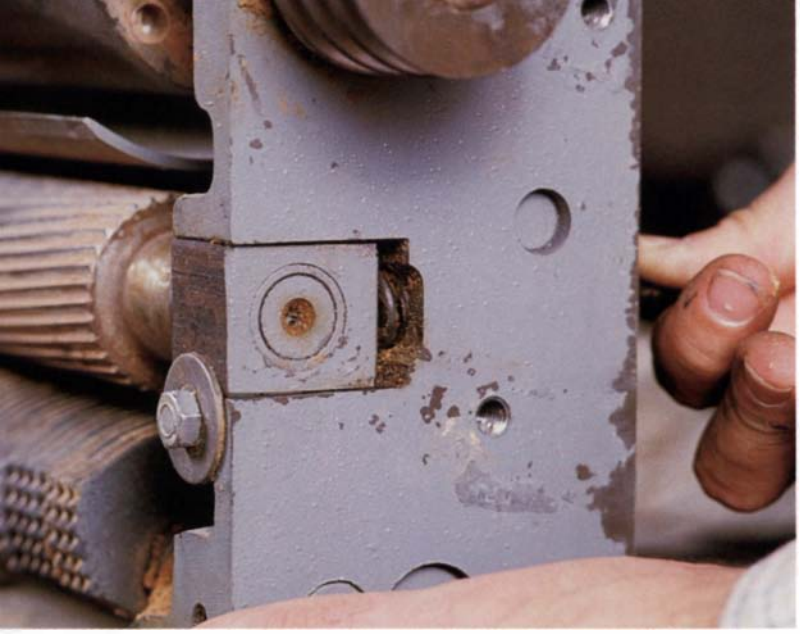


If you remove the head and turn it upside down, you can see (from left to right) the anti-kickback pawls, serrated infeed roll, chip breaker and smooth-steel outfeed roll on this Delta 13-in. planer. A pressure bar, normally located between the cutterhead and the outfeed roll, has been omitted on the Delta.

The cylindrical steel cutterhead has three slots milled in it to hold the knives. The knife-locking screws don't bear directly on knives, but distribute their pressure on wedge-shaped gibs. Each gib has a flute along its upper edge to help deflect chips.

For most adjustments, the cutterhead is the main reference surface. Its position in the frame can't be altered, so the other components must be aligned to it. First, check to see that the planer's bed is parallel to the cutterhead along its length. You can measure the distance between the bed and each end of the cutterhead with an inside caliper or pass a trued-up block of wood between the two components. Place the block under the cutterhead and reduce the thickness adjustment until the block just passes through the opening. If you feel an equal amount of drag as you pass the block through the opening at several points along the cutterhead, the head and bed are parallel. If the block sticks at one end and flies through at the other, you'll have to adjust the bed. When the bed and cutterhead are out of alignment, you might also find that the thickness adjustment is difficult to crank up or down or that you can wiggle the bed up and down or side to side. Realigning the table will likely cure these problems, too.

If the thickness adjustment is based on the synchronized rotation of two or more threaded rods, raising the bed's lower edge by repositioning the drive gear(s) on the end of the rod will level the table. If you have a planer bed with gibs and ways (slotted



With this Delta planer's head partially disassembled and on its side, you can see the infeed-roll pressure spring, which bears on a sliding bearing block supporting the roll's shaft. A screw on top of the head adjusts the spring's tension and how hard the roll presses down on the work. Screws at either end of the roll must be set to give equal pressure.

When the pressure of the infeed roll is set too high, the roll's steel serrations will often emboss a pattern into the planed board. If a light cut is taken, marks will usually remain.

Though it doesn't often need to be reset, the chip breaker's height is set on many planers by turning two adjusting screws that raise or lower the chip breaker relative to the cutting arc.

tracks), you may have to readjust the gibs in the ways by adding metal shim stock between them or by judiciously filing or scraping. If the thickness adjustment is based on two wedges that slide against each other, check for dirt between the mating surfaces. Also, file or scrape away any high spots on the surfaces. If you still can't align the bed and cutterhead, a last resort is to set the knives parallel to the bed by locking them in the cutterhead at a slight angle, but we don't recommend this as a final solution. Get a machinist to take a look at the machine first.

Feed roll adjustment—On most planers, feed rolls are set by tightening or loosening the spring-pressure screws found on top of the planer (see figure 1). The infeed setting must strike a balance—the pressure should be sufficient to move the board but not so great that the serrated roll leaves an imprint deeper than the thickness the cutterhead will plane off. Start with the springs at their lowest compression, then try a paper-thin pass. If the infeed roll slips, increase the spring pressure. Embossing can sometimes be a real problem with thin, soft stock. In this case, it's okay to raise the infeed rolls until they barely contact the wood, as long as you take thin cuts that require less feed pressure. CAUTION: Don't forget to lower the rolls before taking any heavy cuts or else a dangerous kickback could occur. The outfeed-roll pressure isn't as great as on the infeed, but it shouldn't slip on the wood or allow the wood to lift from the bed. The outfeed roll is adjusted the same way as the infeed.

Chip breaker and pressure bar—The chip breaker should be set so its bottom edge is far enough below the cutterhead arc to keep the stock from lifting off the bed. The chip breaker rarely needs adjustment. While the chip breaker's setting isn't critical, the pressure bar is another matter. If it's set too low, the workpiece will jam in the planer. If it's too high, the wood will bounce under the cutterhead, resulting in chatter or tearout. Because the adjustment is so important, we never do it until after we're sure the feed rolls are right and the bed leveled. After thicknessing a scrap, shut the planer off, unplug it and wait for the cutterhead to come to rest. Now slip the surfaced scrap into the planer and check to see if it just slips under the pressure bar with a friction fit. This is largely a matter of feel, but with some practice you'll be able to tell if the piece is sticking or if there's too much play. If necessary, loosen the retaining bolts and adjust. After years of use, the pressure bar will wear more in the center than at the ends, so a board might jam along the edges of the bed but chatter when passed through the center. If this happens, remove the bar and file it straight or have a machinist grind it true.

Bed rolls—How you set the bed rolls depends on the kind of surfacing you do. The rougher the lumber, the higher the bed rolls must be set to reduce friction between the lumber and the bed. If the bed rolls are set too high, the workpiece passing over them may begin to vibrate, creating a rippled surface. While this won't be a problem with 8/4 maple, even a well-adjusted machine will devour thin wood with gusto. Smaller machines generally plane thin stock more successfully, because the smaller-diameter heads and closer positioning of feed rolls shortens the length of a board that can vibrate. For finishing cuts on relatively smooth surfaces, the bed rolls should be set just about dead even with the bed's surface. Measure the setting by laying a straightedge across both rolls on one side of the machine and inserting a feeler gauge between the straightedge and the bed. Settings will vary from 0 in. to 0.002 in. for finish planing and up to 0.008 in. for surfacing rough stock. The bed rolls can be quickly adjusted by

With a straightedge spanning the bed rolls, insert a feeler gauge between the straightedge and table to measure bed-roll length. Eccentric bolts at the ends of the bed-roll shafts can be turned to raise or lower each end of the roll independently. For planing thin lumber, the bed rolls can be lowered flush with the table. The planer's head has been removed for clarity.

built-in levers on some planers; on others, locking bolts must be loosened before any adjustment can be made.

The belts that drive the cutterhead and feed rolls should be checked occasionally for wear and tightened if necessary, but don't overdo it. Overtightening a belt strains bearings and shortens their lives. A good rule of thumb is that when slight pressure is applied, the belts should flex about 1/32 in. for every inch of belt between pulleys. Apply belt dressing, available in spray cans or solid sticks at auto-supply stores, a couple of times a year to reduce slipping. Chains and sprockets exposed to dust and shavings should be lubricated with graphite or other dry lubricants. If they're enclosed in a tight case, a light greasing will do.

Sharpening and installing knives—No amount of adjustment will make up for dull, improperly installed knives. Knife replacement can be tedious, but the more accurately you work, the smoother the surface your planer will produce. Unless your planer is equipped with a special knife-grinding attachment, dull knives must be removed from the head before they can be sharpened. To shorten downtime, keep an extra set of sharp knives handy to swap with the dull ones. After removing the dull knives, clean the slots in the cutterhead, removing any debris that might prevent the knives from seating properly. Use oven cleaner or a Scotch-Brite pad moistened with diesel oil to remove the accumulations of pitch and resins, then wipe the head with a damp rag and let it dry thoroughly.

If you're ambitious or own a knife-grinding setup, you can joint and sharpen your own knives. But it's difficult to get them perfectly straight, so most woodworkers we know send them out to a sharpening shop. When you get your knives back, make sure each edge has been jointed straight and hasn't been burned blue. Properly sharpened knives will have a burr on the edge that must be honed away on a water or oil stone prior to installation. Keeping the bevel flat on the stone, lightly hone each knife until its edge is smooth and shiny. It's likely the bevel will be hollow ground, so the stone will contact only the tip and heel of the bevel, thus reducing the amount of metal that must be removed to eliminate the burr. If you often surface difficult woods, like curly maple, a small bevel can be honed on the back of each knife, blunting the cutting angle slightly and giving it more of a scraping action that's less apt to lift wild grain. (For more on back beveling, see *FWW* #55, p. 74.) These dubbed-over edges are more likely to burn the stock, however, and put additional stress on the cutterhead bearings. When the honing is completed, clean the knives with mineral spirits or naptha.

Install each knife in the cutterhead with its gib and tighten the locking screws enough to hold the knife in the slot, yet leave it loose enough to be moved later on. The trick is to get all the knives to protrude the same amount from the head so each shares the cutting load equally. Otherwise, the knives will wear unevenly and the cut will be rippled. Setting the knives to exact height is best done with a dial indicator on a crow's foot base (see accompanying sidebar on p. 62) or a knife-setting gauge, which sits astride the cutterhead and references the precise knife height.

Tap each knife down into the head (or raise it up if the cutterhead is equipped with jacking screws) until all the knives protrude about 1/8 in. from the cutterhead. As you do the final tightening, each knife will scoot up a bit, but they'll all move a similar amount if everything is clean. Make sure the cutterhead will rotate without hitting anything and check that it is parallel to the bed, as described above.

If the knives aren't set correctly, the high knife will collect more residue and dull faster than the others. As it dulls, it'll heat up and melted resins from the lumber will stick to it. As soon as you notice this buildup, correct the problem. If you wait, the heat might actually anneal the cutting edge, reducing its edge-holding ability.

Operating a planer—The planer is a relatively safe machine to use, but a few words of caution are in order. Thickness planers

can only remove so much material in one pass, usually between 1/16 in and 1/4 in. Attempting to remove more will result in either a jammed or broken machine. If chips jam the feed works, don't lower the bed to remove the stock until the cutterhead has stopped turning. Never reach into a planer that's running. Never plane a board that's shorter than the distance between the feed rolls. Otherwise, the piece could lodge in the planer, only to be shattered as it bounces into the cutterhead. No matter what happens, never look into the infeed end of a running planer; a board might be kicked back by the force of the cutterhead. And always wear eye, ear and breathing protection, even when running the planer for just a few minutes at a time.

There's more to planing than just feeding boards into the machine. By itself, a planer will not make warped stock flat: One side of the wood must first be flattened on the jointer or with a handplane. If you feed a twisted, winding board into a planer, the feed rolls will flatten it out as they move it past the cutterhead, but once the roll pressure is gone, the twist will reappear in the freshly planed board. Joint each piece flat but not necessarily clean on one face; low spots that remain rough will be cleaned up by the planer. Check the board's grain direction and feed it into the planer, jointed side down, with the grain oriented as shown in figure 1. If the grain doesn't clearly run in only one direction, feed it in the most prominent grain direction, angling the board slightly through the planer. Flip the boards end for end to reverse grain direction and then plane the opposite face of each board. Removing equal amounts of material from both faces will minimize warping if the board is case hardened from kiln drying.

Knots, splits, checks—When possible, cut defects out before planing the board. Also, you can cut down on planing time by cutting parts for a project to rough length, then planing the shorter pieces flat and smooth, rather than trying to flatten a long plank along its length and cutting it later. Thin stock, especially with erratic grain, might shatter as it's being planed unless it's supported underneath by a backing board. Smaller boards can be temporarily stuck to a scrap piece of plywood with double-stick tape. Without a backing board, it's usually not possible to plane stock less than 1/8 in. thick to 1/4 in. thick.

Planer problems—One of the most common planing problems is end sniping, which results in a board that's thinner at the ends than in the middle. Sniping usually occurs because the board is not held flat on the planer bed and it rises into the cut-

Adjusting a planer with a dial indicator

by Robert M. Vaughan

When a machinist assembles a stationary woodshop machine like a planer, he often relies on a dial indicator to check alignments and part sizes. It makes sense for woodworkers to use the same tool when adjusting machines. A dial indicator is more suited to fine work than a ruler or tape measure. My eyes find it a lot easier, for example, to see a difference of 0.016 in. as 16 divisions on the face of a dial than to see a 1/64-in. difference on a tape measure. The indicator quantifies adjustments that might otherwise be a matter of "feel," and thus makes them quicker to perform with more predictable results.

The dial indicator I've found best for most planer work has a range of 1/4 in., though indicators with a range of anywhere from 1/8 in. to 1 in. are available. The end of the shaft on most indicators has a removable tip; I keep both rounded and flat tips on hand. The ball tip is ideal for feed-roll work, while the convex tip is best for knife setting.

While of limited use on a thickness planer, a magnetic base is the most commonly used means of mounting the dial indicator and temporarily fixing it to the work area. It has an on-off switch that engages or disengages a magnetic field that holds it to any iron or steel object. An adjustable arm and swivel arrangement allows the indicator to be rigidly held in any position relative to

The cutterhead gauge base allows a dial indicator to be used for setting the depth of the knives in the cutterhead. While the base rides on the head itself, the indicator's tip rides on the blade's edge and registers its height on the dial.

the base. With the base attached to the side of the planer and the indicator shaft pressed against the planer's bed (perpendicular to the surface), I can crank the planer's thickness-adjusting wheel back and forth a few times to see if it raises and lowers the bed (or head) with consistent accuracy. I also can use a magnetic-base mounted indicator to quickly check the straightness of shafts, the roundness of pulleys or sheaves or the amount of free play between any two moving parts.

Besides the magnetic base, two other bases make the dial indicator a particularly useful tool for planer adjustments. The cutterhead gauge base rests on the cutterhead and allows the end of the indicator shaft to ride directly on the edge of a planer knife. With it, you can quickly check how far each knife protrudes from the cutterhead, making sure all the knives are set at exactly the same height. The bed- and feed-roll base is a three-footed base that holds the dial indicator precisely perpendicular to a flat surface, allowing quick checks of cutterhead parallelism and feed- and bed-roll adjustment.

You can make your own cutterhead gauge base and feed-roll gauge base, as I did, from some scrap pieces of steel or aluminum and a few machine screws and nuts. The photos show how they are constructed. If you do make your own bases, make them for the particular dial indicator you plan to use, because the dimensions of various indicators are not all the same. You can also purchase commercially made bases from Powermatic Corp., Morrison Rd., McMinnville, TN 37110. They sell both a feed-roll gauge base (#2230002) and a cutterhead gauge base (#2230007) that will work on Powermatic, as well

terhead. Lowering the pressure bar to eliminate freeplay between the stock and the bed, dropping the bed rolls flush to the bed or increasing the downward pressure of the feed rolls should eliminate sniping. Also, long stock can lever itself into the cutterhead and cause sniping, so always support long boards with infeed and outfeed tables or by hand.

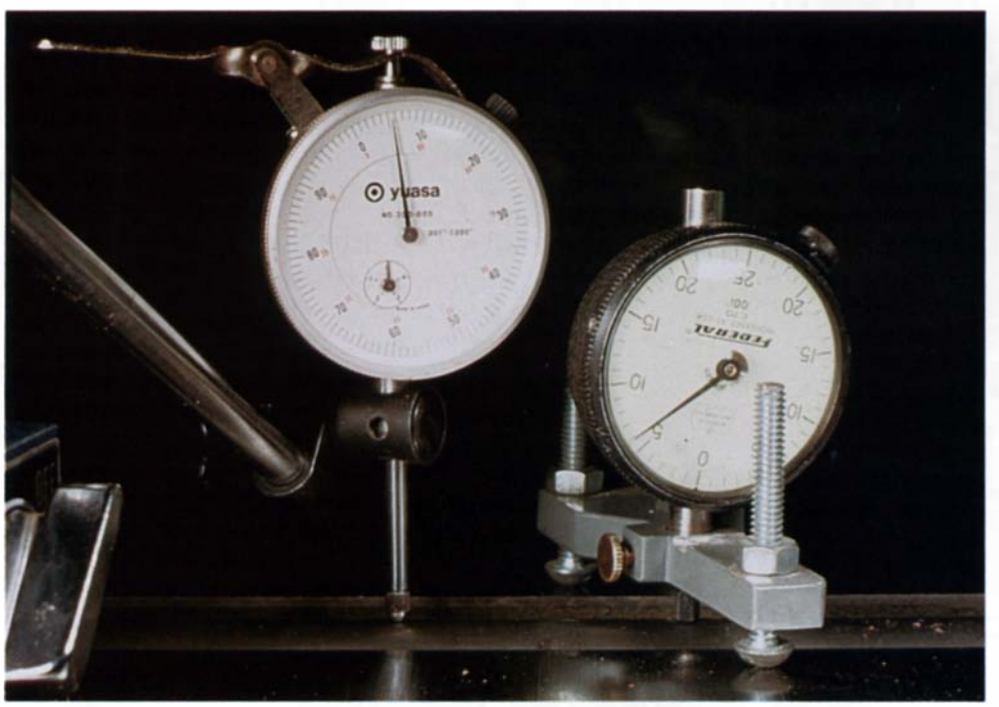
Occasionally, a board with significant variations in thickness will jam in the planer. It can sometimes be freed without shutting the planer off by butting another board against its end (or side, if skewed) and pushing the stuck piece through. Sometimes a large chip lodged between the bed and bed rolls will cause a board to stick or leave a long rut on the bottom of the board. Shut off the planer and clear the chips and any gunk that may have accumulated on the bed rolls before it ruins your lumber or your patience.

If you're not getting surfaces as smooth as you'd like from your planer, chatter may be the problem. It could be caused by an uneven knife setting and/or dull knives, too fast a feed rate or the oscillation of thin stock between the bed and cutterhead. A high knife will cut deeper and leave dozens of little troughs along the board, and as the knife dulls, it will compress the board's fibers and burnish the surface rather than slice it clean. The compressed fibers are nearly impossible to sand out.

The rate at which a board passes by the cutterhead greatly influences the quality of the planed surface: Lower feed rates will produce more closely spaced knife cuts and thus smoother surfaces. But if slow feeding doesn't agree with your production schedule, take the first passes on rough boards at a high feed rate, then slow the feed down for the finish passes. Watch it with woods that have a high resin or sugar content, such as rosewood or cherry, because they tend to burn at slower feed rates—especially if the knives are getting dull. If you can't change the feed speed, take lighter cuts on each pass.

Surfacing any type of wood with ribbon or fiddleback grain, crotch swirls and medullary ray flakes can be challenging. Just remember that a slow feed rate, thin cuts and sharp knives all help conquer wicked grain. If you take too much in a single pass or feed the board against its grain, you'll end up listening to chunks of wood tearing out and clattering through the dust collection system or bouncing off the ceiling. And, the surfaced board will look just as bad as it sounded. □

Alfred E. Holland, Jr. is a woodworker in Orangevale, Calif. David Kinter is a self-employed woodworker in Boise, Ida.



The height of the bed rolls can be set with a dial indicator mounted in a magnetic base, but a three-footed feed-roll gauge base, right, will do the job quicker. The indicator can also be flipped in the feed-roll gauge base to check the alignment of all the parts of the planer's head assembly, including the cutterhead and feed rolls.

as other, machines. Each comes with its own dial indicator and sells for about $90.

To use a cutterhead base, first mount the indicator in the base and position it so the tip touches a smooth section of the cutterhead cylinder. Rotate the indicator's movable outer dial to zero the needle. Now set it over the knife as shown in the photo on the facing page and move it back and forth slightly, perpendicular to the edge, until the dial shows its highest reading, which should be about ⅛ in. Check the knife at both ends as well as at several places along its length before locking it down and checking the next knife.

To check cutterhead parallelism, install the indicator in the feed-roll base with the tip projecting upwards. With the base positioned on the bed, rotate the cutterhead so a smooth section contacts the tip, then take readings at several spots along the cutterhead length. The feed rolls can be checked for parallel this way too, as well as to determine if they've worn more in the middle than at the ends. If the wear is great enough, the feed rolls, or even the planer bed, may need to be re-machined. Use the indicator to check the alignment and straightness of the chip breaker and pressure bar and to recheck them after the final tightening of their locking screws to make sure they haven't shifted.

Reverse the dial indicator in the base so its shaft points down to check the bed rolls for proper adjustment and uneven wear. Zero the indicator by positioning all three base feet on the bed. Then, place the base so its feet bridge the bed-roll gap, the tip contacting the roll at its highest point. The indicator will directly measure the roll's projection above the bed. If you're getting erratic readings, examine the surface of the roll for large dips, rough spots or gunk that could cause the hand to move unpredictably. □

Robert Vaughan is a professional woodworker, with his own shop in Roanoke, Va. Other sources of dial indicators and magnetic bases include Enco Manufacturing Co., 5000 W. Bloomingdale Ave., Chicago, Ill. 60639, and L.S. Starrett Co., 121 Crescent St., Athol, Mass. 01331.

Photos above and below: Stretch Tuemmler

Inspired by shells and buds picked up on the beach, Gillam combined his boatbuilding skills with an avocational interest in turning to produce these slit bowls and vases. They're made of butternut finished with a linseed oil/varnish mixture.

A Boatbuilder's Bowls

Overlapping techniques

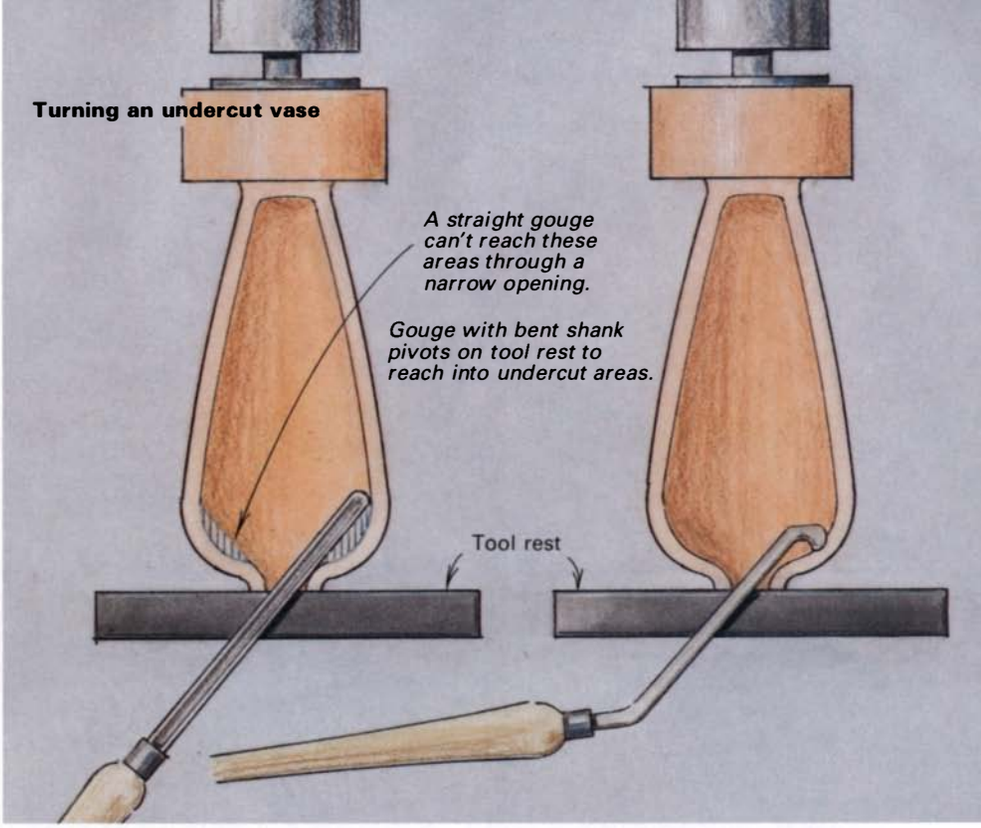
by Stu Gillam

My work as a boatbuilder has both grown out of and fostered my appreciation of shape. Lately, I've found my lathe work is similarly motivated by my preoccupation with examining the various objects around me in terms of shape, surface texture and line. So it was, I found myself on the beach one day, a shell in my right hand, a bud in my left, noting the similarities between the two and admiring how their edges seemed to wrap around each other. It occurred to me that I could produce such shapes in wood by combining boatbuilding techniques with turning.

In brief, my method is to turn the shape, cut it open, boil it and roll it up. The turning is fairly straightforward. If I have a large enough blank, I screw it directly to the faceplate and part off the turning beyond the reach of the screws. If the blank is too small for this, I simply glue on an extra pad of wood with five-minute epoxy, then part off the turning at the seam. The pictured vases are butternut, which has proven to be a near-perfect wood for slit turnings. It's very stable, turns well and bends easily when heated.

I turn the outside first between the faceplate and a live center on my Shopsmith, sanding the wood smooth and sealing it temporarily with Butcher's wax to prevent checking. The finished outside surface then serves as a reference for hollowing the inside. Turning the inside of a vase through a small opening creates a couple of problems. For one thing, the lathe needs to be periodically stopped so shavings trapped inside the vase can be blown or vacuumed out. Also, because the cutting edge is as much as 12 in. from the tool rest, tool chatter becomes a major problem, especially on a Shopsmith, which isn't robust enough to support deep faceplate work. To compensate, I've ballasted the machine with a block of granite and railroad iron and rigged up an adjustable steady rest that supports the outboard end of the turning with two pairs of furniture castors.

To further control chatter and to allow undercutting of the vase's abruptly curved shoulders, I've developed my own turning tools. The largest of these, for deep roughing of the inside, is made of an old file 18 in. long and ¾ in. in section. A second tool has its shank bent so the cutting edge is roughly parallel with the axis of the handle, making it possible to pivot the shank on the tool rest to cut around corners. I press the handle against my hip and grasp the tool shank just inside and just outside the pivot



Deep faceplate work isn't the Shopsmith's forte, so Gillam ballasted the machine with granite and iron, then clamped on a steady rest made with furniture castors. Above, he's roughing the bowl's interior with a gouge made from an old file.

After turning, the vase is sawn along its length. The edges are beveled so they can bend past each other more easily. In the center photo, Gillam pares a teardrop-shaped bevel for clearance. Ten minutes of boiling plasticizes the butternut enough for bending.

point on the tool rest. Using this three-point grip with a little body English, light, controlled cuts are possible.

I've found wall thicknesses of about ⅛ in. bend and fold easily after heating, yet are sturdy enough to withstand bending. Because a section through the wall is exposed after bending, its thickness must be uniform and fairly smooth, otherwise tool marks and pits will show as an irregular edge. When the piece has been turned inside and out, I sand the outside with 320 grit and what I can reach of the inside with 400 grit. Then, using stiff paper as a batten, I lay out a line for the sawcut. While the piece is still on the lathe, I cut to the line with a fine-toothed saw. To ease the strain of one edge passing over the other, both edges must have relief cuts. At the base of the sawcut, I chisel or knife a relief cut on the edge I want to pass underneath. This bevel goes from a straight feather-edge at the top of the sawcut to a teardrop shape nearer the bowl's base, as shown in the photos above. The teardrop shape is necessary because the bowl's walls are less flexible near the base and thus can't be bent as easily as the walls nearer the top. At this point, the vase can be parted off the lathe and prepared for bending.

In boatbuilding, planks are steamed or soaked in hot water to plasticize the wood for bending, but my bowls are small enough to simply plop into a washbasin of vigorously boiling water for five or 10 minutes. To heat the piece evenly, I hold it underwater with a stick. My hands protected with heavy gloves, I fish out the turning and immediately bend it, tucking one edge under the other and rolling it up, just as you would a newspaper. A scrap of cloth wrapped tightly around the bowl holds the shape until the wood cools. I generally shape the exposed edges with carving tools, then sand again with 320-,400- and 600-grit sandpaper, taking care to get under the overlap. I use a sanding disc mounted on the Shopsmith to true up the vase's bottom, because the bending usually distorts it so badly that the vase won't stand up correctly. I finish my turnings with a mixture of one part turpentine, two parts spar varnish and three parts boiled linseed oil.

A final word about shape: A tall, narrow vase, like the one shown here, will roll easily as one edge can be deflected toward the center. The broader-shape bowl won't surrender so easily. The only way I've managed to fold this kind of shape is to carry the sawcut all the way across the bottom and then pare a triangular clearance notch in one edge halfway up the bowl's side. This allows the two edges to interpenetrate during bending. I make a plug from parted-off scrap to patch the bottom. □

Stu Gillam builds boats and turns wood in Hancock, Me.

Demystifying Wax

Clearing up some cloudy questions about an ancient finish

by Bob Flexner

I've used wax for years to restore the luster of the finish on the furniture I repair. But it wasn't until I started testing some of the popular brands that I realized what a thoroughly misunderstood material wax is. Consider, for example, the following statements made by well-known polish manufacturers and authors of books on finishing: "A finish must breathe, and wax prevents this." "You should remove wax twice a year because it builds up and softens the film with age." "This traditional polishing wax ...feeds the wood." "Wax tends to get gradually darker over the years." Despite the authority of the sources, I've found all these claims to be utter nonsense.

The ad hype concerning wax products is so prevalent that I think many people are confused about using wax to polish, protect and care for wooden furnishings. In my quest to clear up confusion about waxes, I interviewed a dozen finish chemists and professional wood finishers. I hope the following explanations will clear the air about what wax does (or does not do), how it works and how to use it.

First, a quick introduction to the waxes. Manufacturers today can choose from many natural and synthetic waxes to obtain a good wax product—one that protects well and is easy to apply. Among the most popular waxes: Beeswax is a soft wax secreted by bees for comb building and was historically the primary wax for woodwork; carnauba wax comes from palm leaves and is the hardest of the natural waxes; candelilla, from a desert plant found in northern Mexico and southern Texas, is often used in blends because of its low cost and compatibility in mixing with other waxes; and paraffin refined from petroleum is a very soft wax that's often blended with harder waxes to make them easier to apply.

Dozens of brands of commercial waxes suitable for applying over furniture finishes are available. Among the most common raw ingredients are the ones shown in the plastic bags at the right. From left to right: beeswax, candelilla and carnauba.

The key to understanding wax lies in knowing its natural properties: It's a substance that's insoluble in water; a thin film of wax is capable of withstanding wear because it creates a low-friction surface things slide off of; wax bonds with tenacity to almost any solid material, but not to itself; and wax can be easily dissolved in a solvent, such as mineral spirits. The first two characteristics are important for understanding how wax protects, the third and fourth for understanding how to apply and remove it.

Wax protection—The primary finish on a piece of furniture, whether it be oil, lacquer or varnish, protects the wood from liquids or abrasion and reduces the exchange of moisture vapor between the wood and the atmosphere. Contrary to the all-too-commonly held belief, wood does not need to breathe, nor does it need to be fed. In fact, ideally, we would want to seal it off entirely from the atmosphere if we could. This moisture exchange, which will occur no matter what type of finish is applied, may cause the wood to warp, veneer to come loose, joints to come apart, and if the moisture is severe enough, wood to rot. Keeping the finish in good shape will postpone these problems, and wax is the best material I know of to accomplish this. It will repel liquids and deflect blows that might otherwise destroy the finish. Most waxes are inexpensive and easy to apply, and a wax finish is simple to keep in good repair. Further, a well-buffed wax coating imparts a soft, pleasing luster to a finish that can accentuate both the wood's color and grain.

Most woodworking finishes bond well to themselves and offer more protection if a thicker layer is built up with several coats. On the other hand, wax used as a polish is a material where less is better. To understand this, take a colored wax crayon and rub it on a piece of glass. If you keep rubbing long enough, all the wax ends up on the glass. But if you try to remove the wax from the glass with a cloth, you'll find that all of it wipes off except for a film so thin you can't see it. No amount of rubbing will remove this. Though wax crayons are softer than most waxes, the analogy still holds. Wax adheres with great strength to almost any solid surface, but it doesn't bond well to itself.

When the excess wax isn't properly buffed off, the effect is somewhat like the crayon on glass. As more coats are added, the wax layer becomes thicker and, like the crayon, will smear and mar easily. Further, this gummy layer collects dust and darkens over the years due to the dirt that becomes embedded in it. This has led many to believe that it's the wax itself that darkens with age. But if only one or two coats of wax are applied and rubbed down to the thinnest possible layer, a water-repellent and mar-resistant surface that will not smear or collect dust is produced. There's no reason to apply more coats of wax, since additional

Photos: Michele Russell Slavinsky

coats won't necessarily add protection and they will probably rub off when you buff it out. So despite the claims of polish manufacturers, a well-buffed wax finish will never develop wax buildup.

Applying wax—You can apply wax with steel wool, a dry or dampened cloth, or with a lump of wax inside a cloth. They all work decently, but there are some distinctions worth noting. Steel wool guarantees a duller sheen when waxing over a glossy finish. It's good if you want to dull a too-shiny surface and apply wax at the same time. But a steel-wool applicator shouldn't be used if you want the final finish to have a maximum gloss. Using a dry cloth works fine, but a dampened cloth makes application smoother. My favorite way of applying wax, however, is to put a chunk of it inside a cotton cloth. I hold it in my hand for a minute or two, warming and kneading the wax so it will spread evenly through the cloth. I can wax a fairly large surface quickly, without having to constantly reach back in the can to pick up more wax.

Obtaining an optimally thin coat of wax on a surface isn't difficult when you understand how solvents are used to make wax work. Solvents such as turpentine, mineral spirits and naptha are added to wax blends to create workable pastes and liquids. (CAUTION: Because these solvents are flammable, never heat commercial or homemade waxes over an open flame.) After the softened wax is applied and the solvents evaporate, the wax resolidifies. If you allow this thicker-than-desired wax layer to dry completely, it will take a lot of rubbing to get the excess off. If, however, you catch the wax at the point where it's bonded to the surface but the excess is still soft, then it wipes off easily—even if you've applied a very thick coat. You can't predict how long this drying process will take, as instructions on most wax products would lead you to believe. The appropriate moment to buff out the wax occurs relatively soon after application, but varies with the temperature and evaporation rate of the solvents. Visually, you can see it happening when the wax loses its wet shine and hazes over. If you wipe the wax before it dries, you'll remove too much. If you wait too long, you'll get streaks that will be difficult to remove, save with an electric buffer or polisher. You can also remove streaks by applying a new layer of wax to redissolve the hardened one, allowing it to be buffed out evenly. If you can smear the surface with your finger, then you have not removed all the excess wax.

In the same way that fresh wax can redissolve dried wax, the solvents used to make wax can also be used to remove it. A rag moistened with naptha or mineral spirits will quickly remove all the wax on a surface. Naptha leaves little residue and evaporates quickly, so it's my favorite solvent. Neither naptha, mineral spirits or any other commercial wax I know of will damage any primary finish, as long as the finish is more than two or three days old.

Solvents—not waxes—are the main ingredients in most liquid-spray and wipe-on polishes sold in supermarkets and department stores. Therefore, never apply one of these polishes to a waxed surface, because the polish might cause the wax to streak or remove it altogether. Waxed woodwork should be dusted with a dry cloth or feather duster and cleaned, if necessary, with a damp cloth. If a waxed surface becomes dull or marred, try rubbing out the marks and buffing up the luster with a soft cloth. If this fails, try another application of wax. This might be needed once every three months to a year on a tabletop that gets constant use and much less often on surfaces that see less use. If marks don't come out with re-waxing, the damage is likely in the primary finish.

Reviving a finish—Wax also can be effective for reviving the appearance of an old, worn finish. You can apply the new wax right over the old, because the solvents will redissolve any remaining old wax. It may be advisable to clean the piece first with mild soap and water to remove any dirt that has accumulated on the surface. It may even be necessary to rub out the piece with steel wool or sand lightly if the primary finish is lightly scratched or crazed. But this should never be done to a very old finish that has historic value. To hide scratches and recolor worn or damaged areas, you can apply pigmented waxes that come in wood tones. Most clear waxes can be colored with regular oil-based pigments. Experiment on a small inconspicuous section of a finished piece to determine the procedure that will get the best results. Remember though, a wax coating is very thin and won't hide imperfections on a badly cracked or worn finish. It should seldom, if ever, be necessary to remove the wax completely from an older piece, and could be ruinous on an antique: It might destroy some of the patina and reduce the value of the piece.

In addition to its use as a polish on an existing finish, wax can be used as a primary finish, as it was in the 16th to 18th centuries. But unfinished woods can absorb a great deal of wax, so it will be necessary to apply many coats. Just as with the wax crayon analogy, wax that builds several layers thick in the wood's pores and crevices does not bond well to itself. But these areas are so small that they have little effect on the overall wax surface. To reduce the number of wax coats needed to finish a piece of woodwork completely, it's best to seal the wood first with a coat of thinned shellac or oil. No more than one coat of wax should ever be needed on a sealed surface, but there are almost always small areas that don't get waxed the first time. A second coat ensures complete coverage and an even luster. □

Bob Flexner repairs and refinishes furniture in Norman, Okla. His videotape, Repairing Furniture, *is available from the Taunton Press, Box 355, Newtown, Conn. 06470.*

Putting wax to the test

I've used many commercially made waxes during my 15-year career as a furniture restorer and also made up my own concoctions from old formulas. I never noticed any substantial differences between waxes, but I always assumed I would find them if I looked closely enough. So, when I tested 13 waxes for this article, I was a little surprised at how close the overall results were, despite the differences in the waxes' cost and composition.

The waxes I tested (shown at the bottom of the facing page) included floor waxes, general-purpose paste waxes, waxes designed to clean and polish fine furniture and liquid wax polishes. Behlen's Blue Label, Minwax, Trewax, Butcher's Wax, Johnson's Paste Wax, Liberon Black Bison, Briwax and Livos Bekos waxes are paste waxes with a stiff consistency out of the can. Renaissance, Beaute and French Buffing Wax are cream waxes, with a consistency between a paste and a liquid—like cold cream. The Liberon Beeswax Polish and George Frank's Water-Wax are both liquid waxes. The Water-Wax is a homemade mixture of carnauba and candelilla waxes emulsified in hot water by a formula given in Frank's book *Adventures in Woodfinishing* (Taunton Press, 1981). The majority of commercial wax prod-

Above, left: If a wax is left on too long before the excess is buffed away, streaks will result, as seen on the right side of this test piece. Reapplying wax will soften the swirled coat so it can be buffed out evenly. Above, right: Wax will cause water to bead up and flow off, but it cannot protect against hot water after a spill. Despite the two coats of wax applied to this test sample, the grain of the maple plywood was raised and the wax dissolved after less than a minute of contact with hot water.

ucts are a mixture of waxes, including paraffin, beeswax, carnauba and candelilla dissolved in solvents. Renaissance wax is a petroleum derivative, like paraffin. The manufacturer says its refining process creates a "microcrystalline" or more compact crystal structure, making the wax tougher and with a higher melting point than paraffin.

I prepared wooden test pieces by staining 1-ft. squares of maple plywood a dark walnut color, then applying a number of coats of shellac. I used shellac because it would quickly show signs of water damage, and I stained the samples dark to show up wax streaking and unevenness in luster. The first test I performed was for sheen, and I compared the 13 waxes by putting two wax coats on each test piece. I was expecting waxes containing mostly soft beeswax, like Livos Bekos, to produce a duller finish than waxes made with a high percentage of harder waxes. But I couldn't see any difference in sheen at all between the samples. I tried the experiment again, but this time on a cherry hutch I had in my shop for repair. I put a different wax on each of the six drawers, two raised-panel doors, two sides and top and still couldn't see any difference in surface luster. However, the cherry hutch had a slightly higher gloss than the newly shellacked and rubbed-out plywood test pieces. Therefore, I decided that the final sheen depended more on the luster of the primary finish than on the type of wax I applied over it.

I performed a scuff test by subjecting each of the samples to repeated glancing blows from the cor r of a book. The scuff marks buffed out easily, unless the wood was hit hard enough to damage the finish underneath the wax. There was no noticeable difference in how the 13 waxes resisted scuffing. There also wasn't any difference in the way the waxes repelled water. The waxes offered very little protection when I allowed small puddles of water to stand on the sample piece, and none prevented the penetration of water for more than a minute or so. After one or two minutes, the maple plywood's grain would start to rise. After each sample was dried, the wax finishes always remained intact—with no blushing or change in color or luster—despite the damage to the plywood. For comparison, I tested Pledge, a spray polish containing silicone; Oz, an emulsified cream polish; and Simoniz II, an automobile wax. All of them yielded the same results as the 13 sample waxes.

Although none of the waxes are impervious to moisture, they do bead up liquids and make them run off easier, reducing the contact of the liquid with the surface. Ultimately, however, water-resistance depends on the kind of underlying finish and its condition. Older varnished and lacquered surfaces with deteriorated finishes may watermark, because the surface film has begun to fail. But on newly-lacquered surfaces, cold water stayed beaded up on the wax for hours with no apparent damage to either the finish or the wax.

Applying hot water to the waxed samples produced more dramatic results. The heated water started to melt the wax at about 140°, and all the samples showed a dull luster where the water had made contact. The dull spot could be eliminated, though, by applying a new coat of wax over it and buffing it up. Water above 150° damaged the shellac and dulled the wax film.

I tried several different methods of wax application during the testing to see if the liquid polishes were more prone to streaking or leaving an uneven sheen than the harder, paste-wax types that have less solvent in them. Once again, all the waxes performed the same and predictably left streaks if left on too long before buffing. I tried using steel wool to remove the excess wax, as advocated by some wax makers. I found it almost impossible to keep the steel wool from removing all the wax, as well as a bit of the primary finish. I also tried following the directions on some wax-container labels, which recommended waiting from 5 minutes to 20 minutes and up to 24 hours before buffing off the excess. In all cases, hand buffing was very hard work, and I often resorted to my electric polisher. In contrast, it was easier to buff the excess immediately after the wax formed a haze, and I couldn't see any difference in the final results.

When evaluating my results, you should remember the tests I performed were under workshop conditions, not laboratory conditions. Even though there are scientifically measurable differences between the hardness and melting points of the components in each mixture, I couldn't detect significant differences in appearance or protection. Further, the tests convinced me that the differences between wax brands are not great enough to have any practical value for the woodworker and surely don't justify buying some of the more expensive brands. Nor do they justify the trouble and danger of making your own wax mixtures. *—B.F.*

Sources of supply

Beaute: Roger A. Reed Inc., P.O. Box 508, Reading, MA 01867.

Behlen's Blue Label and French Buffing Wax: Garrett Wade Co., 161 Ave. of the Americas, New York, NY 10013.

Black Bison and Beeswax Polish: Liberon Supplies, P.O. Box 1750, Mendocino, CA 95460.

Briwax: Briwax Int., P.O. Box 3327, Redwood City, CA 94064.

Butcher's Wax: The Butcher Polishing Co., 120 Bartlett St., Marlborough, MA 01752-3013.

Johnson Paste Wax: S.C. Johnson & Son, Inc., 1525 Howe St., Racine, WI 53403-5011.

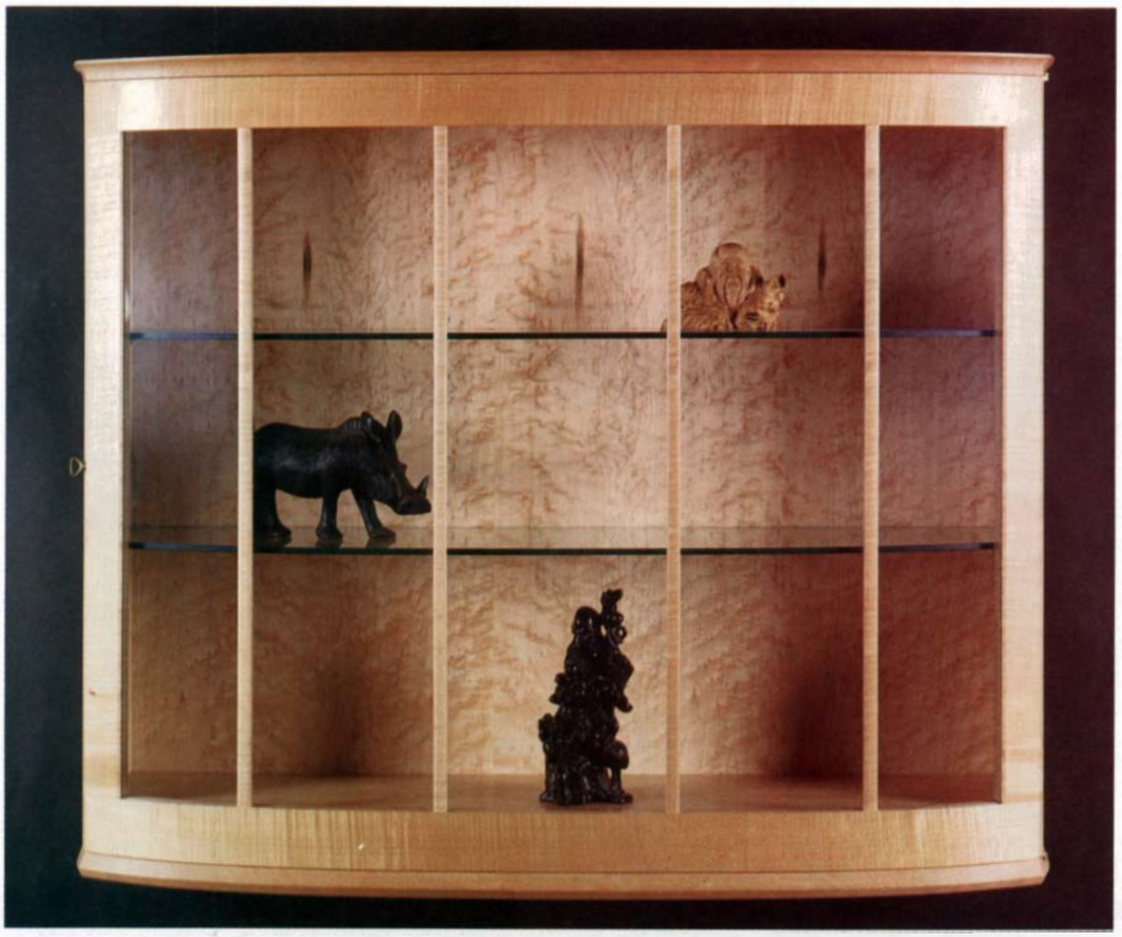
Livos Bekos: Livos PlantChemistry, 614 Agua Fria St., Santa Fe, NM 87501.

Minwax: Minwax Co. Inc., 102 Chestnut Ridge Plaza, Montvale, NJ 07649.

Renaissance: Cereus Inc., 184 Warburton Ave., Hastings-on-Hudson, NY 10706.

Trewax: Trewax Co., 11641 Pike St., Santa Fe Springs, CA 90670.

Water-Wax: Ingredients for George Frank's Water-Wax are available from the Olde Mill Cabinet Shoppe, RD#3, P.O. Box 547A, Camp Betty Washington Rd., York, PA 17402.



Inspired by James Krenov's understated aesthetic, the author built this showcase cabinet from European maple. The carcase is joined by dowels, allowing delicate shaping of the cabinet top and bottom that wouldn't be practical with other corner joints.

Carcase Doweling

Accuracy and patience ensure success

by Monroe Robinson

I learned about cabinet doweling from James Krenov at the College of the Redwoods. Krenov is well-known for his graciously proportioned wall and showcase cabinets, delicate carcases that are ideally suited for doweled corner joints. But the technique is just as appropriate for larger cabinets and, if done accurately, dowels are as strong as any other corner joint and can be made fairly quickly with few tools. More important, doweling is versatile, offering design options not available with other joints.

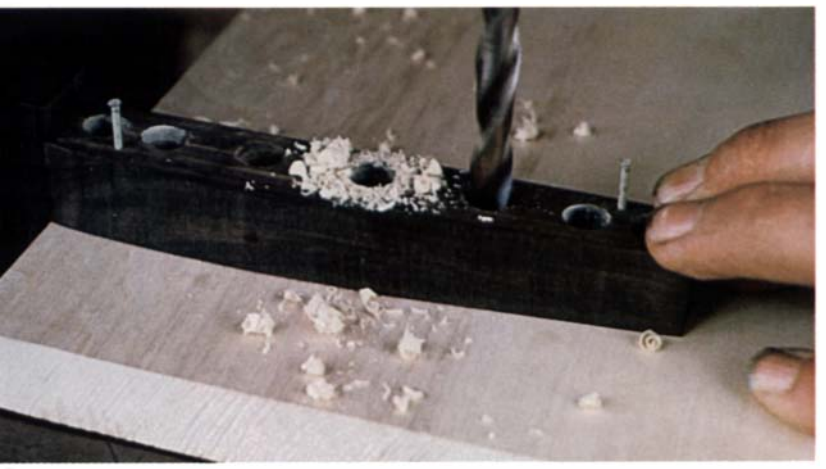
For the European maple showcase cabinet I built to illustrate this article, doweling was really my only choice. Because I wanted to plane a decorative profile on the edges of the cabinet's solid-wood top and bottom, I extended them slightly past the carcase sides. Dovetails here would have been difficult to lay out and cut on the curved carcase sides and would have prevented me from shaping the overhanging top and bottom.

Doweling has one advantage over almost any other joint (except perhaps plate joinery in some applications)—it's equally effective in solid-wood or veneered panels or in combinations of the two. In the rosewood china hutch on p. 70, for example, I wanted the appearance of frame-and-panel construction but the rigidity of veneered panels. To achieve this, I glued rails and stiles to panels made of lumbercore plywood veneered with $^{3}/_{32}$-in. rosewood. Even the rails and stiles are veneered plywood, and the entire lower case is doweled into the base, forming a rigid structure.

Tools for doweling—Since boring accurate holes is what doweling is all about, you need brad-point drill bits and, ideally, a mortising machine or horizontal borer, both to make a doweling

Robinson's rosewood china hutch, above, is also doweled. The lower carcase consists of a mock frame-and-panel structure doweled into a base and a solid-wood top, while the upper carcase is made of frames into which glass panes have been set. He stiffened the structure by gluing veneered panels into the solid-wood frames that form the backs of both upper and lower carcases. Normally, panels would float freely in the frames.

To accurately align dowels in parts being joined, the author makes a scrapwood doweling jig to serve as a boring guide. In the photo above, he has nailed the jig to the cabinet side for endgrain boring. Below, it's reversed and nailed to the cabinet bottom to bore matching holes. The doweling jig is bandsawn to the profile of the carcase side, and a heel is glued and nailed to one end to aid in alignment.



jig for the specific carcase you'll be building and to bore holes in the endgrain pieces. If a mortiser or horizontal-boring machine isn't available, you might consider building one (see *FWW on Making and Modifying Machines*), but the truth is, you can get by with just a drill press and/or a portable electric drill. These two tools can drill holes accurately enough for doweling, but they will require careful setup to achieve good results.

A brad point will bore a much cleaner hole in wood than a regular twist drill. Typically, a selection of ¼-in., 5/16-in., ⅜-in. and ½-in. brad points will be sufficient for matching the dowel sizes you'll be using. If the available brad points won't match an undersize or oversize dowel, standard metal drills—available in a far greater range of sizes—can be ground to make a brad point of the exact size. To regrind a bit, I use a regular bench grinder with an aluminum-oxide wheel. The corner of the wheel has been rounded off slightly, which makes reshaping the bit much easier. For a larger-diameter bit, you need to shape a larger radius on the edge of the wheel. I use a diamond-tipped dressing rod to true the face of the grinding wheel and shape the radius edges. In grinding a point on a metal bit, the exact angles aren't critical but the point must be perfectly centered, so don't rotate or move the bit from side to side while you're grinding. Be careful not to overheat the bit by grinding too aggressively.

Dowels are available in two types: fluted and spiral groove. The flutes and spirals help spread the glue, making a better bond between the dowel and hole. Either type of dowel is fine, although I prefer the fluted ones, because they are machined more precisely and thus fit into the hole more easily. Also, fluted dowels allow excess glue to escape, preventing the dowel from being forced out of the hole by hydraulic pressure. Some people make their own dowels out of standard, hardware-store dowels. If you do this, make sure the dowels match the diameter of the bits you have and chamfer the ends of each dowel so they'll slide easily into the holes. In any case, the diameter of the dowel should be slightly greater than one-third the thickness of the stock you are using. I have no rules on dowel length, but generally I bore side-grain holes to within about ⅛ in. of breaking through the opposite side; the endgrain holes are bored to an equivalent depth.

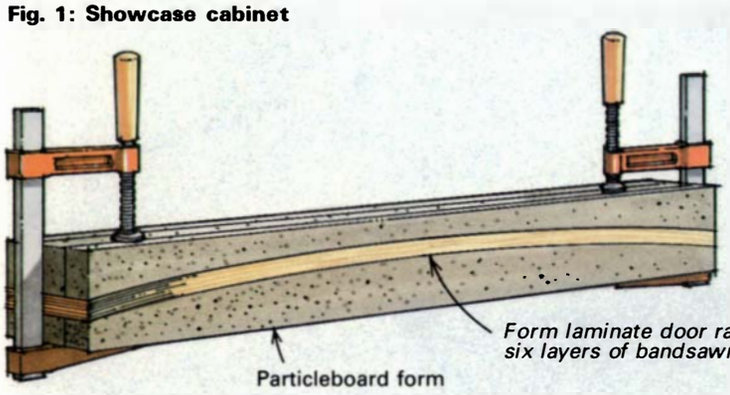
The trick to strong carcase doweling is accuracy, and this is achieved with a doweling jig made specifically for each carcase. The jig I learned about from Krenov is shown in the photos at left. It's nothing more than a block of wood with holes matching the dowel spacing bored through it. The jig is nailed and/or clamped to the carcase parts and aligns the drill bit for boring. I make the jig from a scrap of dense hardwood to minimize wear during boring. Make sure the stock for your jig is perfectly square in section, otherwise your dowel holes will be at an angle, spoiling accuracy. This is especially true if you're boring with a portable drill.

Hole spacing is a matter of personal preference. On my showcase, I spaced the ½-in. dowels about 1 in. apart (center to center), but near the edges of the joint, I spaced them closer to help the joint resist cupping. With the holes marked out on the jig, I bore them on the mortising machine or drill press. I like to bandsaw the jig precisely to the carcase side's cross section—this helps me see if I'm using the jig in the correct relationship to the cabinet during all steps of construction. Finally, I glue and nail a small wood heel on the squared end of the jig to help locate it exactly within the board's width.

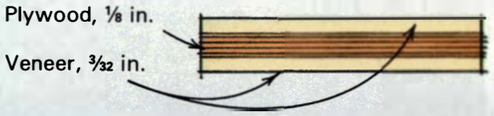
Order of events—Because doweling lends itself to so many construction styles, the actual joinery of a piece can happen at any of various stages. If the parts are all square in section and no subsequent shaping is desired, you can simply cut your cabinet

Photos: Sean Sprague; Drawings: Joel Katzowitz

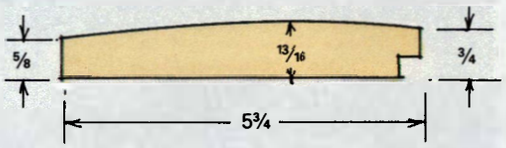
Fig. 1: Showcase cabinet

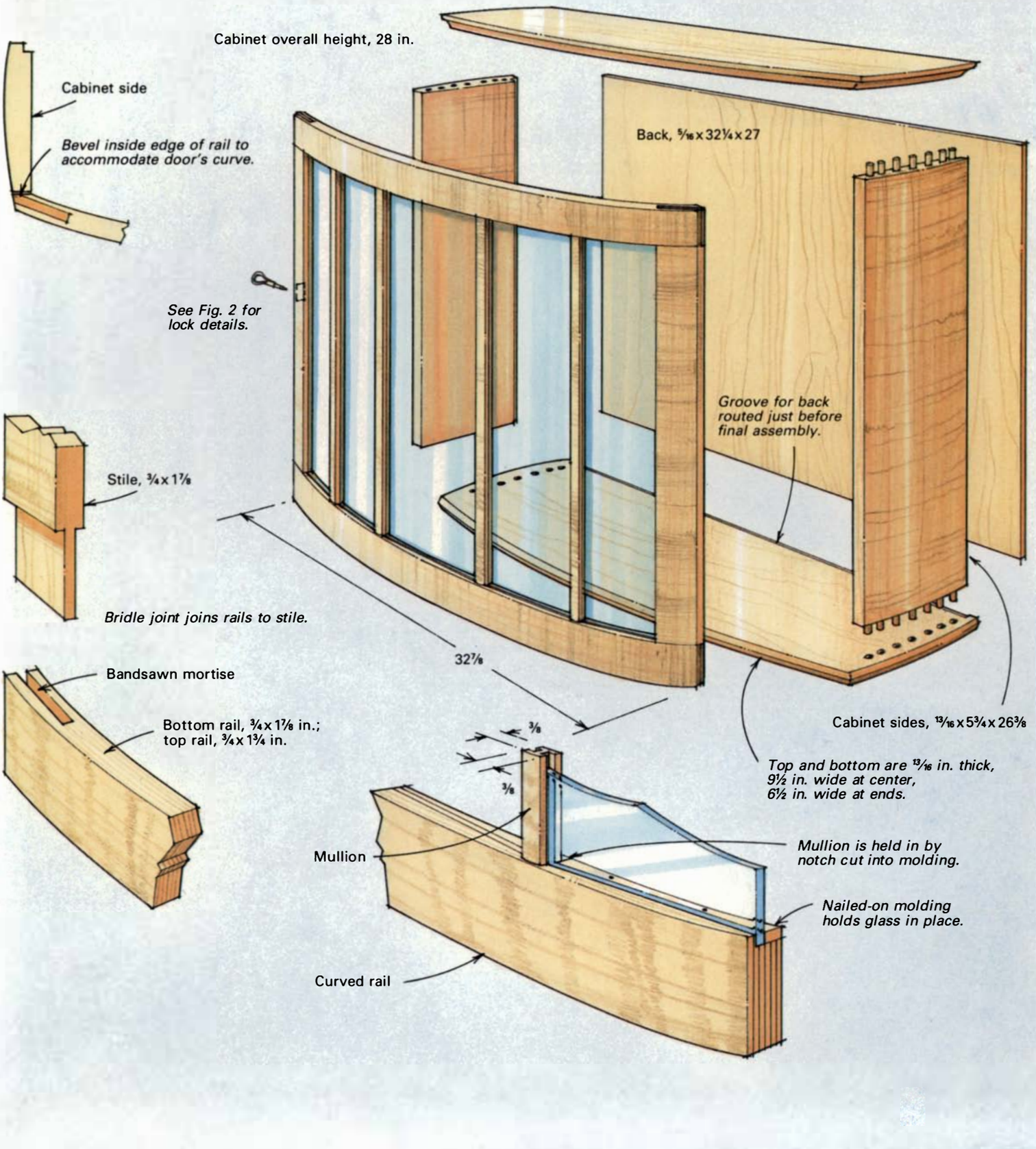


Back panel is 3/32-in. bandsawn veneer over 1/8-in. plywood door skin. Panel is glued into rabbet milled into cabinet back.

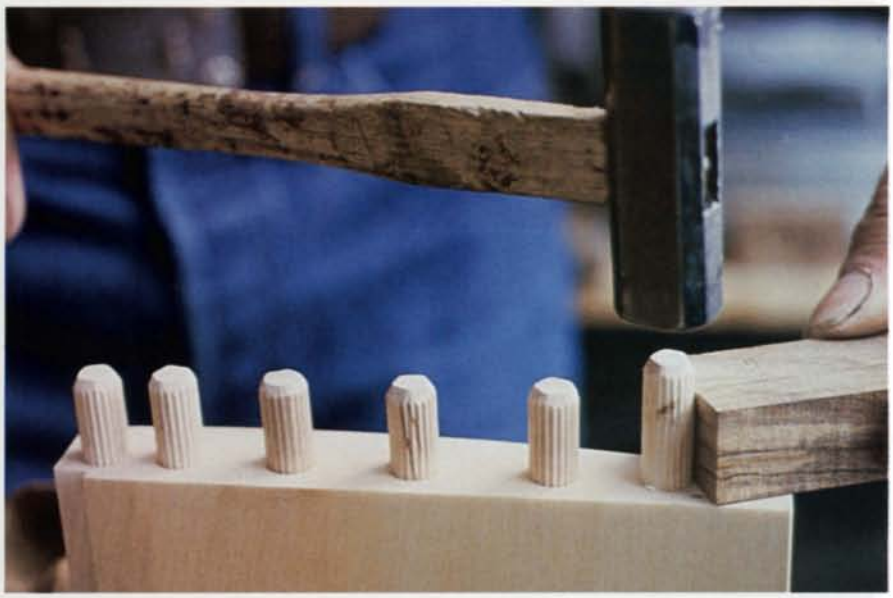


Cabinet side section

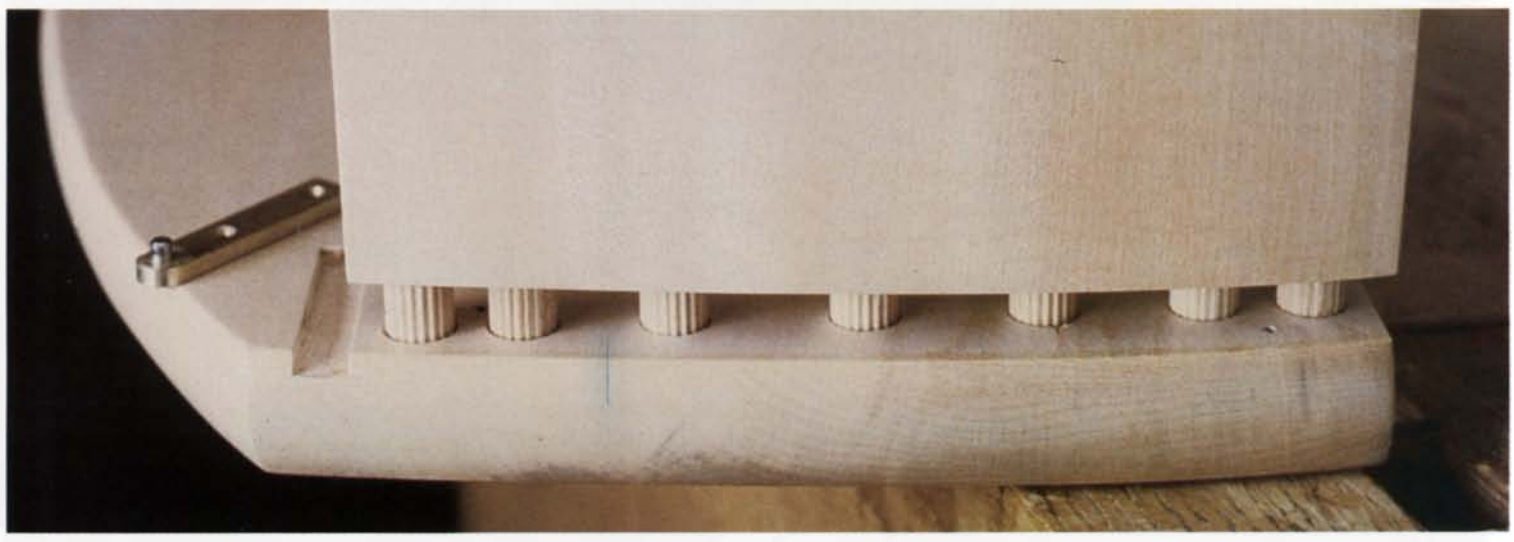


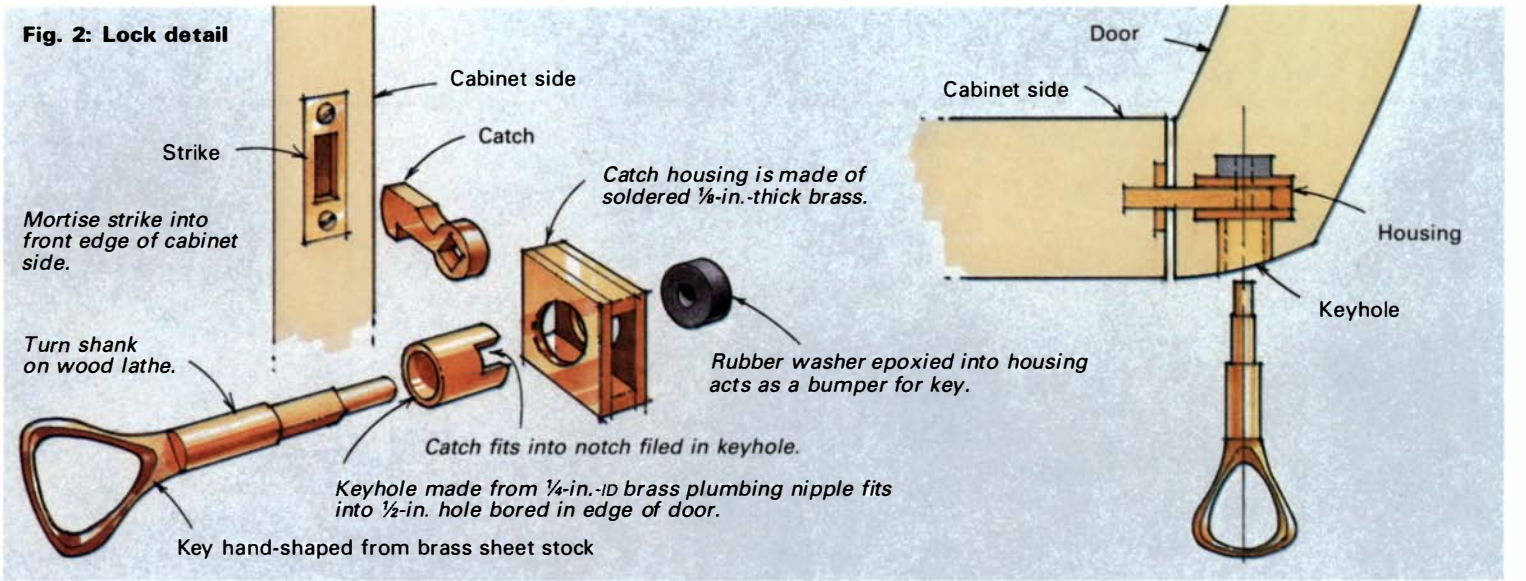


Allowing for springback of the door's form-laminated rails was hopeless guesswork, so Robinson built the curved door first, then made the carcase to match. He dry-assembled the cabinet sides, above, to an oversized top and bottom, then traced the outline of the sides, right, using a compass to allow extra material for shaping. After doweling, the top and bottom were shaped with hand tools.



A carver's burr chucked in a hand drill, left, cleans up the dowel holes and forms a slightly enlarged opening to ease entry of the dowels. To set dowels to the proper depth, above, a scrap makes a handy depth gauge. Spacing of dowels isn't critical, but to prevent cupping from opening the joint, the two outermost dowels should be spaced more closely than the rest. In the photo below, the cabinet is being test assembled. Before final glue-up, Robinson chopped mortises for the door's knife hinges.





parts to size and dowel them together. Because the curved rails of the cabinet door shown here were form laminated, however, and thus subject to springback, there was no way to predict just how the curve would come out. Thus, I made the door first, reasoning that it's far easier to shape the cabinet parts to match the door's curve than vice versa. (For more on controlling springback and form lamination, see *FWW* #54 or *FWW on Bending Wood.*)

When I had finished the door, I cut the carcase sides to the exact length and shaped their convex profile with handplanes. Next, I surface-planed the lumber for the carcase top and bottom and finish-planed their inside surfaces. But at this point, the top and bottom were left longer and wider than their finished dimensions. To locate the dowel holes in the top and bottom, I set the carcase sides up with the top and bottom and with the door in place, and then checked everything for a good fit. Next, I traced the outline of the sides onto the oversize top and bottom, marked all the parts so I could reassemble them correctly and took down my mock-up to bore the dowel holes.

It doesn't matter whether you bore the endgrain or side-grain holes first, but in either case, align the doweling jig so its profile matches the appropriate surface and the glued-on heel is firmly butted to the correct edge. Don't attempt to hold the jig in place by hand. It will surely slip and mislocate the holes. Instead, nail it in place. I use 1⅝-in. hardened paneling nails that push snugly through pre-drilled holes in the jig. The nails are tapped only part way in for easy removal. For boring the endgrain holes in the carcase sides, I use my mortising machine, set at the same boring height I used to make the doweling jig. If you're going to use a portable drill instead, I suggest clamping the doweling jig with a bar clamp to make absolutely certain it won't move. Use a scrap block to keep the clamp from marring the opposite end of the work. Set a stop collar or masking-tape marker on the drill bit so the hole depth is just slightly deeper than the length of the dowel. This will keep the dowel from bottoming, preventing the joint from closing.

To bore the holes in the corresponding piece, in this case the cabinet top or bottom, the jig is reversed and the nails are pulled and put in from the opposite side. Align the jig and tap the nails in. I use a drill press to bore holes in the top and bottom but again, a portable drill is fine, as long as you clamp both the board and the jig firmly to your bench. Once all the holes are bored, I use an eggbeater drill with a countersink or carver's burr to enlarge the lip of the hole a bit so the dowel enters more easily.

Assembly—The beauty of doweling is in allowing an almost unlimited freedom of expression at the points where two boards join at a right angle. After all the dowel holes are bored, I mark out the carcase top and bottom and cut them to the final size to ready them for final detailing. The edge of the carcase bottom was then detailed with a gently sloping bevel, which I formed with a handplane and chisels. I routed a cove along the top edge and then used carving tools to texture the machined surfaces.

The final fitting and a test assembly follow the detailing. For test fitting, glue the dowels into the cabinet side only, using a short scrap of undersized dowel to spread glue evenly in the hole. Dab just a little glue on the dowel itself, not too much or you'll have a mess to clean up. Tap the dowels into their holes, using a scrap block of the appropriate thickness as a depth gauge. Now, do a complete dry clamp-up of the cabinet, making sure the dowels seat completely and the carcase is perfectly square. Check for square by measuring diagonally from corner to corner either with a tape measure or with a pair of sticks or pinch rods. The dry assembly is a good time to iron out any problems in clamping strategy. Now's the time to find out if you don't have enough clamps and/or pads to do the real thing.

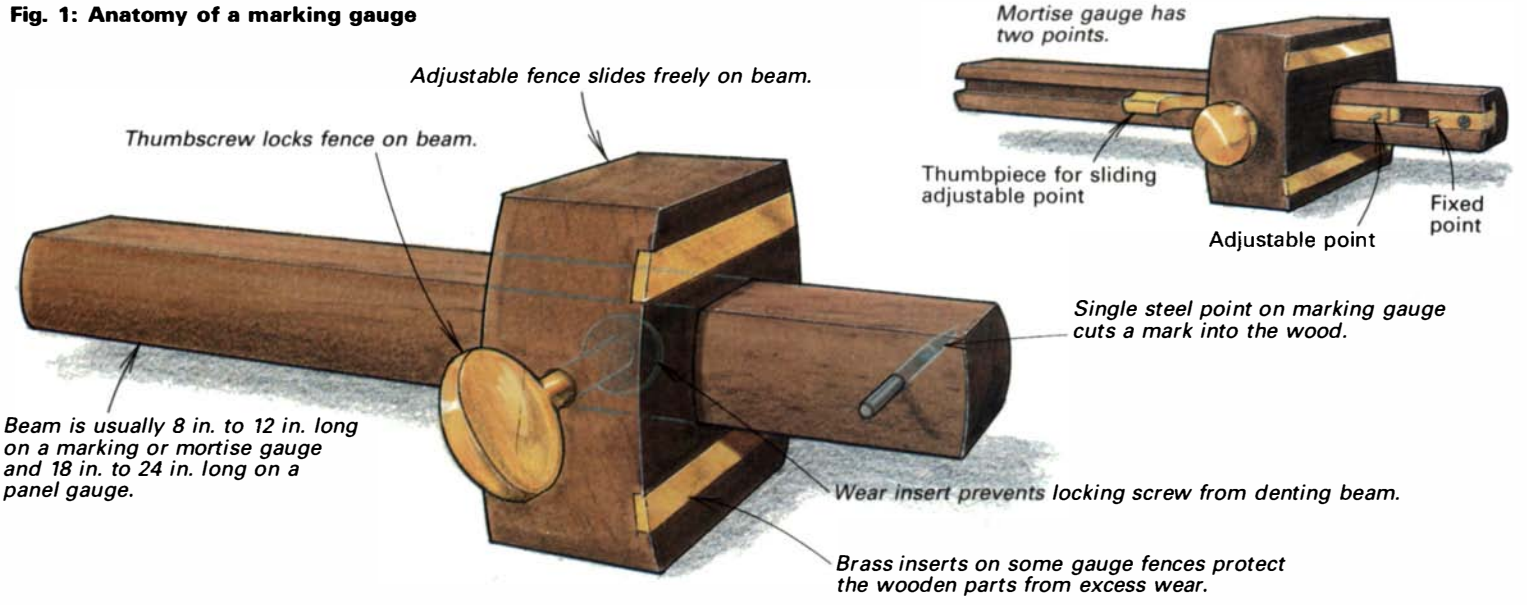
If everything checks out, I knock apart the test assembly using padded blocks and finish any pre-assembly details. This cabinet involved routing the rabbet for the back panel and chopping mortises for the door's knife hinges before proceeding to the final glue-up. I finished the cabinet with several coats of very thin shellac, sanded between coats with 400-grit sandpaper and finished up with a coat of Goddard's furniture wax.

One final note about hardware: The knife hinges for the cabinet door are available from many local hardware stores and various mail-order supply houses, but the lock and key are custom-made. Although this might seem difficult to do, cutting and shaping brass is quite easy. The drawing above shows how the lock was made, using a hacksaw, files and soldering iron. The parts were made from brass sheet stock, except for the keyhole, which is a standard ¼-in.-ID plumbing nipple. The key's shank was turned round on a wood lathe. □

Monroe Robinson is a graduate of the College of the Redwoods in Fort Bragg, Calif., and a professional furnituremaker in Little River, Calif. Goddard's wax is available from Woodcraft Supply Corp., P.O. Box 4000, Woburn, Mass. 01888, and in Canada from Lee Valley Tools Ltd., P.O. Box 6295, Station J, Ottawa, Ont. K2A 1T4.

Marking Out

Fig. 1: Anatomy of a marking gauge



Using the Marking Gauge

by Frank Klausz

When I want to cut some dovetails or make a few mortise-and-tenon joints by hand, the first tool I reach for isn't the saw or the chisel—it's the marking gauge. A marking gauge is the fastest and most accurate way I know to lay out lines for cutting joints and to mark stock to be edged, jointed, thicknessed with a handplane or ripped to width with a handsaw.

A basic marking gauge consists of a sharp steel point set into a stick called a beam. A block with a hole in it, called the fence, slides on the beam and locks firmly to it with a thumbscrew or cam lock (see figure 1 above). In use, the fence rides against the edge of the stock being marked while the point scratches a thin line. The distance from the point to the fence determines how far from the edge the line is scribed. Marking can be done with the grain, across the grain or on the endgrain of a workpiece.

The advantage of using a marking gauge instead of a pencil to mark a layout line is that the scribed line is much thinner than a pencil line, so it can be placed on the workpiece with pinpoint accuracy. This is essential if you want to cut precise joinery. When you saw or pare to the relatively wide pencil line, it's easy to make a mistake and produce a loose or too-tight joint. Further, the marking gauge scribes a consistently thin line, whereas a pencil line changes in thickness depending on whether the pencil point is sharp or dull. A disadvantage to scribing layout lines with a gauge is that if you make a mistake, you can't erase the etched-in line—it has to be scraped or sanded out.

Types of gauges—I keep several kinds of marking gauges handy in my shop: a regular marking gauge, a mortise gauge and a panel gauge. Each has a specific use. The marking gauge has a single point and a beam that's 8 in. to 12 in. long. It's used for many layout jobs, from marking stock that's to be dressed to locating the position of a row of holes to marking the depth of dovetails. The panel gauge is also single pointed, with an 18-in.-long to 24-in.-long beam. It looks like a longer, bigger version of the marking gauge. It's great for marking boards or panels to be ripped to exact width or for doing marking jobs on boards too wide for a regular marking gauge. The mortise gauge also looks like the marking gauge and has a 8-in. beam, but it has two points and can mark out two parallel lines at once. This is essential for good mortise-and-tenon joints.

Marking and mortise gauges are readily available from tool shops, or you can make a gauge yourself (see accompanying article on p. 76). Panel gauges are uncommon, because most people do their ripping on the tablesaw instead of by hand. You'll have to find a panel gauge either at an antique tool sale or make one. Regardless of type, most gauges have nail-like points, which scratch the surface of the workpiece instead of cut it cleanly. A nail point that just scratches will make a fuzzy line when used across the grain and is likely to follow the grain and veer off when working along the grain. For best results, the point of a gauge should be refiled to a knife-like profile. Remove the point from the gauge before filing; otherwise, the beam of the gauge will be scratched. After filing the point to the knife shape, shown in figure 2, reset the point into the beam so the leading edge of the knife points away from the fence about 5° to 10°. When you pull the edge toward yourself during marking, the skewed leading edge will pull the fence tighter against the workpiece. On mortise gauges, both points are filed and set as above. Set the points to protrude from the beam the same amount so they'll make equally deep marks.

The marking gauge—When I use my marking gauge for a layout job, say marking the depth of dovetails on a set of drawer sides, I first set the position of the gauge's adjustable fence. Because the distance from the gauge's fence to the point must match the thickness of the drawer sides, it's easiest to set the position by holding the gauge against a drawer side for direct reference instead of measuring the side with a ruler and then transfering the distance to the gauge. With the gauge's fence in position, tighten the

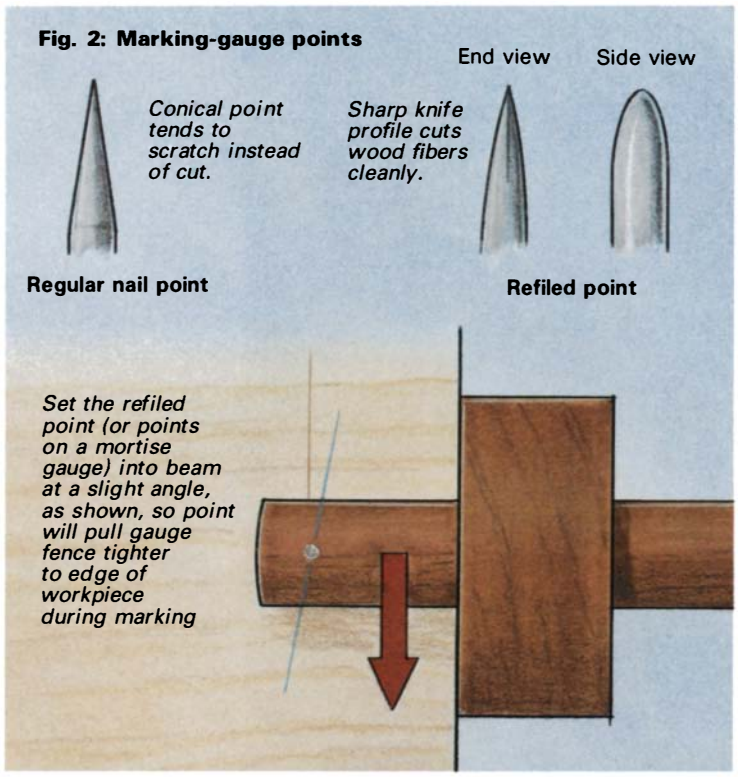
fence's locking screw enough to secure the fence on the beam. Don't overtighten the screw; otherwise, its point may dent the beam. Before I begin marking, I stack all the pieces to be marked on top of one another with their ends overhanging as shown in the photo at right. Holding the top drawer side firmly with one hand, I bring the fence of the marking gauge against the edge of the drawer side and, with light pressure, score a line across the end. I apply pressure at a 45° angle as I pull the gauge toward me—to press the fence firmly against the stock and engage the point so it'll scribe a light line. When I finish all the pieces, I flip the stack over and do the other sides. Then, I turn the stack end for end and repeat the process. This way there's no wasted motion and less chance that an end will miss getting marked.

A marking gauge will score endgrain as cleanly as it scores across the grain. When cutting half-blind dovetails on a drawer front for instance, the dovetails' depth must be marked on the endgrain as well as on the sidegrain of the drawer front. If you have trouble holding the piece steady while you mark the end, support it in a vise or hold it firmly under your armpit. Also, the scored line may be harder to see on the endgrain, so highlight it with a pencil if necessary.

You have to be a bit more careful when marking along the grain, because the grain may cause the gauge's point to veer off. To prevent this, refile the point as described on the previous page and keep the fence firmly against the work. Also, it's best to take a couple of light passes with the gauge rather than one heavy one, especially on an unplaned surface. I often use my gauge along the grain to size and thickness a square chair or table leg by hand. I first square two adjacent sides of a piece wider and thicker than the finished leg with a jack plane and try square. These two sides provide reference surfaces for marking and planing the other two. I then set my marking gauge to the final size and scribe a line down the length of one squared-up side and the unplaned side parallel to it, with the fence bearing on the second squared side. With the leg clamped down on the bench, second squared side down, I use a jack plane to chamfer the top edges at about 45° down to the scribed lines. Then, with a smooth plane, I plane down the leg's thickness until the chamfers are gone—a sign that I've reached the scribes. Repeat this process to square the remaining unplaned side.

The panel gauge—The panel gauge works just like the marking gauge, except you must use two hands—one to hold the fence against the edge of the workpiece and the other to press the scribing point to the stock. Square one edge of a board and use it as a reference surface to mark the board's width on both sides with the panel gauge. The board can then be ripped (or trimmed by the chamfer method above) to the same width from one end to the other. This is especially important if you're gluing up several boards for a large rectangular tabletop and want the top's final dimensions even.

Although marking gauges are best for scribing straight lines, I occasionally need to mark around the top of a round table for edgebanding or scribe along the length of a serpentine leg or table apron. Since the fence of a regular marking gauge is straight, the gauge will wobble as you try to work around a curve. On a single radius concave edge, you can keep both ends of the fence firmly seated as you scribe. A convex edge gives the fence only one point of contact in the middle, so you must wrap your fingers around the ends to act as shims and keep the gauge's beam pointed toward the radius center. This is very difficult if you try to scribe more than 1 in. to 2 in. from the edge. A better method is to shape an auxiliary fence to fit the curved edge and



To make marking a set of drawer sides quick and orderly, stack the sides and mark your way down through the pile. Mark each set of ends in sequence to minimize the risk of mismarking similar pieces or skipping a piece.

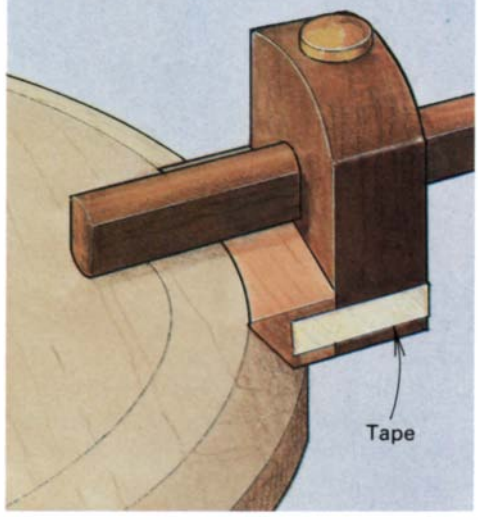
Although it's an uncommon marking tool, the panel gauge is handy for marking a panel or a wide board to be handsawn to consistant width. Two hands hold the long-beamed gauge for stability and to get a clean scribe line.

The mortise gauge scribes two parallel lines for marking mortise-and-tenon joints or grooves to be plowed out with a multiplane. The distance between the points is adjustable, as is the position of the fence on the beam.

Using a tightly held pencil as a marking gauge, Klausz marks the board's edge from both sides to find its center.

Fig. 3: Auxiliary marking-gauge fence

Shaped scraps taped to the marking gauge's fence act as auxiliary fences, allowing a gauge to mark along a curved or beveled edge.



tape it to your gauge. This can also be the solution if the edge you want to scribe is mitered or beveled and the gauge's fence can't contact it solidly.

The mortise gauge—Mostly used for laying out mortise-and-tenon joints, as shown in the photo above, left, the double-pointed mortise gauge can be used to mark grooves and slots as well. One of the two points is fixed and the other can be moved up and down on the beam. Before marking out a mortise-and-tenon joint, I set the distance between the two points to match the width of the chisel I'll use to chop the mortise. I hold one edge of the chisel's blade against the fixed point's tip, then slide the other point until it just touches the blade's other edge. Then the fence is set so the two points will scribe at a set distance from the stock's edge. Locking the fence also locks the movable point on many gauges.

Mark the mortise first, then use the same gauge adjustment to mark the tenons (if the faces of the two frame members will be flush). Remember to saw to the outside of the scribed line; otherwise, your tenon will fit too loosely in the mortise. I start at the tenon's base and mark with the grain, moving the gauge around the end and then finishing at the base on the other side, marking all three sides in one motion. If you have several sets of mortises and tenons to mark, lay the pieces side by side and mark them in order. Just as with the dovetail depth marking, this makes the layout process faster and more orderly.

Marking without a gauge—If you don't have a marking gauge, you can easily mark lines with a sharp pencil, as long as the lines aren't more than an inch or two from an edge. Grasp the pencil firmly with your thumb, middle and index fingers and use the middle finger's nail as a fence, as shown in the photo above. Be sure to mark with your fingers pointing away from the direction you move your hand, lest you get a splinter under your fingernail. You can find the center of a board's thickness by grasping the pencil and marking a line you estimate to be centered along the edge of the board from one side. Then, without changing your grasp on the pencil, mark the edge from the other side. The difference between the two lines will be the exact center. □

Frank Klausz makes furniture and restores antiques at his shop in Pluckemin, N.J.

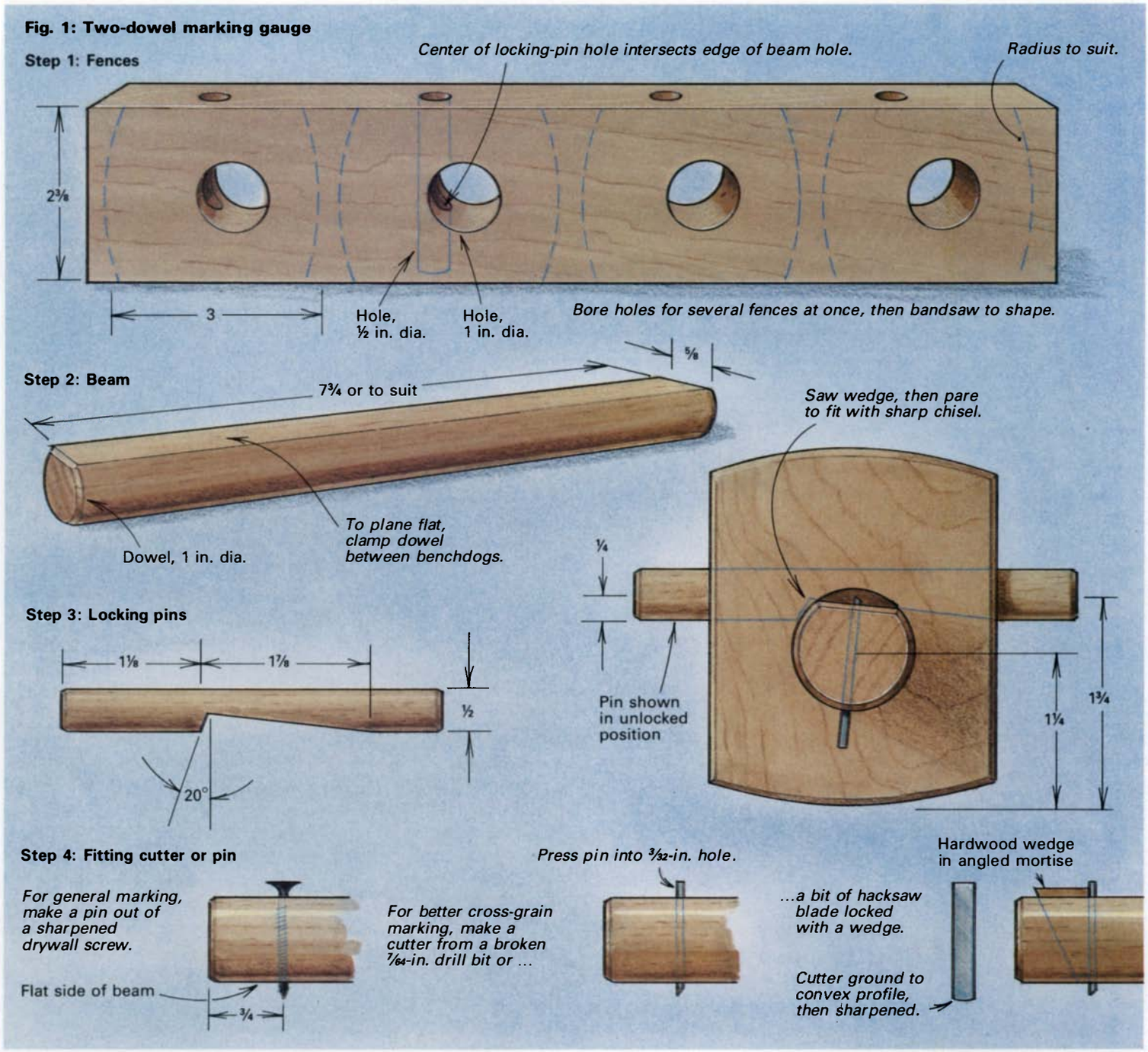
Shopmade Marking Gauges

by Fred Palmer

I got the idea for this two-dowel marking gauge while trying to simplify a more complex gauge. The tool couldn't be much easier to make: It's nothing more than two short lengths of dowel and a piece of scrap for the fence block. Unlike traditional gauges, the locking mechanism requires no thumbscrews or clumsy wedges, just the two dowels sliding in intersecting holes. The larger of the dowels, the beam, carries the pin or blade that does the marking. The smaller locking dowel has a wedge cut into it, which presses against a flat on the beam, locking the gauge setting.

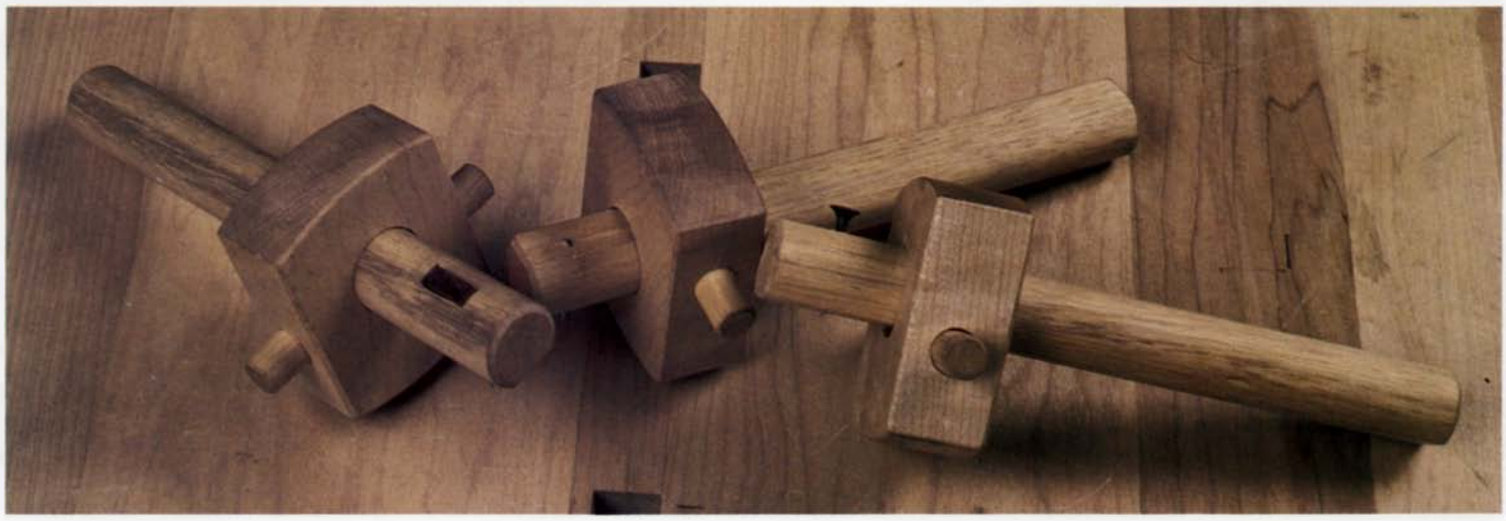
Figure 1 shows the sequence of construction. I prefer maple for the fence because it's cheap and durable, but any tight-grained hardwood will do. For the beam and pin, you can turn your own hardwood dowels or buy them at your local hardware store. I recommend making several fences at once from a single piece of stock—it'll be easier to clamp the stock for hole boring, preferably with a drill press. After boring, bandsaw the fences to shape and sand their edges smooth.

The dowels for the beam and locking pin should be turned or sanded slightly undersized so they'll slide smoothly in their holes without binding or sticking. The beams shown here are 7¾ in. long, but this dimension can be altered to suit. I handplaned the flat on each beam by clamping the dowel between dogs on my bench. The flat should be about ⅝ in. wide and uniform from end to end. The low-angle wedge cut into the locking pin is the



Made from a pair of dowels and a scrapwood fence, each of these gauges is fitted with a different type of cutter. At left, a hardwood wedge holds a cutter made from a hacksaw blade.

A broken drill bit sharpened and fitted into the center gauge's beam is good for general marking, and the drywall screw in the gauge at right works well for most applications.



secret of the gauge's quick adjusting action. To fit the pin, saw the deep end of the notch with a backsaw, then pare out the notch with a chisel until the beam slides easily through its hole with the pin fully unlocked. A tad of looseness is okay, but too much play will allow the beam to rotate, making the gauge cantankerous to adjust. To lock the gauge, simply press the pin with your thumb. The pin should travel less than ¼ in. before firmly engaging the beam's flat.

If the locking action works to your satisfaction, mount a pin or blade in the beam, as shown in step 4. With a drywall screw or a drill point as a scribing pin, the gauge is excellent for general marking work; but for cleaner cross-grain cuts, say for tenon shoulders or dovetail layouts, file the point to a knife edge to serve as a cutting gauge. Although the three cutters shown in the drawing work well, the cutter made from a hacksaw blade held in place by a hardwood wedge is easiest to remove and sharpen, even if it is more work to make. A couple of coats of oil or wax will make the beam slide smoothly and protect the gauge against dirt. □

Fred Palmer is the managing editor of the Pensacola News Journal *and is an amateur woodworker. He lives in Pensacola, Fla.*

Large-Scale Layout

by Percy Blandford

I've spent a lifetime woodworking, mostly building boats and dealing with large sheets of plywood and other materials. Before a boatbuilder even touches a stick of wood, he must loft the boat's curved lines, that is, draw a full-size layup on the shop floor that serves as the actual template for the boat's parts. The layup is drawn on a precise grid of straight lines, with crossings at exactly 90°. Errors in the basic grid could lead to inaccurate measurements and consequent difficulties in building the boat.

Cabinetmakers too need to mark out large surfaces accurately, yet tool manufacturers haven't provided squares, bevels and straightedges large enough for this sort of work. They seem to assume we never want to mark out or test a right angle greater than 12 in. The solution is to make your own marking tools and refresh yourself on those geometric constructions you did in school with a compass and paper.

For short lines up to 48 in., I use a steel straightedge; for longer lines, I use wooden straightedges. Note the plural. I have two 8-ft.-long straightedges—enough to span a plywood sheet. Having two means one can test the other. Mine are made from straight-grained spruce, but you could just as easily use a hardwood like ash, which would better resist damage along the edges. When I first made them, I had to replane the edges every few weeks until the sticks settled to the shop atmosphere enough to retain their straightness indefinitely. My straightedges have a chamfer on their working edge and a curve planed in their back edge. There are two reasons for the curved back: It gives stiffness and resistance to bending at the center, but just as important, it stops me from using the wrong edge. To get the edge straight, joint the stick on a jointer with at least a 4-ft. bed or simply plane the edge with a try plane, sighting as you go and correcting any quick bends or flat spots.

As with squares, a line longer than 8 ft. is never marked by successive moves of a straightedge. For longer lines, the solution is a chalkline, but not the rather coarse string carpenters use—this leaves a line 1/16 in. wide, much too wide for a cabinetmaker. Instead, use crochet cotton, which is fine, strong and whiskery enough to take up the chalk dust. I keep my line on a reel I turned. The reel has hollows for thumb and finger, so it revolves easily. For the other end of the line, I made a little awl with a point out of a steel knitting pin. For chalking most surfaces, I use ordinary school chalk; for a darker line on a light surface, charcoal will do nicely.

To strike a line, push the awl through a loop in the line and into the wood. Hold the reel so it revolves easily, then walk back from the awl, using the other hand to rub chalk on the line. When you have the distance you want, stretch the line without jerking it and hold it to the surface being marked. If the length is not more than 15 ft., reach out as far as you can and lift the line a few inches while maintaining tension. Let it spring back to deposit a line of chalk. If the line is longer, get an assistant to lift the string near the center to strike it. It is important that the lift be square to the surface; otherwise, the struck line will not be true.

Deposited chalk is not very permanent. If you need a more permanent line, put pencil marks at intervals along the struck line, then use a straightedge and pencil to go over the line between the marks.

There are several geometric methods for drawing one line square to another. At small scale, this is easily done with a compass, but when the measurements involve feet rather than inches, you will need a pair of trammel heads attached to a long stick of wood. If you don't have these tools, you can get by with nails driven through a strip of wood or several strips nailed together. But it is not difficult to make a pair of trammels secured to a bar with wedges, as shown in figure 1. The dimensions are not critical, but if you make the heads to fit a 1-in. by 2-in. bar, use ¼-in. steel rod secured with epoxy for the marking points. At times, a pencil is preferable to a steel point—one can be put through a hole in the trammel head and held with a wedge.

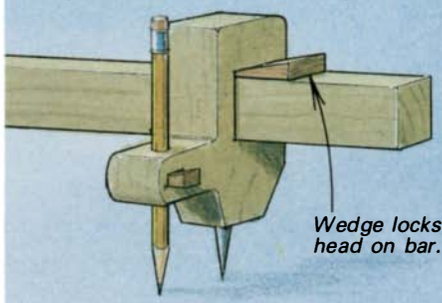
The simple way of using trammels to erect a perpendicular is shown in method 1. If your work demands great accuracy, there are two considerations. It is difficult to be certain of the exact crossing point of the arcs at point D if they meet at a shallow angle, which is the result of too narrow a baseline. Therefore, proportion your trammel settings so the arcs at point D will cross at near 90°. Second, have the arcs at point D crossing farther from the baseline than the final length you want the perpendicular line to be; otherwise, you might introduce error by extending the line past the intersection with a straightedge.

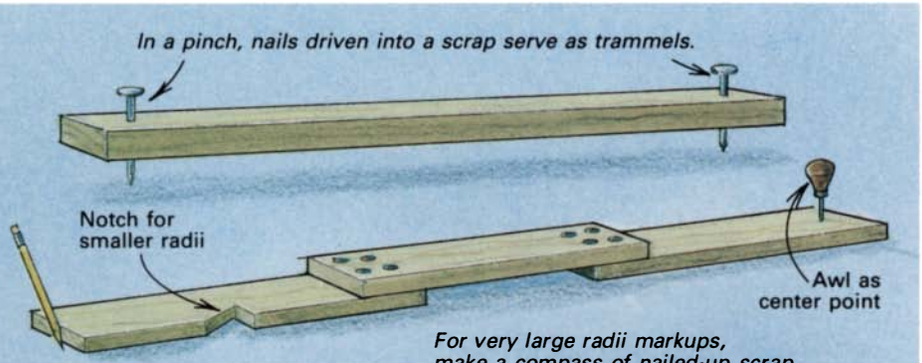
Very often the perpendicular must be marked near a corner and the method just described will not work. In this case, use the technique described in method 2, which relies on the fact that any triangle whose base is the diameter of a circle and whose apex is on the circumference of the same circle must have an apex angle of 90°. As with the first geometric method, choose a size that puts the arc crossings farther from the baseline than the most distant point on the perpendicular.

When you need really large sizes, a trammel becomes rather unwieldy. It is possible to use a steel tape measure, marking the

Fig. 1: Trammel points

Shopmade trammel head with point and pencil





Two methods for laying out perpendiculars

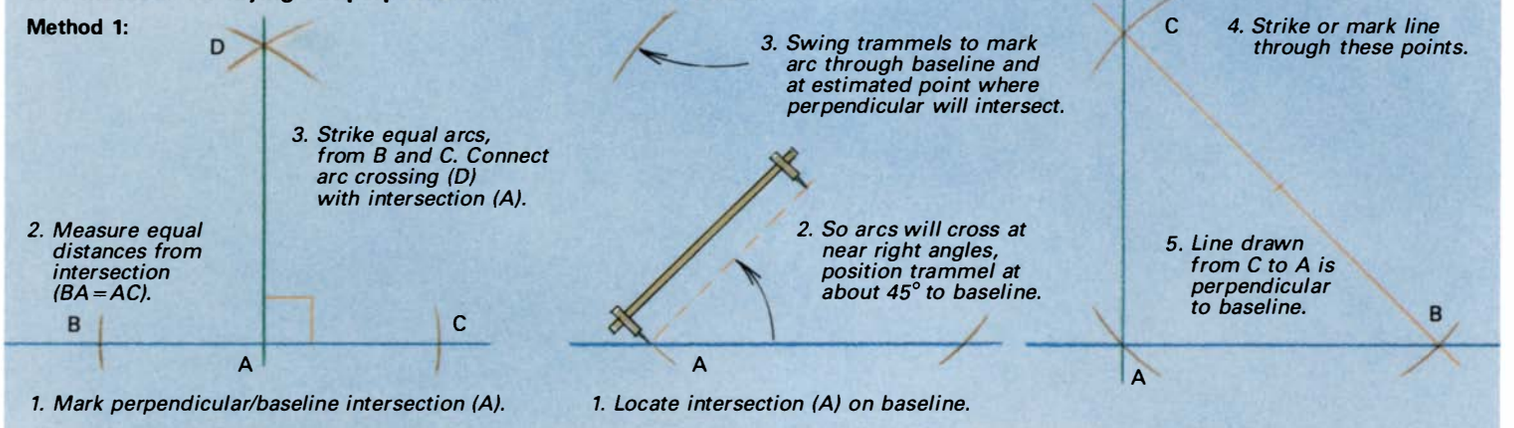
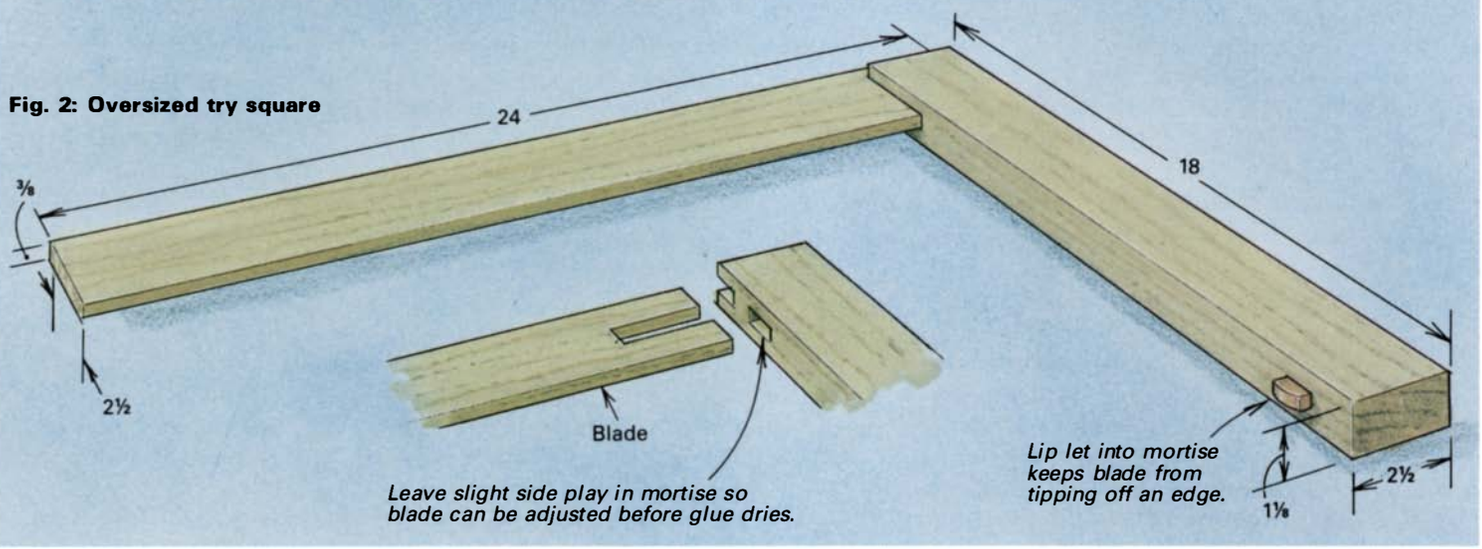


Fig. 2: Oversized try square



distance with a pencil while the center is held with an awl by an assistant. A more accurate method, however, is to improvise a compass from scrapwood temporarily nailed together. An awl provides the center, and the compass length is cut to the intended radius. If shorter radii are needed, cut notches in the compass, as shown in figure 1.

Geometry takes care of the very large constructions, but it can be unnecessarily tedious when working with pieces 18 in. wide to 48 in. wide. If you often work within these sizes, it is worthwhile to make your own large squares. I have two and would feel lost without them. The first is simple. It is just a giant plywood drafting square cut as large as a standard plywood sheet will allow. It is made of marine-grade mahogany plywood, which is stout enough to be stiff without being very heavy. The square is laid out using the geometric method described above. The center is cut out for lightness.

I also have a wooden try square made of oak, mainly because that was the wood I had at the time. Any straight-grained species will do just as well. The square is difficult to adjust if the wood warps after you have made the square, so prepare the pieces some time in advance and keep them in the shop for a month or so to give them time to acclimate to the shop's humidity. Construction is straightforward, but sizes and assembly have to be accurate. In particular, edges must be straight, square and perfectly parallel. Give the mortise and tenon very slight sideways clearance, then as you assemble with glue in the joint, set the blade to a line marked square to the edge of a plywood sheet. Try the blade both ways, then leave the glue to harden. The little lip mortised into the handle prevents it from tilting in use. The lip is acceptable, because the square is used mainly for surface work and not for testing over edges—a small square does that. □

Percy Blandford is a boatbuilder, draftsman and author. He lives in Stratford-upon-Avon, England.

Tropical Deforestation

Are woodworkers to blame?

by George Putz

Woodworkers who regularly build with rosewood, padauk and other exotic timbers may sometimes worry that they are encouraging the destruction of tropical forests, but the amount of wood they use is almost insignificant. While it's true that 1.7% of the world's moist tropical forests are being cleared annually, the exotics prized by woodworkers are what commercial fishermen would classify as a "bicatch," a saleable material gathered incidentally to the real business at hand—cutting trees for construction lumber and firewood, and clearing land for pulp-tree plantations, hydroelectric projects, cattle ranches, farms and roads.

The destruction of these forests would continue even if small cabinet shops and hobbyists stopped buying exotic timbers. This is not to say that woodworkers are blameless. Our contribution to the problem is smallest among the lumber consumers, but it's the most specific. We are virtually the sole users of such exotic species as cocobolo, rosewood, ebony and purpleheart. The money we pay for these timbers trickles down to loggers in Africa, South America, Asia and other countries and encourages them to continue the "harvest" of exotics. This might be acceptable if the jungle regenerated quickly and easily from this cutting, but it doesn't. It can take hundreds of years for a tropical forest to regenerate and even then, many species of plants and animals may never come back. We owe it to ourselves as craftspeople to understand the problem and wield what clout we can to encourage the preservation of these virtually irreplaceable forests.

You must realize, though, that in much of the world, tropical timbers are not prized for their beauty or considered very valuable. The wood is so cheap in Asian countries that vast quantities are used for dunnage, a trade name for pallets and ship ballasts. Hardwoods that would be a woodworker's delight in this country become paper, plywood or cheap mass-produced furniture for growing Asian markets. It may seem criminal to waste magnificent trees for such mundane products, but they are crucially important sources of hard cash in the tropical forests of developing Third World countries, where day-to-day survival is more of an issue than the environment or conservation.

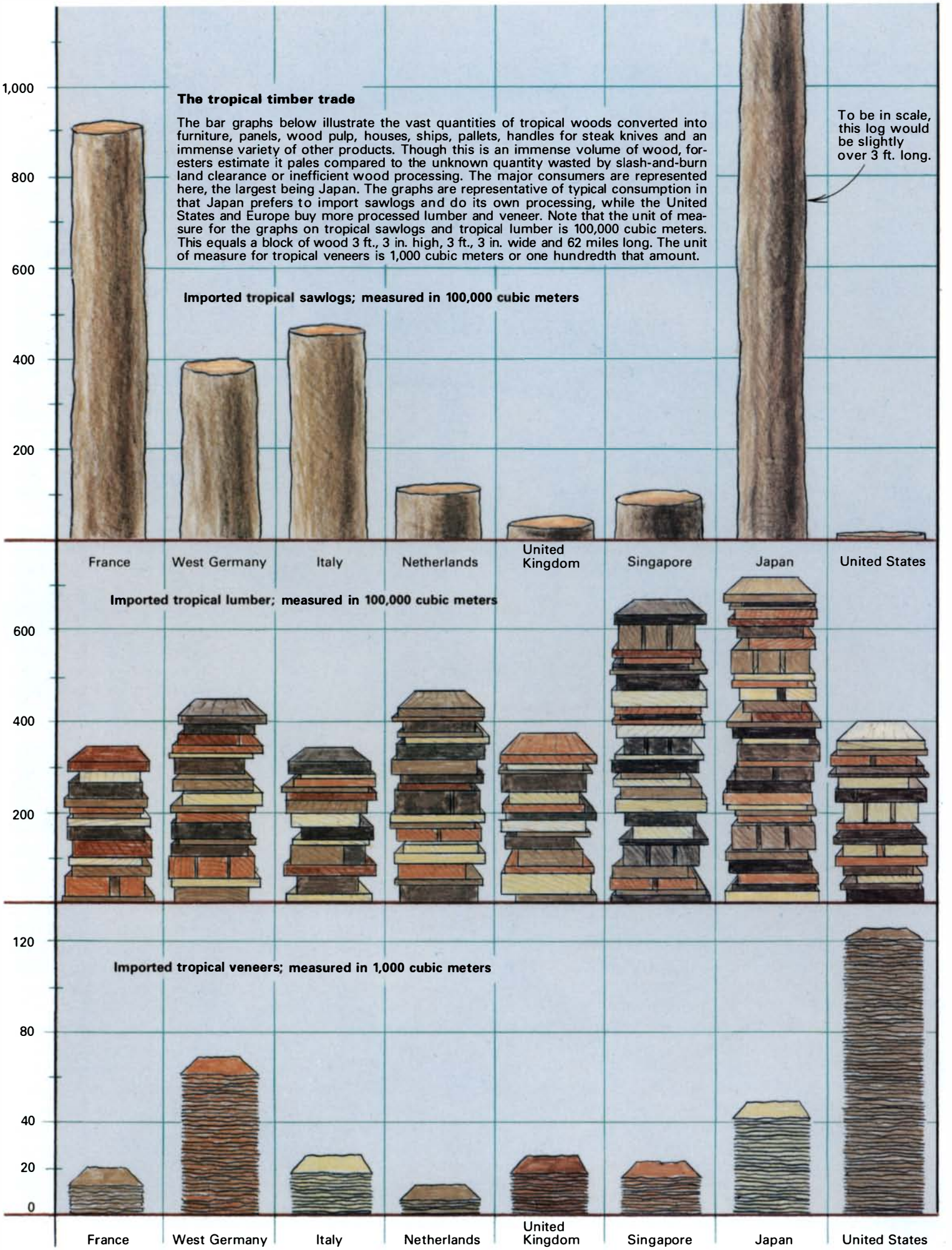
Human survival versus forest conservation—Explosive population growth and unsound farming practices also promote tropical deforestation. The populations of many developing countries are growing at alarming rates. Brazil's population, for instance, is expected to double in the next 30 years. Hundreds of thousands of landless, urban poor are relocating to the Amazon basin as part of the government's land reform policy. The peasants move into the forest, cut trees for lumber and firewood, then slash and burn much of the remaining timber to create farmland. Unfortunately, the jungle floor is not fertile enough to sustain many crops. After several meager harvests, which further deplete the soil, the peasants bring in cattle to range on any remaining scrub growth. When the land won't even support cattle, it's abandoned—a highly eroded, parched semi-desert. The peasants move on to clear-cut another jungle tract, and the cycle is repeated. There are similar jungle resettlement programs underway in Peru, Bolivia and Colombia.

It's not surprising that Third World people don't understand the problem or need for reform. Much of the rest of the world is equally unaware. Too often, vital news concerning these forests goes unreported. In 1982, a sawmill waste fire ignited a blaze that consumed 3.9 million acres of Borneo jungle. Weeks later, the fire received one paragraph on the third page of the *New York Times*. And, much of what little is reported is wrong and misleading. Several timber-exporting countries, apparently unaware of environmental-monitoring satellites, habitually lie to the international community about their forest cutting. India and Indonesia are worst in this regard, underreporting their cuts by as much as 800%.

The importance of rain forests—Like Mideast oil wells, tropical forests are far from Western woodworkers, but they are important to us. Life-saving drugs, like vincristine and vinblastine, used to treat leukemia are produced from the rosy periwinkle, a jungle plant destroyed in clear-cutting. Gums and resins produced in the rain forests are components of varnishes and inks. Oils from the tropics provide the essence for mouthwashes, perfumes and deodorants. Other oils and waxes, like carnauba, are still gathered solely from forests in northeast Brazil. The latex used in paints comes from both forests and plantations. This is to say nothing of the potential, undiscovered resources within these forests. With every tree burned, up in smoke go undiscovered organisms for genetic research, future food crops and other possible life-saving drugs.

Tropical forests can infinitely supply food, fuel and lumber, providing these products aren't taken at a rate that exceeds the forest's ability to supply them. Agro-forestry is the science of cultivating the forest so it continuously supplies more than just wood. For instance, citrus and mulberry trees have been planted successfully in the jungle throughout Polynesia. Third World countries are beginning to realize that agro-forestry can provide much of their country's needed foreign exchange while preserving their forests.

These forests have more than economic importance. Even though they comprise only 7% of the world's forest cover, scientists believe they are crucial to maintaining the carbon dioxide level in



Information in graphs: United Nations Food and Agriculture Organization

the Earth's atmosphere, important for plant photosynthesis and, in part, for maintaining the Earth's atmospheric temperature. The vegetation of the tropical forests soaks up rainfall and maintains proper continental drainage patterns, preventing flooding and reducing erosion.

Tropical versus temperate forests—Rain forests exist in a wide swath, extending hundreds of miles north and south of the equator. They are found in southern Central America, northern and central South America, throughout much of Southeast Asia, western, coastal and central Africa and northern Australia. Rainfall in these areas often exceeds 100 in. a year (as compared to about 44 in. to 46 in. where I live in northern New England). The diversity of plant and animal life in tropical forests is staggering. They are home to several thousand tree species (as opposed to about 700 found in the United States and Canada), millions of insect species, and at least 100,000 species of birds, fish and reptiles.

Tropical forests are a product of the basic biological axiom that organisms thrive and diversify in a nurturing environment. Forests that grow in harsh environments have large numbers of fewer species. To illustrate this, compare a one-acre plot from the three forest types that produce many of our wood stocks: a birch-beech-maple forest in northern New England, a mixed hardwood forest of West Virginia and a Brazilian rain forest.

A fully developed northeastern hardwood stand would include about two dozen species of woody plants, including shrubs. About a half dozen of these species, including ash, red oak and maple, are suitable for woodworking. The West Virginia forest contains about 70 species—two dozen of them suitable for woodworking. Added to some of the species previously mentioned would be walnut and cherry. In the Brazilian stand, more than 100 tree species grow in an acre and perhaps 75 of them would be suitable for woodworking.

If a woodcutter seeks a particular tree species, he will find as many as 30 in the Northeastern forest, perhaps eight or nine in the West Virginia forest, but only one in the Brazilian forest. Harvesting a large quantity of good clear logs of a particular species is rather simple in fully developed temperate forests—say 30 oak trees can be taken from one acre. To get just one Brazilian rosewood tree, however, entails a comparatively huge effort and yields enormous waste as surrounding trees are bulldozed away to make logging trails or damaged by the felling and skidding process—a situation only slightly improved where elephants are used in Southeast Asia. A huge area, perhaps hundreds of acres, must be cleared to take 30 rosewoods. In tropical logging, the rule of thumb is that 50% of the forest must be cleared to extract 10% of its wood.

Then there is the problem of how tropical forests grow. Consider that the hardwood stand in the northeastern United States is only about 10,000 years old and that all the vegetation you see represents about 23% of the living matter in the forest. The rest is in the soil. On the other hand, the usual tropical forest is between 40 million and 70 million years old, and as much as 93% of the forest's living matter exists above the soil. Cut all the trees in the temperate woods, and we still have a lot of resources left with which to grow a new forest. Cut down a tropical forest, and we've taken the whole biological ball of wax.

Furthermore, the thin and fragile topsoils are compacted by the bulldozers that clear logging roads and drag out felled trees. Without the shade provided by the tree canopy, the exposed soil bakes in the sun and is pummeled by rainfall that otherwise would have been deflected by the leaves. Instead of being absorbed, the water runs along the ground's surface and gains speed going down hills, washing away meager topsoil and leaching the few nutrients in the soil left behind. In Costa Rica, scientists studying soil erosion in clear-cut forests have found that suspended matter (soil and organic debris) in lakes and streams near the felled area increases by 1,600%. Nitrogen, an element vital to soil health, leaches from the soil into the water, with increases of 800% found. It's estimated that it takes 1,000 years for a badly eroded forest soil to completely regenerate, whether it be in a tropical or temperate forest.

In a northern forest, a responsibly harvested clear-cut, one in which measures have been taken to reduce erosion, has good rich soil on which to regenerate and lots of parent stock nearby to reseed the barren area. In a tropical forest, the nearest tree of the same species is acres away. Tropical forests should not be thought of so much as a stand of trees, but rather as a very complex and diverse community of organisms. Tropical tree species need more than just another tree to provide seeds for continuation of a species; they need an enormously complex and diverse system involving mammals, birds, insects, reptiles and other pollinators and seed dispersers.

This complex system is easily disturbed. Every time an exotic tree is cut, we risk throwing a wrench into the tropical forest's ecosystem. The more trees removed, the more damage done. If trees are to be harvested for lumber, they need to be taken sparingly and carefully to allow the forest enough time to regenerate.

Growing demand, shrinking supplies—The supply of exotic sawlogs exported to the United States is bound to dwindle in coming years for at least two reasons, aside from blatant deforestation. As Third World nations develop their economies, they will pocket more profit from their wood exports by turning their own timber into chipboard and finished or semi-finished wood products like desk accessories, furniture parts or finished furniture. They will saw more of their own lumber and slice more of their own veneer rather than export sawlogs. Their paper consumption will also increase, and trees that otherwise would have been sawn for furniture-grade lumber may be pulped instead. You would think that those trees worth more for lumber or veneer than for pulp would be reserved for those products, but expediency often rules the day in developing nations, and the logs may be pulped regardless. The result is that wide, solid planks of exotic timber will be more expensive and scarcer. Woodworkers will have to use more veneer and more veneered panels produced in the exporting countries.

Increasingly, exotics and other timbers are being traded as a future's commodity in the same sense that soybeans and corn are. When you buy a select piece of exotic lumber, you may be competing with traders buying vast quantities of the same wood. Lumber is not as readily available as yearly food crops, so when timber futures are traded, vast quantities are locked up in warehouses, awaiting the day when the contract comes due, perhaps 10 years hence. I've heard that vast quantities of premium softwoods have been warehoused in British Columbia. I'm not sure whether premium exotics have been warehoused as well, but it wouldn't surprise me, in light of the demand for exotics (see the bar graph located on the previous page). Too, fads can wreak havoc. In the late 1970s, the Japanese discovered bowling, and in 18 months, built 50,000 lanes, driving up the price of rock (sugar) maple from 70¢ a bd. ft. to $4 a bd. ft. Entire groves of sugar maples evaporated, and several furniture, flooring and cabinet veneer mills were driven to their knees as a result. A similar situation could occur just as easily with tropical timbers.

A call to action—Though at ever-increasing expense, there is a sufficient supply of exotics to meet the needs of industry and the small-shop woodworker for another 30 years. During the next 15 years, when traditional species give out or near depletion, new species with unfamiliar names and working qualities will appear on the market. Whether or not woodworkers use these exotics will have a negligible effect on tropical deforestation. My advice is to buy quality stocks now—store and protect them. They should appreciate at about double the general inflation rate, and you will have them regardless of fluctuations in the timber market.

As woodworkers, we should organize into acquisition cooperatives that monitor the forest policies and cutting practices of tropical-wood exporters. We can then contract with those countries to buy exotic timbers, paying the premiums and costs necessary to maintain forests on a sustainable basis. This has the effect, essentially, of buying easements on the future tranquility of these forests. This would be very expensive to do and would make for extremely expensive exotic timbers, so I'm not hopeful that this will come about.

We should exert what influence we can, because small doesn't necessarily mean insignificant. The cumulative effect of our efforts, plus those of biologists, botanists and others who care about the future health of the rain forest, can be substantial. We should take what actions we can, while there are still rain forests left to save. □

George Putz, a freelance writer, editor and naturalist in Vinalhaven, Me., is currently working on a book on global deforestation to be published by Houghton Mifflin Co. For more information on rain forest destruction, contact the Environmental Defense Fund, International Program, Suite 150, 1616 P St., N.W., Washington, D.C. 20036; Rain Forest Action Network, Suite 28, 300 Broadway, San Francisco, Calif. 94133; or Friends of the Earth, 530 7th St., S.E., Washington, D.C. 20003.

A cabinetmaker visits the jungle

by Lucinda Leech

Bougainville, Papua New Guinea: "Temperature in the mid-90s (Fahrenheit), ground extremely muddy. Struggling to balance on logs and clumps of palm leaves in the mud. I frequently slip or get caught and tripped up by barbed vines. Razor-edged leaves shredding my legs. I stop for a minute to catch my breath and find flies and inch-long ants crawling in the mixture of sweat and blood around my ankles. Struggle on, hot, tired, thirsty, hungry, longing to find a bulldozer and hitch a lift back. Oh, you concerned environmentalists sitting on your backsides in comfy city offices—what do you want to save this hell of a jungle for? You think it pretty, yet you don't bother to come here to see for yourself. As for me, I'm too busy trying to find a footing and keep up with my guide to stop and gaze."

This excerpt from my diary, May 16, 1987, reminds me of how intense the jungle can be to a cabinetmaker such as myself, whose only contact with the tropics was with the wood I worked. An overreaction, fortunately I felt better after lunch. Mind you, I wasn't hacking my way through the jungle, but was slogging along a bulldozed logging trail with the manager of an Australian timber company. The rain forest is a beautiful and compelling place, true to the image nurtured in glossy coffee-table books, but it's also hostile. Jungles are as impenetrable as they are said to be, but you're attacked by ticks, leeches and ants rather than exciting tigers.

My interest in rain forests began a few years ago when I started hearing more and more about tropical deforestation. I wondered what my responsibilities as a wood user were and was determined to find out firsthand if the horror stories I had read about were true. In 1986, with the help of a travel scholarship from the Worshipful Company of Furniture Makers (a London-based guild), I took a three-week trip to the Amazon basin in Brazil. The next year, I financed my own eight-week trip through peninsular Malaysia, Australia, Papua New Guinea (P.N.G.) and the Solomon Islands—all areas that support dense rain forests. My stay in these countries was briefer than I would have liked, because I couldn't spend too much time away from my cabinet shop in Oxford, England. Therefore, my views are shaped more from observation than from thorough, academic-like research afforded by a long stay in an area.

I started my trip with many preconceived notions of ecological disaster. In the course of the two trips, my views on the subject were broadened, and I can see now that the issue is more com-

The author visited rain forests such as this one near Aseke, P.N.G., while investigating tropical deforestation in Southeast Asia, South America and Australia.

Photos: Lucinda Leech

plex than I once thought. It's certain that forest products must be harvested to meet the economic and social needs of the developing nations in which they are located. The question remains whether the changes will be for the long-term benefit of these nations, and ourselves, or whether they will be to our collective detriment.

Timbering in the tropics: While on Bougainville, I saw loggers felling 150-ft.-tall trees, some of them with 100 ft. of trunk to the first branch. A man wielding a chainsaw with a 3-ft.-long bar stepped up to each tree and in five minutes, felled what took centuries to grow. Roaring bulldozers and log skidders crashed, smashed and ground through the jungle, tearing up undergrowth and spewing diesel fumes. It's easy to look on this destruction and say it should be banned. But the developing countries I visited cannot simply leave their forests alone; they need the income from their timber exports. Worldwide tropical hardwood timber exports are worth $8 billion a year in U.S. currency, and the tropical-timber trade accounts for about 60% of the world's hardwood trade.

Yet using rain forests as a resource need not destroy them. For instance, The Hyundai Group (a major international industrial corporation based in Seoul, South Korea) representatives in the nearby Solomon Islands proudly showed me how they observed logging regulations, keeping the required 164 ft. (50 meters) from streams, rivers and ponds and not logging on slopes with more than a 20% grade. Even small companies can carefully harvest small quantities of high-quality timber. I saw such a logging operation in the Ewingar Forest in the state of New South Wales, Australia. I was several miles into the logging area before I discovered a single felled tree. Short logging trails had been cut at an angle off the main road and trees were carefully dropped into these trails so they would do minimum damage as they fell.

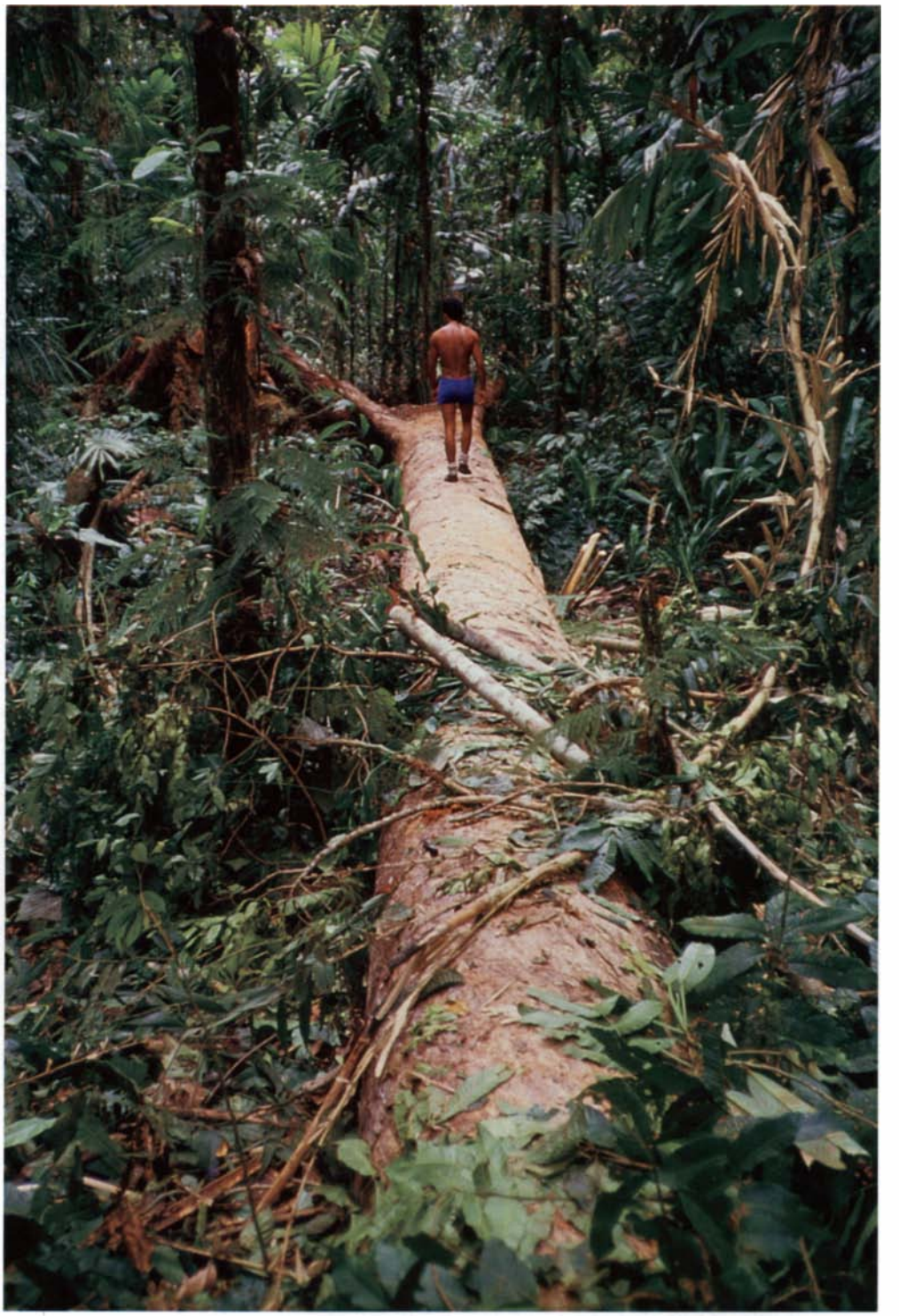
Environmentalists often give the impression that tropical forests will be logged out tomorrow. After visiting Guadalcanal in the Solomon Islands, I learned that much of the forested terrain in tropical countries often is too steep or swampy to log economically. I heard from various sources that in another five years, Guadalcanal would be logged out. In fact, this applies only to the 15% of the island accessible for logging; the rest is too mountainous or swampy. P.N.G. consists of 46 million hectares, and of that, only 15 million are considered accessible for logging (1 hectare = 2.47 acres). In addition to natural barriers, all the countries I visited have legislation limiting the amount of timber that can be cut. Malaysia enacted a National Forest Policy in 1977 that declared 39% of the country's total area to be a permanent forest estate. Of this, 7.9 million hectares are loggable, while 3.7 million are protected forest. The policy was a reaction to massive timber cutting there—one third of the country's forest had been cleared in the last 20 years. Incidentally, this was not Malaysia's first step to protect its forests. In 1938, it set aside 4,343 square kilometers of rain forest for Taman Negara National Park.

I'm not naively saying that tropical deforestation is easily controlled with legislation. It's virtually impossible to police remote jungle logging, and corruption is a way of life in many developing nations. Timber money is said to run politics in Sarawak (a region north of Borneo belonging to Malaysia). And, a couple of thousand miles east, I arrived in P.N.G. only to find some key government people I needed to talk to had disappeared in the wake of a timber-price scandal. Allegedly, the quantity, grades and species of timber shipments had been purposefully misrecorded so less export tax would be due on them. A commission of inquiry had been established to investigate the scandal. I wonder if the commission would also learn of the activities of a timber company I visited there. I was bumping along a logging trail in a truck with the company's manager when he let it slip that two logging teams (I'd estimate 10 or 20 men) were felling illegally, in preserved forest, that day.

This rain forest, near Manaus, Brazil, was cleared in typical fashion—the area was clear-cut, then burned, with much of the wood being wasted. Cleared rain forests are poor sites for farming. Their topsoil is too thin and too deficient in nutrients to grow crops, and they can hardly support grazing cattle.

Tree plantations: I believe the rain forest's recuperative powers and its own inaccessibility will probably have more to do with saving it from destruction than high-minded conservation goals. I visited a forest in Guadalcanal that had been logged 20 years ago and found the dense undergrowth that had sprung up was hiding most traces of previous activity, at least to my uneducated eye. The only clue of logging was that the giant trees were gone. Still, the load on the jungle can and should be reduced by growing tree plantations for construction materials or paper pulp, neither of which require the high-quality forest trees being felled to provide them.

Plantations are still new and somewhat experimental. Those begun 30 years ago are only now starting to pay off, and the ones I visited in P.N.G. and peninsular Malaysia would still not be harvestable for another 10 or 15 years. Plantation trees are more easily harvestable and more uniform than their natural counterparts. Their uniformity makes them less ecologically diverse



Above, a worker bucks up a log at a sawmill on Bougainville, P.N.G., while the mill's waste and marginal logs burn in the background. Many sawmills in developing nations aren't equipped to process wood beyond basic sawing. This is changing, however, as developing nations look to boost their income by exporting finished and semi-finished wood products. Right, the author's guide walks atop a tree felled on Bougainville. Rain forest trees are often 150 ft. tall with 100 ft. of trunk to the first branch.

than the native rain forest trees, however, so plantations can be wiped out from insect attack and disease that the natural forest withstands.

The Stettin Bay Lumber Co., owned jointly 25% by the P.N.G. government and 75% by the Japanese, was involved in a large-scale plantation program growing kamarere, teak and erima for construction lumber and pulp. I visited their kamarere plantation on New Britain island and, much to my surprise, found it quite beautiful. The rows of kamarere trees were almost like a large-scale scuplture. Walking through it in the leaf-filtered sunlight, I thought that if it had been woods at home, it would have been the subject of a preservation order on account of its natural beauty. Plantation trees are generally harvested in 15- to 30-year cycles, but the kamarare can be harvested sooner. After six years, trees about 4 in. in diameter are cut for poles, and final harvesting is done 14 years later when the trees are 15 in. to 16 in. in diameter at breast height. Apparantly, plantations aren't enough to meet the company's needs. It's cutting trees on 200,000 hectares of natural forest and negotiating to log on another 100,000 hectares.

Peninsular Malaysia is "recycling" plantation-grown Para rubber trees for use as construction lumber. The trees need to be cut down and replanted every 25 years, but rather than burn the logs, as in the past, they are sawn for lumber. A bland wood, it glues and stains well and is well-suited for inexpensive furniture. I saw several attractive chairs made from it at The Malaysian Timber Promotion Board in Kuala Lumpur.

Ultimately, economic arguments carry more weight in developing nations than environmental ones. If timber was more valuable, that is if timber-producing nations were paid more for it, then they'd treat it more like a sustainable resource. They would be more inclined to enforce timber-cutting quotas, crack down on illegal cutting and replant for the future. Similarly, taxes on timber exports or timber income could pay for plantations, forest research and selective, small-scale felling.

I'd be willing to pay more for timber, because I've seen how expensive it is to extract from the jungle. Though many woodworkers would object at first to paying more for exotic timbers (they are expensive enough already), I suspect they'd be more willing if they knew the money was subsidizing timber research. □

Lucinda Leech builds custom furniture at her shop in Oxford, England.

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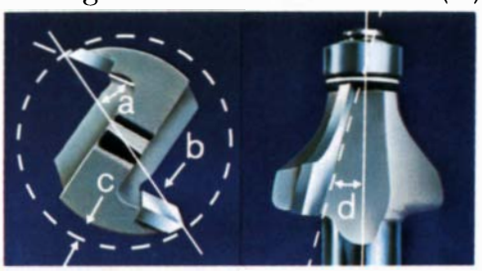

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1676-1	Hole-hawg kit	235.
3002-1	Electricians rt. ang. drill kit	175.
3102-1	Plumbers rt. ang. drill kit	180.
5397-1	3/8" VS hammer drill kit	149.
8975	Heat gun	54.
5680	2 hp router	220.
5925	3" x 24" dustless belt sander	219.
5935	4" x 24" dustless belt sander	225.
6012	1/3 Sheet pad sander	114.
6014	1/2 Sheet pad sander	119.
6215	16" Electric chainsaw	149.
6226	2 speed bandsaw w/case	275.
6245	Single speed jigsaw	125.
6258	Variable speed jigsaw	140.

Milwaukee

2 Speed Sawzall model 6511 **119.**

6507	Var. spd. sawzall w/case	129.
6305	6½" cordless circular saw	135.
6365	7¼" top handle circular saw	105.
6405	8¼" circular saw	127.
6539-1	Cordless screwdriver	59.
6543-1	VSR Screwshooter	145.
6750-1	VSR Drywall driver	89.
6754-1	VSR Magnum drywall driver	115.
6798-1	Adj. clutch screwshooter	115.

HITACHI

½" Plunge Router model TR12 **169.**

C6DA	6¼" cordless circular saw	119.
F20A	3-¼" Plane w/case	89.
TR6	Laminate trimmer	85.
TR8	¼" Plunge router	119.
CR10V	VS, Var. orbit recipro saw	115.
DRC10	3/8" Cordless drywall screwgun	85.
W6V1	0-4000 drywall screwgun	69.

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Deluxe 10" Miter Saw model C10FA **279.** FREIGHT INCLUDED

C15FB	Deluxe 15" miter saw	379.*
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C12Y	12" Table saw w/o motor	1189.*
C12Y	12" table saw w/3 HP Hitachi motor	1269.*
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10" Portable Planer **369.** model AP10 FREIGHT INCLUDED

RA200	8" portable radial arm saw	259.
L120U	3-5/8" Planer kit	109.
R500	2¼" HP plunge router	179.
R150K	1 HP plunge router kit	109.
TR30U	Laminate trimmer	79.
B7075K	3"x21" Belt sander kit	119.
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TS380	14" Miter saw	345.

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3/4 HP Twin Tank Hand-Carry Air Compressor model AM39-HC4 **269.**

David White Instruments

Sight Level Package **229.**

Makita

VS Cordless Driver/Drill w/ Clutch Kit model 6093DW **129.**

DP4700	1/2" Drill	109.
6012HDW	2-spd. cordless driver/drill kit	115.
6510LVR	3/8" Drill, heavy duty	75.
9207SPC	7" Electronic sander/polisher	139.
3612BR	1/2", 3HP Plunge router	195.

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7¼' Framers Saw w/hypoid gears model 5077B **139.**

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9401	4"x24" Dustless belt sander	189.
9900B	3"x21" Dustless belt sander	135.
LS1020	10" Miter saw	229.

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3304	1 hp electronic plunge router	225.
4023	3x21 belt sander	195.

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7790	12" DeWalt cont. radial arm saw	879.*
7770-10	10" DeWalt cont. radial arm saw	669.*

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Drywall Screwdriver 0-4000 rpm model SCR11E **79.**

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EZ502	Cordless screwdriver	59.
EZ506	3/8" Cordless drill-screwdriver	109.
SB2E13RL	½" Hammer drill	109.

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TD514L	24" Dovetail jig, through	195.

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Var. Speed Var. Orbit Jigsaw model 1581VS **129.**

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3238VS	VS, var. orbit std. duty jigsaw	95.
1651	7¼" Builders circular saw	99.
1500	16 gauge shears	205.
1942	Heavy duty heat gun	69.
3268	Std. duty heat gun	59.
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1606	1¾ HP, D-handle router	128.
90300	3¼ HP Production router	329.
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1609	Off set base laminate trimmer	119.
91064	3/8"Mighty Midget VSR drill	99.
1631K	NEW 2-spd Panther recipro saw	119.

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91066	1/2" Mighty Midget VSR drill	109.
1158VSR	3/8" VSR Drill	59.
1196VSR	3/8" Hornet 11 hammer drill	109.
1198VSR	1/2" VSR hammer drill	125.
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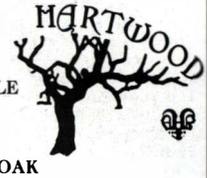

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Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We'll list events (including entry deadlines for future juried shows) that are current with 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.

ALABAMA: **Conference/Workshops**—"Continuity & Innovation—American Craft: Southeast Meets Southwest," American Craft Council Southeast Region annual conference, June 8–11. Features workshops and seminars in Tuscaloosa and Northport. Write Craig Nutt, conference coordinator, ACC–SE, c/o Kentuck Museum, Box 127, Northport, 35476.
Juried exhibition—"Spotlight '88: Southeast/Southwest Crafts," June 2–July 1. Moody Gallery of Art, Univ. of Ala., Tuscaloosa. Contact Kentuck Museum, Box 127, Northport, 35476. (205) 333-1252.

ALASKA: **Workshops**—Wilderness workshops; scribe-fit log construction, Mark Fritch, May 4–15, tuition $325; building a sailing pram, Simon Watts, May 18–27, tuition $375. Harmony Point.Wilderness Lodge. For information, contact Harmony Point Lodge, Box 110, Seldovia, 99663. (907) 234-7858.
Seminars—A number of seminars and workshops offered by the Alaska Creative Woodworkers Association for its members. For more information, write 2136 Alder Drive, Anchorage, 99508, or call (907) 278-2455.

ARKANSAS: **Workshops**—Furniture design and construction by Ken Burnett & Tony Bilello, May 16–20. Gallery B, 11121 Rodney Parham Road, Little Rock, 72212. (501) 221-0266.

CALIFORNIA: **Workshops**—Woodworking workshops for women, covering traditional joinery using hand tools, basic furniture construction and safe power tool use, June 27–July 1 or July 11–15. Maximum 7 women per class. Contact Debey Zito, 103 Wool St., San Francisco, 94110. (415) 648-6861.
Show—Kern River Carvers & Lake Isabella Woodcarvers' 1st annual woodcarving show, May 14–15. Kern County Fairgrounds. For details, contact Doug Lake, 1512 Club View Drive, Bakersfield, 93309 or call (805) 833-6315.
Workshops—Traditional Japanese woodworking classes. Shoji screen, Tansu chest, joinery and hand-shaping. Contact Hida Tool & Hardware Co., 1333 San Pablo Ave., Berkeley, 94702. (415) 524-3700.
Juried show—West Coast Woodworking open juried furniture show, July. Highlight Gallery. Send SASE for prospectus to Highlight Gallery, Box 1515, Mendocino, 95460, or call (707) 937-3132.

COLORADO: **Workshops**—17 one- and two-week summer workshops, the 1988 furniture design symposium "Making a Living," and a weekend workshop with Sam Maloof, June–August. Anderson Ranch Arts Center, 5263 Owl Creek Road, Box 5598, Snowmass Village, 81615. (303) 923-3181.

CONNECTICUT: **Juried show**—31st annual crafts exposition, July 14–16. Historic Guilford Green; 12 P.M. to 5 P.M. For information, write Guilford Handcrafts Expo., Box 589, Guilford, 06437, or contact Fernn Hubbard or Joyce Wright at (203) 453-5947.
Exhibition—"Four Rising Stars" wood vessels by Dan Kvitka, Stoney Lamar, Michael Peterson and Peter Petrochko, April 30–May 29. New work by David Ellsworth, June 4–26. Gallery hours: Thurs. thru Sun. 12 P.M. to 5 P.M. Mendelson Gallery, Titus Square, Washington Depot, 06794. (203) 868-0307.
Exhibition—"Container Exhibit," national juried craft exhibition, May 4–24. The Mill Gallery, Guilford. For more information, contact Guilford Handcrafts, Inc., Box 589, Guilford, 06437. (203) 453-5947.
Workshops—Lamination by Jere Osgood, May 14–15; furniture construction by Robert March, Apr. 30–May 1; furniture design for alternative materials by Peter Handler, Apr. 23–24; and making a shoji screen by Toshio Odate, May 21–22. Brookfield Craft Center campus. For info. and/or catalog, write or call the Brookfield Craft Center, Box 122, Brookfield, 06804. (203) 775-4526.

DISTRICT OF COLUMBIA: **Presentation/lecture**—Free slide presentation and lecture by master woodworker Tage Frid, Apr. 24. Renwick Gallery from 3 P.M. to 5 P.M. For info., contact Mogul Gallery, 2114 R St., N.W., 20008. (202) 328-8222.
Juried show—1988 Washington Craft Show, Apr. 22–24. Departmental Auditorium, 1301 Constitution Ave., N.W. Featuring more than 100 artists; general admission $5. Contact Smithsonian Visitor Information and Associates' Reception Center at (202) 357-2700.

GEORGIA: **Workshops**—Making Shaker boxes, John Wilson, Apr. 22–23; making a block plane, John Wilson, Apr. 23–24; making a Windsor chair, Michael Dunbar, Apr. 30; and getting the most out of your tablesaw, Brad Packard, May 7. Contact Highland Hardware, 1045 N. Highland Ave., Dept. F, Atlanta, 30306. (404) 872-4466.

IDAHO: **Juried show**—20th annual "Art on the Green" festival, Aug. 5–7. Deadline for entries, July 21. For entry blanks, contact Citizens Council for the Arts, Box 901, Coeur d'Alene, 83814.

ILLINOIS: **Class**—Simon Watts' building the Herreschoff pram, Apr. 23–30. Contact Bruce Helmreich, RR#3, Quincy, 62301. (217) 434-8742.
Juried show—9th annual Fountain Square Arts Festival, Jun. 25–26. Outdoor show. For more information, contact the Evanston Chamber of Commerce, 807 Davis St., Evanston, 60201. (312) 328-1500.

INDIANA: **Show**—Madison Heritage Days festival, June 3–5. Pioneer crafts of the pre-industrial era staged along Madison's historic river frontage on the banks of the Ohio. For more info., write 1119 W. Main St., Madison, 47250. (812) 265-5080.
Exhibition—"American Folk Art: Expressions of a New Spirit," Apr. 30–Jul. 5. Conner Prairie, Noblesville. Exhibition from the Museum of American Folk Art's permanent collection. Contact Susan Flamm, 444 Park Ave. S., NYC, NY 10016. (212) 481-3080.
Show—Hand-Crafted Wood Furniture, Sept.'88. Chesterton Art Gallery. Slide deadline Jun. 30. Send SASE for more information to Marsha Demkovich, Chesterton Art Gallery, Box 783, Chesterton, 46304. (219) 926-3041.

IOWA: **Show**—Holzfest '88, Aug. 20–21. Colony Village Restaurant, I-80 Amana Exit 225; Sat. 9 A.M. to 8 P.M., Sun. 10 A.M. to 5 P.M.; no admission. Exhibitors' product line must have at least 80% wood content. For information on Holzfest and also the Rural Crafts Fair arts and crafts section of the World Ag Expo, Sept. 7–10, write Holzfest, Box 193, Amana, 52203 (Administrator RC) or call (319) 622-3100; (319) 668-1223 (on event day).
Juried show—18th annual "Art in the Park," May 14–15. Four Square Park on Main Ave., Clinton. For more info., write the Clinton Art Assoc., Box 132, Clinton, 52732, or call Carol Glahn at (319) 259-8308.
Show—13th Old-Time Country Music Contest & Festival and Pioneer Exposition of arts and crafts, Aug. 31–Sept. 5. Pottawattamie County Fairgrounds. Exhibitors' deadline for open space is Aug. 15. For information and reservation forms, write Bob Everhart, director, 106 Navajo, Council Bluffs, 51501.
Competition—22nd International Woodcarvers' Congress, June 23–26. Featured exhibitor will be one of China's most famous wood sculptors and painters, Ma Hai Feng. Putnam Museum. For info. on competing at the "Congress," seminars or Mr. Ma's exhibit, write AWC Ltd., Box 10408, Bettendorf, 52722, or call Larry Yudis at (319) 359-9684 (days).
Classes—Various woodworking and leatherworking classes, April thru Aug. Vesterheim, Decorah. Contact the Norwegian-American Museum, 502 W. Water St., Decorah, 52101. (319) 382-9681.

KANSAS: **Juried show**—Dimensions '88, 4th annual nat'l 3-dimensional art show, May 13–15. Outdoor show, Lenexa's Sar-Ko-Par Park. For information, contact William H. Nicks, Jr., show director, City of Lenexa, 12350 W. 87th St. Parkway, Lenexa, 66215.

KENTUCKY: **Meeting/Exhibit**—Kentucky Woodworkers Assoc. meeting, May 21. Windsor chairmaking aspects at 3 P.M. Annual KWA exhibit, June 17–19. 10 A.M. to 5 P.M. The Unfinished Universe, 525 W. Short St., Lexington, 40508. (606) 252-3289.
Symposium—Berea College Wood Symposia 1988. Woodturning/sharpening, May 26–28; joinery/finishing May 31–June 4. Cost: $175 and $200 respectively. Enrollment limited to 30. For registration info., contact James R. Hall, CPO 758, Berea, 40404. (606) 986-9341, ext. 5503 (office); (606) 986-8083 (home).

LOUISIANA: **Juried show**—13th annual fall crafts festival, Sept. 21–23. Outdoor show, North Blvd., Baton Rouge. Booth fees: $100–$110. Application deadline is July 15. For prospectus, send SASE to River City Festivals Assoc., 427 Laurel St., Baton Rouge, 70801, or call (504) 344-3328 for more information.
Show—FestForAll'88 and FestForAll Gallery Show, May 20–23. FestForAll will be held downtown, North Blvd.; gallery show at Baton Rouge Gallery in City Park, opening reception 7 P.M. to 9 P.M., May 21. For more info., contact Gina Castle, River City Festival Assoc., at (504) 344-3328.

MAINE: **Workshops**—2- and 3-week summer craft classes, June 5–Sept. 2. For detailed course info., faculty and workshop listings and fee info., write Haystack Mountain School of Crafts, Deer Isle, 04627-0087 or contact Howard M. Evans, director, at (207) 348-2306.
Classes—Post & beam building, Sept. 18–23, and 2- & 3-week design and build classes through Nov. For specific class dates and more information, contact Shelter Institute, 38 Centre St., Bath, 04530. (207) 442-7938.

MARYLAND: **Show**—11th Annual Spring Crafts Festival, Apr. 29–30 & May 1. Maryland State Fairgrounds, Timonium. For detailed information, send 66¢ to Deann Verdier, director, Sugarloaf Mountain Works, Inc., 20251 Century Blvd., Germantown, 20874. (301) 540-0900.
Juried show—25th annual Havre de Grace Art Show, Aug. 20–21. Tydings Memorial Park, 10 A.M. to 5 P.M.; free to public. Applications require photos or slides. Call (301) 879-4404 or 939-3303, or write Box 174, Havre de Grace, 21078.

MASSACHUSETTS: **Workshops**—Cabinetmaking, Apr. 25–29; finish carpentry, May 9–13 & June 13–17; comprehensive housebuilding, May 16–June 3 & June 20–July 8; timber framing, July 11–15 & Aug. 15–19. For information and other workshop dates, contact Heartwood Owner-Builder School, Johnson Road, Washington, 01235. (413) 623-6677.
Juried exhibition—"The Craft of Containment: Vessels in All Media," July 22–Sept. 18. Berkshire Museum, Pittsfield. 2 slides for each entry, maximum of 3 entries; $5 fee. Deadline: May 11. Contact The Berkshire Museum, "The Craft of Containment," 39 South St., Pittsfield, 01201. (413) 443-7171.
Craft fair—1988 American Craft Council (ACC) Craft Fair for wholesale buyers, June 21–23. Eastern states exposition. For more info., buyers may call the buyers-only phone at (800) 527-3844; in NY and outside the U.S., call (914) 255-0039 between 9 A.M. and 5 P.M. EST.
Workshops—"Woodbending: An Introduction to Working in Solid Wood," Apr. 27 & 28. Intensive 3- and 6-week summer sessions for high-school students. Contact Horizons: The New England Craft Program, 374 Old Montague Road, Amherst, 01002. (413) 549-4841.
Exhibitions—"Massachusetts Craftspeople," a series of multi-media exhibitions and studio workshops, Jan. 19 thru June 30. Contact Signature, Fine Art & American Crafts for details: Village Market Place, Hyannis, 02601, (617) 771-4499; Dock Square, North St., Boston, 02109, (617) 227-4885; and The Mall at Chestnut Hill, Chestnut Hill, 02167, (617) 332-7749.
Juried show—3rd annual Crafts at the Castle, Dec. 2–4. Park Plaza Castle, Boston. Application deadline: May 16; fees: $300–$350; application fee: $15. Contact Andrea Brown, Family Service of Greater Boston, 34½ Beacon St., Boston, 02108. (617) 523-6400, ext. 505.
Show/Workshop—9th annual miniature show and sale, Aug. 21; workshops, Aug. 20 from 10 A.M. to 5 P.M. For details and advance registration, send SASE (business) to Cape Cod Miniature Society, Box 691, Hyannis, 02601.
Workshop—Wood identification workshop by Dr. R. Bruce Hoadley, June 7–10. Cost: $235; registrations accepted until class of 20 is filled. Univ. of Mass./Amherst. For info./registration, contact Trudie Goodchild, Div. of Continuing Ed., Goodell Bldg.–Room 608, Univ. of Mass., Amherst, 01003. (413) 545-2484.
Craft fair—18th annual, May 20–22. Worcester Center for Crafts. Contact Craft Fair Registrar, Worcester Center for Crafts, 25 Sagamore Rd., Worcester, 01605. (617) 753-8183.
Workshops/seminars—Numerous events. Contact The Woodworkers' Store, 2154 Massachusetts Ave., Cambridge, 02140. (617) 497-1136.
Juried show—"Art at Work," handmade furniture for the office. Slides due May 15; entry fee of $15. Send up to 6 slides, fee and SASE to The Society of Arts and Crafts, 175 Newbury Street, Boston, 02116. (617) 266-1810.

MICHIGAN: **Exhibition**—"An Art of Deception: American Wildfowl Decoys," May 15–July 9. Midland County Historical Society, Midland. Contact Susan Flamm, 444 Park Ave. S., NYC, NY 10016. (212) 481-3080.
Juried show—Woodworking '88, Oct. 27–30. Application deadline: July 1. For application, write Somerset Mall, 2801 W. Big Beaver Road, Troy, 48084. (313) 643-6360.

MINNESOTA: **Juried show**—6th annual Upper Midwest Woodcarving Exhibition, July 25–30. Blue Earth. For info., contact Harley Schmitgen, 311 E. 14th St., Blue Earth, 56013. (507) 526-2777.
Workshops/seminars—Numerous events. The Woodworkers' Store, 3025 Lyndale Ave. S., Minneapolis, 55408. (612) 822-3338.
Classes/Seminars—Woodcarving, woodturning, tool sharpening. Write for schedule. The Wood Carving School, 3056 Excelsior Blvd., Minneapolis, 55416. (612) 927-7491.

MISSOURI: **Show**—Works Off The Lathe: Old and New Faces '88, July 10–Aug. 16. Craft Alliance Gallery, St. Louis. Tues. thru Fri. 12 P.M. to 5 P.M. and Sat. 10 A.M. to 5 P.M. For more info., contact Barbara Jedda, gallery director; Valerie Miller, education director; or Albert LeCoff, director of the Wood Turning Center, at (215) 844-0151.

MONTANA: **Festival**—Western Montana College Industrial Arts Department's Annual Festival of Arts and Industry, Apr. 29–30. Includes cabinetmaking, woodcarving and woodturning; 9 A.M. to 7 P.M. Contact Western Montana College, Dillon, 59725. (406) 683-7011.

NEW HAMPSHIRE **Exposition**—11th Annual Pratt Summer Creative Arts Institute, June 26–July 19. Lincoln. For more info., write or call Leslie Abrams, chairperson, Creative Arts Therapy Dept., 200 Willoughby Ave., Brooklyn, NY, 11205. (718) 636-3428.

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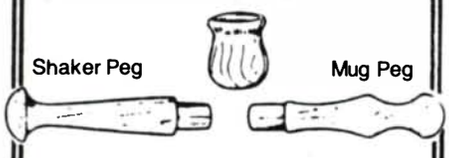

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Woodcarvers, June 20–24. Handcarving instructors include Joan & Jim Seibert, Harry Shourds, Anthony Hillman & Elmer E. Jumper; $125 for each carver (excluding materials). Convention Hall on the boardwalk, Cape May. Contact Elmer E. Jumper, 142 DiMarco Drive, Philadelphia, PA, 19154. (215) 637-8128.
Show–8th annual South Jersey Wood Carvers Show, June 4–5. Wheaton Village, Millville. 10 A.M. to 5 P.M. For info., contact Jack Raleigh, chairman, 716 Wood Lane, Cinnaminson, 08077. (609) 829-8731.
Show–Annual Gallery Focus: Mary Lou Higgins–Recent Work, June 11–July 9. Sheila Nussbaum Gallery, 358 Millburn Ave., Millburn. Open Tues. thru Sat. 10 A.M. to 5 P.M. and Thurs. 10 A.M. to 8 P.M. For more information, call (201) 467-1720.

NEW YORK: **Juried show**–Chautauqua Crafts Festival '88, July 2–4, Aug. 12–14. Bestor Plaza, Chautauqua Institution. Application and slides deadline: May 1; application fee: $5; 4 slides of each media entered. For application, send SASE to Gale Svenson, director, Chautauqua Crafts Festival '88, Box 89, Mayville, 14757.
Juried show–1988 I.A.C. Annual International Art and Craft Competition, including wood and furniture. Deadline: May 26. Winners will be exhibited in two Soho, NYC galleries, Aug. 4–25. For applications, write I.A.C., Dept. PRR, Box 245, Eastchester, 10709. (914) 699-0969.
Exhibition–Architectural Art: Affirming the Design Relationship, May 12–Sept. 4. American Craft Museum, NY. Admission: $3.50 adults; Tues. 10 A.M. to 8 P.M., Wed. thru Sun. 10 A.M. to 5 P.M.. Contact the Museum Education office for special events at (212) 956-3535. American Craft Museum, 40 W. 53rd St., New York, 10019.
Juried show–New Paltz arts & crafts fairs, May 28–30 & Sept. 3–5. Ulster County Fairgrounds, New Paltz. Holiday crafts fair at Old Westbury, Jul. 2–4. Ambrose Clark Estate, SUNY College at Old Westbury. Contact Scott & Neil Rubinstein, Quail Hollow Events, Box 825, Woodstock, 12498. (914) 679-8087, 246-3414.
Workshops–Hand-tool workshops by Robert Meadow, Apr. 9–10, 23–24; May 7–8, 21–22. Cover Japanese tools, sharpening techniques, joinery, furnituremaking, instrumentmaking. The Luthierie, 2449 W. Saugerties Road, Saugerties, 12477. (914) 246-5207.
Juried show–The Lilac Art Show, May 14–15. Highland Park, Rochester. Show, sale and demos. Contact Arts For Greater Rochester, 335 E. Main St., Suite 200, Rochester, 14604. (716) 546-5602.
Juried show–12th Annual American Crafts Festival, July 2–3, 9–10. Lincoln Center, NYC. Contact Brenda Brigham, American Concern For Artistry and Craftsmanship, Box 650, Montclair, NJ. (201) 746-0091.
Juried show–5th Annual Autumn Crafts Festival, Aug. 20–21, 27–28, Sept. 3–5. Lincoln Center, Fordham Univ. Plaza, NYC. Contact Brenda Brigham, American Concern For Artistry and Craftsmanship, Box 650, Montclair, NJ. (201) 746-0091.
Exhibition–11th Annual Wood Carving Exhibition, May 7–8. Free admission, non-juried, by the Southtowns Wood Carvers of Western NY. Creative Arts Building, Erie County Fair Grounds, Hamburg.
Exhibition–"Joseph's Coat: 1111 Stripes," constructions, sculpture and drawings in wood and painted canvas by Basha Ruth Nelson, May 17–June 5. Contact the Noho Gallery, 168 Mercer St., NYC, 10012. (212) 473-9619.
NORTH CAROLINA: **Workshops**–5- and 6-day-long classes in 11th annual summer program, June thru August. For details, contact Drew Langsner, Country Workshops, 90 Mill Creek Road, Marshall, 28753. (704) 656-2280.
Juried show–"NC Showcase of Visual Art," May 20–22. Raleigh Civic Center. Contact Gail Gomez, High Country Crafters, 19 Haywood St., Asheville, 28801. (704) 254-7547 or 254-0070.
Juried show–13th annual "Highland Heritage Art & Craft Show," June 16–19. Asheville Mall. Contact Gail Gomez, High Country Crafters, 19 Haywood St., Asheville, 28801. (704) 254-7547 or 254-0070.
Classes–Woodworking with a strong emphasis on design techniques by Leo Doyle, Apr. 25–May 13. For detailed information on courses and scholarship opportunities, write Registrar, Penland School, Penland, 28765, or call (704) 765-2359.

OHIO: **Workshop**–Equipment Maintenance and Repair, June 13–18. Sponsored by Bowling Green State Univ. & Ornamental Products Tool & Supply Co., Cleveland. Contact BGSU, Dept. of Technology Systems at (419) 372-2439.
Class–Building the Chamberlin Dory-Skiff by Simon Watts, June 25–July 2. Marietta. For more information, contact James Stephens, 425 Mulberry St., Marietta, 45750. (614) 374-6997.
Workshop–Spray finishing technology workshop, May 9–13. Technical Training Center of the DeVilbiss Co., World Headquarters, Toledo. Contact Judy Jennings at (419) 372-2439 or write her at the College of Technology, Bowling Green State Univ., Bowling Green, 43403.
Show–The Great Lakes wood carving exhibit, May 14–15. Brooklyn Recreational Center. For exhibition information, contact Ed Katzenmeyer, 116 Goodhue Drive, Akron, 44313. (216) 864-0784.

OKLAHOMA: **Show**–12th annual national woodcarving show, July 8–10. Kensington Galleria shopping mall, 71st and S. Lewis, Tulsa. Sponsored by the Eastern Okla. Woodcarvers Assoc. For more information, contact Tom R. Ferguson, show chairman, 3421 S. 95th East Ave., Tulsa, 74145. (918) 627-5169.

OREGON: **Workshops**–Four Sunday woodworking seminars, Mar. 28–June 4. 10-week classes and numerous short courses also available. For more info., write Oregon School of Arts & Crafts, 8245 S.W. Barnes Road, Portland, 97225. (503) 297-5544.
Exhibition–"An Art of Deception: American Wildfowl Decoys," July 9–Sept. 2. Portland Art Museum, Portland. Contact Susan Flamm, 444 Park Ave. S., NYC, NY, 10016. (212) 481-3080.
Exhibitions–Numerous shows, exhibitions. The Gallery, World Forestry Center, 4033 S.W. Canyon Road, Portland, 97221. (503) 228-1367.

PENNSYLVANIA: **Juried show**–Pocono Crafts and Arts Festival, June 25–26. On the grounds of the Shawnee Inn Resort; 10 A.M. to 6 P.M.; adults $3, children under 12 free. For more info., contact Penn. Designer–Craftsmen, Box 718, Richboro, 18954. (215) 860-0731.
Workshops–Numerous workshops in all craft media, June thru Aug. Contact Pioneer Crafts Council, Box 2141, Uniontown, 15401. (412) 438-2811.
Juried Show–2nd Annual Studio Days–Design '88, quality design in all crafts. Chester Springs Studio, Chester Springs. Juried by 5 slides; application needs to be postmarked by June 20; fee $10. Contact the Chester Springs Studio, Box 374, Chester Springs, 19425. (215) 827-7277.
Seminars–Drew Langsner, building a ladder-back chair, Apr. 30 & May 1; women in woodworking, May 7; Toshio O'Date, hands-on shoji screen, May 13–15; basketmaking with Martha Weatherbee, May 21–22; antique finish with Prew Savoy, June 4; and finishing and refinishing with Bess Naylor, June 18. Olde Mill Cabinet Shoppe, York. Contact Bess Naylor at (717) 755-8884.
Workshops–Numerous workshops, exhibits and shows through Dec. 4. For information, contact Penn. Guild of Craftsmen, Box 820, Richboro, 18954. (215) 860-0731.
Juried show–12th Annual Philadelphia Craft Show, Nov. 10–13. Armory in W. Philadelphia. Application deadline: May 1. Requires 5 slides; booth fees of $400 (inside) and $500 (corner). Contact Women's Committee of the Philadelphia Museum of Art, Box 7646, Philadelphia, 19101-7646. (215) 787-5448.
Conference/Fair–Timber Framer's Guild of N.A. 4th annual conference & trade fair, June 9–12. Elizabethtown. For information, write Box 1046, Keene, NH 03431 or call (603) 357-1706.
Show–"Symposium 88–A national exposition of stringed musical instrument making and repair," June 9–12. Registration deadline: May 30. The Morris R. Williams Center for the Arts, Lafayette College, Easton. All inquiries and application requests, send SASE c/o Dick Boak & Susan Ellis, symposium coordinators, 14 S. Broad St., Nazareth, 18064. (215) 759-7100 (evenings).
Classes/Show–Realistic bird carving, June 20–24; relief woodcarving, July 4–8; woodcarving in the round, July 11–15; 4th annual woodcarving show, July 9–10. Sawmill Center for the Arts, Cook Forest State Park, Cooksburg. For brochure, write Sawmill Center for the Arts, Box 6, Cooksburg, 16217.
Workshops–Basic woodturning with Palmer Sharpless, May 6–8; birdcarving with Bill and Grace White, May 13–15. For info., contact The PA Guild of Craftsmen, Box 820, Richboro, 18954. (215) 860-0731.
Exhibition–Wharton Esherick Museum, sculpture, furniture, utensils from 1920–1970, daily. For reservations or directions, write or call The Wharton Esherick Museum, Box 595, Paoli, 19301. (215) 644-5822.

SOUTH DAKOTA: **Exhibition**–The Guild of American Luthiers' 11th national convention/exhibition, June 16–19. Featuring lectures, demos, and exhibitons of handmade instruments and sale of instrumentmaking wood. Univ. of South Dakota in Vermillion. Contact, Guild of American Luthiers, 8222 South Park, Tacoma, WA 98408. (206) 472-7853.

TENNESSEE: **Classes**–1- and 2-week wood workshops, June 6–Aug. 8. For information or a summer brochure, write Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, 37738. (615) 436-5860.
Demonstration/Workshop–Woodturning, Ernie Conover and Rude Osolnik, May 7–8. Contact East Tenn. Woodworkers' Guild, Dan Duncan, Box 5282, Knoxville, 37918. (615) 922-9627.
Juried show–Master furnituremakers show, Dogwood Arts Festival, April 22–24. Open to individuals and those representing woodworking schools. Contact the Dogwood Arts Festival, 203 Fort Hill Bldg., Knoxville, 37915. (615) 637-4561.

UTAH: **Juried show**–47th annual multi-media art exhibition, Celebration '47, Apr. 14–May 6. Braithwaite Gallery, S. Utah State Coll. Cedar City Art Committee, Iron County School District, Box 879, Cedar City, 84720.

VERMONT: **Exhibitions**–For listing of special exhibitions, retail gallery info., craft instruction programs, classes and workshops, write Vermont State Craft Center at Frog Hollow, Middlebury, 05753. (802) 388-3177.
Exhibition/sale–Exhibit and sales space available in year-round open market for arts, crafts and antiques. Kennedy Brothers Marketplace. Contact Win Grant, Kennedy Bros., 11 Main St., Vergennes, 05491. (802) 877-2975.

VIRGINIA: **Juried show**–13th annual Richmond Craft Show, Nov. 19–22. Richmond Centre for Conventions and Exhibitions. Application fee: $10; slides due June 1. For more info. and/or application forms, call or write the Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.

WASHINGTON: **Seminar**–Annual Kasha Design seminar with luthier Richard Schneider for interested guitarmakers, Aug. 6–14. Write Todd Bryant, Lost Mountain Center for the Guitar, Box 44, Carlsborg, 98324.
Seminars–Artistic & traditional turning, sharpening, design. Group sessions last Sat. of each month; private sessions by appt. The International School of Woodturning, Seattle. Contact Shawn Christman for brochure or to sign up, 647 S. Alaska St., Seattle, 98108. (206) 587-5354.
Symposium–Woodcarvers' symposium featuring workshops, artisan action & works for sale, June 24–26. The Methow Valley, Washington State. For application, write the Methow Arts Alliance, Box 723, Twist, 98856. Contact Dick Ewing (509) 996-2098 or Richard Wrangle (509) 997-0071.
Workshops/Show–Quick and simple plywood pram, June 13–18 & Aug. 1–5; Maine guide canoe, July 11–23; lapstrake boatbuilding the "Lawley Tender," Aug. 20–27. Also, Lake Union Wooden Boat Festival, July 2–4. Contact The Center for Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-BOAT.
Workshop/Seminar–A number of workshops and seminars offered throughout the year. Paints and finishes, May 7; caulked and canvas decks, May 21; spar making, June 4. For information, contact Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.
Show–"Chairs," a gathering of NW-style seating by local designer/craftsmen, May 5–28; "Creations in Precious Materials," by Emmett Day, June 2–26. Northwest Gallery, 202 First Ave. S., Seattle, 98104. (206) 625-05452.
Workshops/demonstrations–Tools-In-Action series, free, every Saturday, 10 A.M. Boatbuilding, woodcarving, sharpening, other woodworking topics. The Wooden Boat Shop, 1007 N.E. Boat St., Seattle, 98105. (206) 634-3600.

WEST VIRGINIA: **Exhibition**–Exhibition of work and seminar by traditional furnituremakers on making a living in the woodworking field, June 25–August 21. Seminar on June 25, 12 P.M. to 3 P.M.; $3 fee. Contact John Ellis, Stifel Fine Arts Center, 1330 National Road, Wheeling, 26003. (304) 242-7700.
Workshops–Augusta Heritage Arts Workshops, July 10–Aug. 12. For info., write Augusta Heritage Center, Davis & Elkins College, Elkins, 26241-3996. (304) 636-1903.

WISCONSIN: **Festival**–6th Annual Festival of Crafts, June 18–26. Sponsored by Center for Craftsmanship, Univ. of Wisc.-Stout, Menomonie. For info., contact Nancy Blake or Jim Bjornerud, 245 Tech Wing, Jarvis Hall, UW-Stout, Menomonie, 54751. (715) 232-1102 or 962-3062.

CANADA: **Show**–Wood '88, May 28–June 5. The Saskatchewan Woodworkers' Guild's 10th annual exhibition of fine works. Sedco Centre, Innovation Place, Saskatoon, Saskatchewan. Admission: free. Contact Denis Murphy, show coordinator, (306) 477-0158 (evenings).
Show–Craft Focus 3 slide competition of craft works in all media. Deadline for receipt of entries, June 15. Open to all members of the Ontario Crafts Council in Canada and non-members living in Ontario. For entry forms and details, contact Ontario Crafts Council, 346 Dundas St. W., Toronto, M5T 1G5. (416) 977-3551.
Exhibition–Woodworking exhibition, as well as a series of lectures/demos by Tage Frid, May 17–28. N.S. College of Art and Design, Anna Leonowens Gallery. For information, contact Valda A. Kemp, Atlantic Woodworkers' Assoc., Box 3501, Halifax, NS, B3J 3J2.
Workshops–1987-88 workshop series. Mixed media & business topics. Contact Anne Fox, New Brunswick Craft School, Ecole d'Artisanat du N-B, Box C/P6000, Fredericton, N.B., E3B 5H1. (506) 453-2305.
Exhibition–"Summer Celebration '88," a mixed media of fine Canadian crafts, including songbird wood carvings by Joanne Mallen, June 23–Sept. 7. Heritage Crafts, Sheridan Mews, 182-186 King St. W., Brockville, Ont., K6V 5Y4. (613) 342-2521.

EUROPE: **Trip**–Timber-framers' tour, sponsored by Mafell N. America Inc., tentatively scheduled for June. For information, contact Mafell N.A., Inc., Box 363, Lockport, NY 14094. (716) 434-5574.

ITALY: **Study tour**–Seminar on Italian furniture with George Frank, Oct. 12–26. Visits to craft, art and restoration centers of Milan, Verona, Florence and Rome; and seminars on the artistic Renaissance furniture made in the Tuscany craft centers. For details, write Eva Frank, 3504 Beneva Rd., Sarasota, FL, 34232. (813) 923-3377.

SWITZERLAND: **Tour**–Woodworking tour hosted by Gottlieb Brandli, Sept. 6–20. Departs from Boston, New York or Chicago; $2,600 per person. For details, call (800) 521-7623 (outside N.H.). The Image Group, 1575 Logan St., Clearwater, FL, 34615. (813) 447-3050.

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Wood Handbook: Wood as an Engineering Material by Forest Products Laboratory, U.S. Dept. of Agriculture. ***Superintendent of Documents, U.S. Government Printing Office, 710 N. Capitol St., Washington, D.C. 20402; 1987. $27, paperback; 466 pp.***

This book is a real gem, and it seems to get better the more you use it. Twelve years ago when I bought my first copy, *Wood Handbook: Wood as an Engineering Material* had just been revised and republished. What a relief to wood enthusiasts who were rumored to be paying several hundred dollars for the previous edition. The new edition is even better. There is a problem though.

Before one can use this handbook effectively, one really needs to know something about wood. The more you know, the more you can learn. This book is packed with information, distilled and condensed, refined and compressed. No organization can collect information like the Federal Government. This is the definitive reference on wood. Before a woodworker goes wading through this handbook, he should have plowed through Tage Frid's books, Ernest Joyce's encyclopedia and a few books on design. Then, the information and format presented here will give a serious scholar a matrix to understand wood and how its properties are a function of internal and external forces.

When I experimented with ammonia woodbending, it was the *Wood Handbook* (published as *Agriculture Handbook No. 72*) I referred to: not on how ammonia affected wood, but on how to bring the wood to the right equilibrium moisture content, what woods to bend and what property changes to expect. The chapter on bonding dispelled the myths of the pagan gluing rituals. Now I know the importance of wood moisture content, the moisture added by the adhesive, the importance of open time, closed time and clamp time, and that too much clamping pressure can be as harmful as too little pressure. I found the section on wood grading very interesting but not helpful.

Another good section is on the characteristics and availability of wood commercially used in the United States. A brief description of a hundred or so woods along with synonyms and Latin names fills the first chapter. The glossary section is a comprehensive collection of wood buzz words along with explanations. You too can now know the difference between a bole and a bolt and find out once and for all that a son of a birch is an angiosperm and not a gymnosperm.

Several sections are devoted to the engineering properties of wood and are more useful to architects and contractors than to woodworkers. Even these sections give guidance to woodworkers in terms of strength properties. The mathematical modeling is impressive, if not intimidating, and of use to only a limited segment of people involved with wood.

Not everything you know about wood is in here, but you will certainly be humbled by all you don't know. Considering its modest price, this book should be included in every serious woodworker's library. ***–Huff Wesler***

Creating Small Wood Objects as Functional Sculpture by Dona Z. Meilach. ***Crown Publishers, Inc., 225 Park Ave. S., New York, N.Y. 10003; 1987. $14.95, paperback; 288 pp.***

The title *Creating Small Wood Objects as Functional Sculpture* implies that this is a technical manual, and the cover notes reiterate this. We anticipate learning how to make objects for ourselves, but the book doesn't deliver this information. It is a thick volume of shallow content. My impression is that the author obtained lists of names and wrote off to craftspeople asking for photographs and information, and then published anything printable.

Technical information is scant and frequently downright misleading or dangerous. Terminology is misapplied, and this must confuse any novice delving further into a particular area. For example, on p. 44 we are assured that a lathe spur drive is actually known as a "live" center. This term has usually been applied to a revolving tail center, but maybe we turners will have to adjust to the new terminology if this book sells in quantity.

Clearly no aesthetic judgements have been made concerning the objects included in these pages, and there is virtually no comment other than the occasional platitudinous adjective. It seems Meilach doesn't like to state an opinion, especially while giving credibility to all manner of hideous trivia that should not be brought before public gaze. By setting these objects up as heights to which we might aspire, the author does nothing to improve the already pitiful standards of wood design. Meilach does not seem to realize that novelty and pretty grain are not art, for she compounds this infamy by referring to the creators as artists, when several of the "artists" demonstrating techniques manifestly don't even make the grade as craftsmen. This would be laughable except for the fact that credibility is often gained through publication.

This book might spark off a few ideas, but mostly it will remain a record of some of the bizarre things some woodies got up to in the privacy of their own workshops in the latter part of the 20th century. ***–Richard Raffan***

Making Wood Toys That Move by Alan and Gill Bridgewater. ***Sterling Publishing Co., Inc., 2 Park Ave., New York, N.Y. 10016; 1987. $8.95, paperback; 126 pp.***

Weekend Wood Projects for Toymakers by Jeff Burke, Ron Fuller, Dik Garrood and Fiona Nevile. ***Sterling Publishing Co., Inc., 1987. $9.95, paperback; 144 pp.***

After carrying out a survey to determine how detailed their instructions should be in *Making Wood Toys That Move*, the Bridgewaters report that "all (these parties) agree that yes, yes, yes! definitions, descriptions and details on everything from 'pivots' to 'prototypes' are possibly a bit tedious, but nevertheless, they are necessary." These things *are* necessary in a toymaking book, and the Bridgewaters cover them thoroughly.

Without pedantry or condescension, the text covers every possible problem of construction related to the projects. It manages the difficult feat of telling the reader everything while maintaining great respect for the reader's creativity and common sense.

Even better, the toys are fun. They're fun to make and fun to play with, and they should sell very well. The toys are made of simple materials (chiefly plywood, glue and paint), but require enough precision in the location of the moving parts to make their construction challenging and interesting. They are the kinds of toys kids love to play with, but are complex enough to catch the attention of the adults that buy them.

The instructions in the text are the best possible. Each stage of construction is formated in its own box on the page, making the directions very easy to follow. With this arrangement, there'll be no missed steps because you lost your place in the text. Moreover, each toy has precisely the information needed for completion of that toy: "Thoughts on the project," "Considering the Project," "Materials," "Tools" and "Afterthoughts," a section that tells you what to do if the fool thing won't work.

The book's only drawback is its lack of color plates. It has no color pictures except those on the cover. Even so, this is one of the best books out on moving toys.

Burke et al. have written a delightful book as well. All of the toys in *Weekend Wood Projects for Toymakers* are guaranteed child, and adult, pleasers. The instructions are clear, and each

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project includes a complete, specific cutting list, which is extremely handy. Even better, the book is printed in a four-color format, and each page has full-color illustrations and photographs.

The instructions are not quite as basic as those in the Bridgewaters' book. Burke et al. assume a little more woodworking skill and knowledge. Still, the text gives you all the information you really need to know. There are 20 projects in the book, and you couldn't go wrong in making any of them.

One note, however: The authors of this book are British, and apparently, British softwood is sized differently than American wood. All of the plans assume that softwood boards are ⅝ in. thick, not ¾ in. thick. This means you need to think through the projects in your mind before you do any cutting so you make the appropriate adjustments. This is always a good idea, of course, but for these projects, it's essential.

If you like toys, buy these books. If you can only afford one, flip a coin and get your best friend to buy the other one. Either of these books would be a valuable addition to any woodworker's library, and your kids will love the toys. *—Richard Griffin*

Shelves, Closets & Cabinets by Peter Jones. ***Popular Science Books; distributed by Sterling Publishing Co., Inc., 2 Park Ave., New York, N.Y. 10016; 1987. $12.95, paperback; 304 pp.***

This large-format book with an attractive jacket will be of more use to the home handyman and do-it-yourselfer than to the woodworker concerned with a nice use of tools, advanced joinery and fine furniture.

Shelves, Closets & Cabinets contains a large number of clearly illustrated designs for all types of storage facilities ranging from bookshelves to display cases to closets—under eaves, in corners and in walls. Innumerable cabinets, hampers, boxes, racks, and basic face-framed kitchen cabinets, rolling modules, storage towers, and pullout pantries are also covered. A section entitled "Cabinets That Are Furniture" includes items such as a basic credenza, a military chest and twin etageres.

The majority of these projects are intended to be constructed largely of "glue-screwed" plywood, although a chapter on the basics of veneering, commercially available inlay, lumberyard molding and trim is included for those who might wish to upgrade the finish product. The chapters on joinery are written for those equipped primarily with a tablesaw, router and drill press, although a "dovetail-and-rabbet" joint illustrated in the section on drawermaking would seem to require the techniques of a 19th-century French ebeniste.

Although the author declares in the introduction that "this book is not for the occasional handyman who puts up a shelf once every three years, if he is pressured to do so. This is a book for the dedicated craftsman...," it will prove to be of more use to the homeowner with a few power tools in the garage for whom "the discussions of the various ways to conceal imperfections...will help...achieve a broader frame of mind when approaching any project." *—Graham Blackburn*

Richard Raffan is a professional turner, mostly mass producing one-off bowls. He lives in Canberra, Australia. Huff Wesler is an engineering manager and a chemical engineer. He lives in Springfield, Mass. Richard Griffin is an amateur woodworker, a minister and a former librarian. He lives in Sumner, Neb. Graham Blackburn is a contributing editor to FWW*, and his shop is in Santa Cruz, Calif.*

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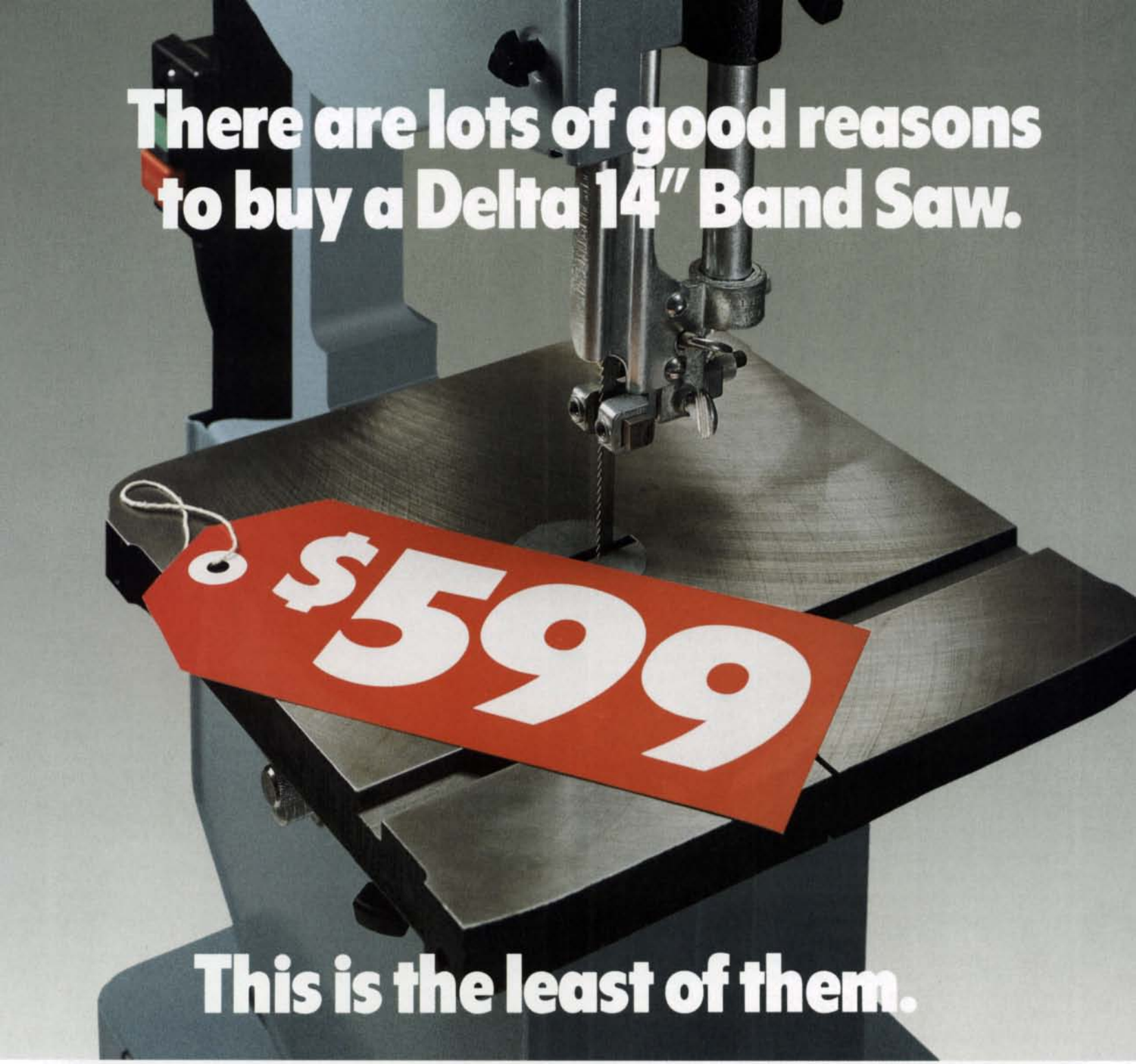

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Building On Tradition

Photo: Michele Russell Slavinsky

Pencils are made from clear incense cedar slats cut from California trees that are 250 to 300 years old. Nine pencil leads are glued up between two cedar slats. The glued-up slats are shaped and then cut apart to make nine pencils.

Pencil building

Let's start at the beginning of the woodworking process. First, there's the pencil, then the design, then the woodworking. Wait a minute. Pencils are made of wood, too. Somebody had to do a good bit of woodworking before you even can begin to jot down your design.

I had never thought much about pencils until I visited a Berol USA factory. Pencils are serious business to the people there. The Berol family started the industry in the United States in 1856, when they opened the Eagle Pencil Factory in New York City. In recent years, the company name was changed to Berol USA and the firm relocated to Tennessee, where it now produces pencils by the millions.

Everyone knows that a pencil is a wooden cylinder filled with a rod of powdered clay and graphite, but I was surprised by the manufacturer's high-tech methods and the quality of the basic materials. First of all, only the choicest California incense cedar is good enough for the best pencils. Incense cedar grows in other places, but the California trees provide soft, almost grainless wood. This softness makes the pencils easy to sharpen. The fine grain provides the support that keeps the lead from breaking.

The Hudson Lumber Company of San Leandro, Calif., harvests incense cedar for 17 different pencil companies in the U.S. In a typical tree, 21.7% of the wood ends up as pencil slats, 28% becomes sawdust and the remaining 50.3% winds up as bark, pulp chips and various grades of lumber. The prime trees grow at altitudes of 3,000 to 6,000 feet, and most are 250 to 300 years old. The trees are felled with great care to avoid harming the younger incense trees nearby. Those trees will be pencils for future generations. Each log is cut into 3-in.-thick by 3-in.-wide by 7¼-in.-long straight-grained chunks called "cants." After cutting, the cants are stickered and air-dried for a year in the desert-like Sacramento Valley.

After the cants are dried, they're shipped to the Hudson Lumber Company's San Leandro slat plant. There, the cants are stored for an additional three or four months so the wood can acclimate to the cooler climate of the San Francisco Bay Area before being cut into slats. Each of the slats is nine pencils wide, one pencil long and a half a pencil thick. Each slat is impregnated with stain and wax, then kiln-dried. The stain improves the color of the wood; the wax increases the wood's machinability at the pencil factory and in your pencil sharpener. Next, the slats are shipped to pencil companies for assembly and painting.

Pencil companies like Berol USA make pencil leads. Lead is a slight misnomer, because there's no lead in a pencil. The writing material is actually a mixture of graphite and clay. Mexican graphite is preferred because of its intense black color.

The finer the particles of graphite and clay before mixing, the better the pencil will write. The graphite is ground until the particles are small enough to float on air indefinitely. The clay is strained through a "super-decanter" until it's fine enough to float on water. A carefully measured ratio of graphite to clay, which determines final pencil-lead hardness, is blended together for days in a revolving drum. This clay and graphite mixture is then compacted into blocks, which are placed in a 60-ton hydraulic press fitted with a special nozzel. As the pressure increases, the mixture extrudes from the machine in a long string, which is then cut to pencil lengths. At this stage, the pencil lead is too soft to use for writing. So, the lead is kiln-dried to 160°, then fired to a white heat. This firing creates a rigid, graphite-loaded rod.

Nine grooves are cut in each slat to accept the pencil leads. Once the leads are in place, two slats are glued together. A specialized high-precision shaper then cuts one side of the glued-together slats into nine round or hexagonal shapes, each containing a pencil lead. When the opposite side is shaped, the nine pencils separate from each other. Surveys show that 11 out of 12 people prefer hexagonal pencils to round ones.

Now the pencil blanks are ready to be painted. The pencils are fed one at a time through a rubber grommet at one end of a shallow tray filled with lacquer-base paint. The pencils snake through the paint bath in a continuous line, then exit through a second rubber grommet at the other end of the tray. The rubber grommet wipes most of the paint from the pencil, so the pencil drys almost instantly. And because each pencil is longer than the paint-filled

Living at woodworking

Making a living is as important to professional woodworkers as any detail of craftsmanship or design. This summer, nine successful craft professionals will meet to discuss strategies for success in a demanding, competitive field like woodworking. The program, part of the 1988 Woodworking/Furniture Design Symposium at the Anderson Ranch Arts Center, will be held the weekend of July 8 to July 10. Speakers at the "Making A Living" symposium will include woodworkers, a gallery owner, a furniture manufacturer, a designer and an educator.

Saturday's discussions will focus on the business of woodworking. Topics will include selling through galleries and craft shows, marketing furniture as art and teaching to supplement income. Sunday will be devoted to the role of woodworkers in society and the choices and compromises they must make to survive. Sunday's topics will include craftsmen in society, the cultural need for designed objects and the rewards of a craftsman's life.

Woodworkers expected to participate in the symposium include Art Carpenter, Hank Gilpin, Glenn Gordon, Thomas Moser and Gail Fredell Smith. Tuition is $195, and housing prices range from $56 to $160 for the two nights. For more information, write to the Anderson Ranch Arts Center, P.O. Box 5598, Snowmass Village, Colo. 81615.

tray, the rubber grommets are always filled with pencils and no paint can leak out. Each pencil gets five to seven coats. The company logo and the pencil grade are then stamped on the blank.

Softer lead pencils, like the No. 2 most people use, are fitted with a ferrule and eraser. Harder drafting pencils get metal caps instead. A new No. 2 pencil will draw a line about 12 miles long. Drafting pencils will draw a line about 35 miles long. Despite this mileage and the sophisticated machinery needed to produce pencils, they're still a bargain—about 60¢ each.

—John Decker

Turning seminar

Photo: Ben Bacon

Turner Ed Moulthrop of Atlanta, Ga., demonstrates his bowl turning techniques at the annual British Woodturning Seminar.

Although 180 turners officially signed up for the British Woodturning Seminar last year, many last-minute arrivals bribed their way in by offering to wash dishes, sweep floors, clean workshops—anything to see master turners practice their craft. Or, is it finally and forever art?

The seminar, entitled "From Craft To Art," questioned the very idea that turned objects must always be useful spindles or vessels. The demonstrators, lecturers and turners focused on creativity, style and technique from the very start.

The informal structure of the lectures and demonstrations allowed attendees to observe the turning techniques of several acknowledged experts. And, the experts were always ready to discuss their philosophies of turning and art with anyone who wanted to talk. Ed Moulthrop of Atlanta, Ga., started the three-day seminar by telling everyone that they were free to develop new work and shouldn't feel limited by old ideas or conventional tools. English turner Jim Partridge attacked the very sanctity of vessels by asking turners these questions: "Why must the exterior of a turned object follow the interior?" "Must there always be two surfaces, one inside and the other outside?" He answered his own questions with the display of his donut-like "bowl," a turning with no definitive inside or outside.

American turner David Ellsworth talked about taking risks. Any turned object can make a statement, he said, but all statements run the risk of rejection. He cautioned turners that they must be prepared to deal with questions that their work will arouse in others and in themselves.

Many of the talks were candid. One craftsman gave a personal account of the benefits and drawbacks of learning to turn while serving a rather severe German apprenticeship. The talk sparked a debate that lasted the rest of the seminar: Is it best to learn technique first, then work on artistic ideas? Or, should ideas and techniques be developed simultaneously?

For me, the debate ended when I watched Ellsworth sitting on the ways of his lathe, turning bowl after beautiful bowl, simply to demonstrate techniques to the group that looked on. It made me realize his best turnings are the result of finely tuned artistic sensibilities, yet his grasp of technique is so thorough that turning is second nature to him. It took Ellsworth five long years of repetitive turning to develop his almost automatic turning skill.

The organizers of the seminar in Loughborough, Ray Key, Mick O'Donnell and Margaret Lester, purposely designed the 1987 seminar to be informal. Attendees were invited to bring their work to display. There were no juried shows, and lecturers and demonstrators were always available to speak to turners on a one-to-one basis and to give informal critiques when asked.

Works by master turners such as Ellsworth, O'Donnell and Moulthrop were also displayed. Everyone was encouraged to heft, handle, touch and discuss these works with the men who turned them.

Perhaps the only disappointment of the seminar was the absence of young faces in the crowd. I can only hope there is a young generation of turners out there, some of whom will attend this year's seminar.

—Ben Bacon, London, England

Bleaching bowls

Bleaching green maple and elm bowls to a bone-white patina is not an exact science. I experimented for more than a year before I produced the color in the bowls pictured on the back cover. The results of the bleaching process are somewhat unpredictable because of the complex interaction of many variables. These include the strength of the bleach, the length of time the bowl is exposed to sunlight, the amount of wood removed during final sanding and the type of finish applied. I'm still experimenting to perfect my technique, and I like that challenge. If you would like to try bleaching, here's the most effective procedure I've found so far.

I sand the turned bowls with 220-grit paper before applying the bleach. I've had best results with Daly's two-part bleach (available from Daly's, 3525 Stone Way N., Seattle, Wash. 98103; 800-521-0714, ext. 276). To avoid chemical burns, I always wear rubber gloves, a long-sleeve shirt and goggles when bleaching. The basic bleach mixture is one part of Daly's solution A mixed with three parts of Daly's solution B. I always do the mixing in glass or ceramic vessels; bleach corrodes metal.

Next, I thoroughly soak all parts of the bowl with the bleach. A sponge on a stick works as a good applicator. To activate the bleach, I place the bowl in direct sunlight. All parts of the bowl must be exposed, so I turn or rotate the bowl every four or five minutes until all surfaces have been exposed to the sun at least twice. Placing a green bowl in the hot sun can dry the wood quickly and possibly cause checking, so I never leave the bowls unattended. If the sun seems to be drying a bowl too quickly, I swab on another dose of bleach.

After the sun treatment, I take each bowl inside and let it sit for at least half an hour until it is thoroughly dry. Then, I repeat the bleaching process. Sometimes this double bleaching will get the bowl white enough. In other cases, however, I've had to bleach bowls as many as five times to get a nice effect. I've also found that

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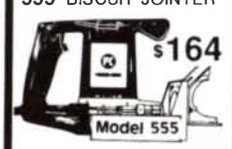

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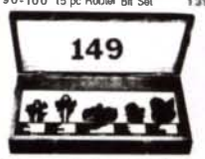

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99-034	Lock Miter Router bit	59
99-261	Ogee Stile and Rail set	79
99-263	Cove/Bead Stile&Rail	79
99-PK1	Multiform Router bit	75
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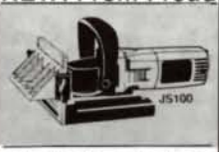

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S500A	Block Sander	39
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TS380	14" Miter Saw	349
W201S	16 1/4" Beam Saw	319
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16¾"

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6650	1/2" Vsr Drill 5.0 Amp	114
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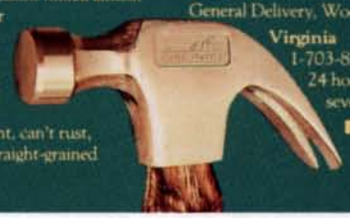

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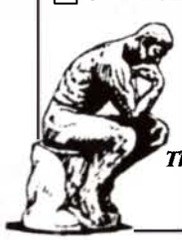

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the brighter the sunlight and the quicker the bowl drys, the whiter the bowl get.

Daly's recommends that the bleach should be neutralized with vinegar. I've found that vinegar restores some of the wood color, so I skip that step and let the bowl sit indoors for about a week so time can "neutralize" the bleach. The bowls generally become whiter during each day of this neutralization period.

After the bowl reaches the color I want, I finish-sand it. Since the bleached surface is not very thick, the trick here is to avoid removing the thin bleached layer. Sometimes mistakes can be rewarding, though. I recently found that sanding through the bleached layer sometimes reveals a striking pink-to-red color. This is especially true with maple bowls. Carnauba wax is the only finish I use on bleached bowls. Oils and other finishes put too much color back into the wood.

—Michael Peterson, Edmonds, Wash.

Photo: Bob Hanson

This cherry chest, shown by John Dunham of Glens Falls, N.Y., at the Baltimore Winter Market, featured dovetails on its curved sides and a wooden hinge.

Otto H. Heuer 1904-1988

Otto H. Heuer, finishing expert and consulting technial editor to *Fine Woodworking*, died on Feb. 24 at the age of 83. For 60 years, Otto was technical advisor to finish companies, manufacturers and woodworkers around the world. He worked at his craft until five days before his death.

I met Otto three years ago when he helped me with an article on testing polyurethane finishes. At 80 years of age, he drove from his Waukegan, Ill., home to the *FWW* editorial office in Connecticut, just to make sure that our article was exactly right. That kind of precision and an unbridled enthusiasm for seeing an object brought to final beauty were Otto's trademarks. Despite his stature in the finishing industry, Otto wouldn't think of giving an ivory-tower view of a product. When I asked about particular finishes or procedures, Otto offered insight and expertise that could only come from a lifetime of first-hand experience. His expertise was not limited to wood, either. He had a hand in everything from protective coatings on space capsules to graffiti-proof finishes for elevator interiors.

In addition to helping the *FWW* staff with articles, Otto also spent countless hours writing and calling readers who asked for help. He didn't have to do that, and he was never paid for the extra work. Finishing was important to him, and he wanted people to share the joy he experienced whenever he saw something finished to perfection.

Otto is survived by his wife, Erna, two children, three grandchildren and two great-grandchildren. *—Dick Burrows*

Product review

TTAC dowel system, *Bridge City Tool Works, 1104 N.E. Ave., Portland, Ore. 97232; (800) 253-3332.*

Dowels have changed little since the early Egyptians used them. Today, we have power drills, better bits and elaborate dowel guides, but the process of doweling is unchanged. You bore mating holes in two pieces of wood, add glue, pop in a dowel and then clamp the wood together.

If you use TTAC (tighter than a clamp) dowels, you'll still dowel like an Egyptian, but the process may be simpler and cleaner. Each TTAC dowel comes with its own little glue supply, packed in two tiny containers that look like miniature versions of the plastic creamers you get with your morning coffee. You pop a capsule in each hole,

Photo: Michele Russell Slavinsky

Each TTAC dowel comes with its own pair of premeasured glue containers.

insert the dowel and clamp the wood. As the wood comes together, the dowel's stepped ends break the containers. The glue escapes from each capsule and flows up the dowel holes and through the flutes on the sides of the dowel. Because the glue in the containers is premeasured and the holes are drilled to a specific depth, there's no squeeze-out, and the dowel gets the right amount of glue for maximum strength.

I tested several TTAC dowels and found the manufacturer's claims were true. To test for squeeze-out, I clamped 1-in. pine boards together with the TTAC system, but I didn't glue the mating surfaces. Before the glue dried, I resawed the joint, cutting the dowels in half lengthwise. The glue had indeed surrounded the dowel up to the mating surfaces with absolutely no squeeze-out. In actual use, you still would glue the mating surfaces to ensure a strong joint. Spread too much glue on the mating parts, and you *will* have squeeze-out. The fact that the TTAC dowel wouldn't be responsible will be small consolation as you clean up the sticky mess.

To test strength, I glued up conventional dowels alongside TTAC dowels in ¾-in. maple, again, without gluing the mating surfaces. After the dowels dried, I pried the boards apart, and the TTAC dowels proved as strong as conventional dowels.

There are advantages to using TTAC dowels. When working with large numbers of conventional dowels, it takes time to insert glue in all the holes prior to assembly. Often, the glue in the first hole is almost dry by the time you put glue in the last hole. That can't happen with TTAC dowels because the glue containers remain sealed until clamping breaks them open. The measured amount of glue also eliminates the

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chance of excessive glue creating enough hydraulic pressure to split the wood.

TTAC dowels sound neat and simple, but there are some drawbacks. The dowels are available in only 5/16 dia., with a length of 1⅜ in. It also costs $7.95 to buy a hundred dowels with glue containers. That's more than three times the price of conventional dowels. Also, the directions state that the glue containers won't open unless the holes are bored exactly 23/32 in. deep. Setting the drill-press quill stop or clamping a collar onto a drill bit to achieve this exact depth is not too much of a problem if you are going to be boring a lot of dowel holes. If you only want to use a couple of these dowels, however, setting up a drill bit to exact cutting depth might prove as inconvenient as the little glue containers are convenient. Then again, conventional dowel holes have to be drilled to the proper depth, but they don't necessarily have to be as exacting as the TTAC dowel holes.

When using TTAC dowels in maple, I found I had to drill the holes slightly deeper than 23/32 in. to avoid squeeze-out. When I used them in pine, however, I found 23/32 in. to be just the right depth. I suppose this is because there's a little more tearout when drilling pine. Softwoods like pine might also absorb more glue than hardwoods like maple. One advantage of TTAC dowels is that the little glue containers have a long shelf life, a welcome feature for occasional woodworkers.

I won't be switching to TTAC dowels exclusively, but I'll keep a hundred or so around for the times when I'm doing large glue-ups that involve many dowels and when the 5/16-in dia. by 1⅜-in. length is correct.

—Monroe Robinson, Little River, Calif.

Short shavings

A new museum and research library devoted to the best in contemporary and traditional woodturning is off and running in Philadelphia. Albert LeCoff, executive director of The Wood Turning Center, wrote in the museum's first newsletter, *Turning Points*, that "The Center will educate the general public, private collectors, gallery people and museum curators. It will also work with individuals and local, regional, national and international associations to create further awareness of turning."

The Center already has two exibitions to its credit. An exhibition called "Works Off The Lathe" was held last summer at the Craft Alliance Gallery in St. Louis, Mo. A second exhibition featured objects from the Center's collection, which includes works by turners such as Rude Osolnick of Kentucky and Del Stubbs of California. That exhibit was held last fall at the Kipp Gallery at Indiana University of Pennsylvania.

The Wood Turning Center also will host a juried and invitational exibition, "The International Turned Objects Show" (ITOS), from Sept. 17 through Nov. 13 at the Port of History Museum in Philadelphia. If you would like to become a member of The Wood Turning Center or want information about ITOS, write The Wood Turning Center, P.O. Box 25706, Philadephia, Pa. 19144, or call (215) 844-0151.

■ The Hambidge Center for Creative Arts and Sciences is offering resident fellowship grants to craftspeople and others pursuing creative endeavors. The Center was established in 1932 by Mary Crovatt Hambidge in honor of her late husband, Jay Hambidge, an art historian, illustrator and discoverer of "dynamic symmetry" in Greek art and architecture.

Those accepted for the fellowship will receive a private cottage and work studio for periods of up to two months, and evening meals are included. There will be no work or teaching responsibilities expected of those accepted for the fellowship. "All we ask is that the resident concentrate fully on the task they have chosen to work on during their stay," said Ray Pierotti, executive director. "They experience total privacy and have the opportunity to exchange ideas over the evening meal, which is taken in common with other resident fellows and the staff."

To obtain application forms for a residency grant, send a self-addressed envelope with 37¢ in postage to The Hambidge Center for Arts and Sciences, P.O. Box 339, Rabun Gap, Ga. 30568. For more information, call the Center at (404) 746-5718.

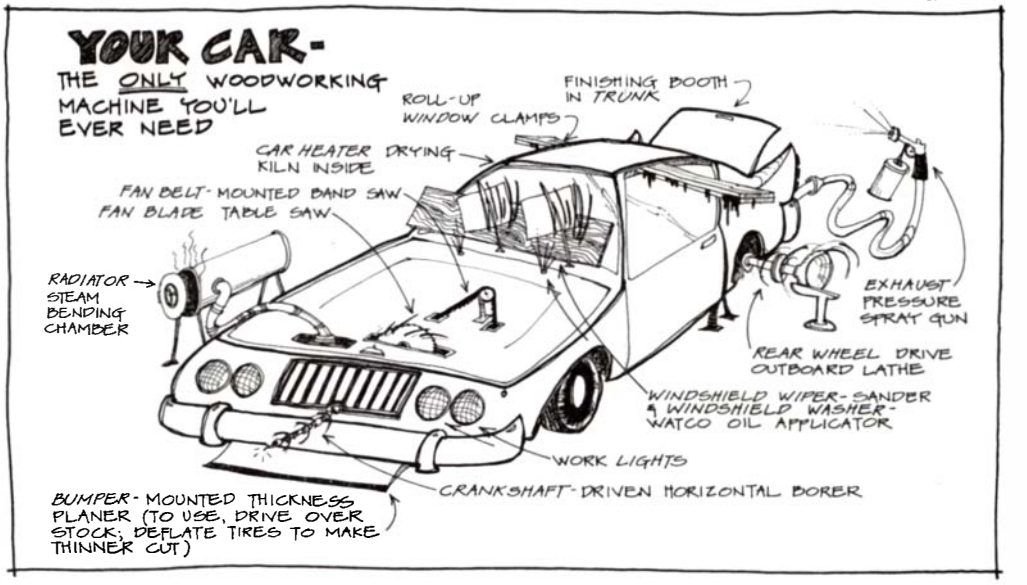
■ Want to learn how to recreate historic house interiors, build furniture or sculpt dolls? Break out your tweezers. The International Guild of Miniature Artisans is hosting its seventh annual guild school, June 18 through June 25 at the Maine Maritime Academy. The classes range from 12 hours long to 48 hours long.

The standard $900 tuition includes 36 hours of instruction, a shared room and meals. Classes offering 48 hours of instruction cost an additional $170. For more information, contact Betty Burkey, school director, The International Guild of Miniature Artisans, 88 Carrollton Ave., Elmira, N.Y. 14905; (607) 734-8012.

■ Safety is a major concern for people who make toys, furniture and other children's items. The United States Testing Company has revised its booklet entitled the *Buyer's Guide to Meeting Product Safety and Quality Standards in Toys and Children's Articles.* The booklet outlines mandatory standards required by the Consumer Product Safety Commission and the voluntary standards set forth by the American Society of Testing and Materials. The booklet also covers the testing procedures used by both organizations.

Single copies of the booklet are free, just write to the United States Testing Company, Direct Mail Division, United States Mail Division, 1415 Park Ave., Hoboken, N.J. 07030.

Cartoon: Leah Hernikl/Sandor Nagyszalanczy



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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LANDSCAPE IMPRESSIONS

Michael Peterson's turnings evoke feelings of sand and stone carved by centuries of wind and weather. That's just what Peterson wants. For seven years, he has been experimenting with ways to turn wood so it resembles the natural forms of the southwest deserts and canyons, and the coastline near his Edmonds, Wash., home. Last year he discovered a sandblasting and bleaching technique that might fool Mother Nature. "White Stone Desert," shown top left and above, has a sandblasted surface resembling wind-worn outcroppings of sandstone. Bleaching enhances the effect. In the maple burl "Ocean Spray," at left, Peterson's technique works so well you can almost see surf breaking on a rocky coast. Below, an elm turning called "Taos" reminds him of the shifting dunes found in a desert. Peterson explains his bleaching procedure on p. 110.