Fine WoodWorking

Nov./Dec. 1987, No. 67, $3.75

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Steel-String Guitar

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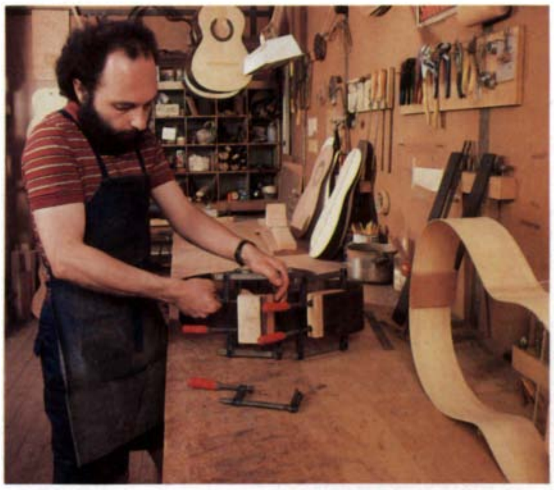

Guitarmaking is an ambitious undertaking, but it brings considerable rewards. On p. 46, luthier Grit Laskin, above, begins a series of articles on building a steel string guitar. Photo by Brian Pickell. Cover: David Ray Pine's mahogany tip-and-turn table, plans for which appear on p. 81.

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.

I was interested in the letter that appeared in *FWW* #66 from Eugene Walker stating that the use of the small end of a joiners' or Warrington hammer was for setting cap irons and adjusting the lateral set of molding plane irons.

I was a museum cabinetmaker for several years; for the past eight years, I have operated my own shop where I restore some furniture but primarily restore and make reproductions of antique tools and scientific instruments (see *FWW* #45, p. 76). I have often used a Warrington pattern hammer to adjust the lateral set of molding planes, but as a researcher of old tool uses and an active member of both the Mid-West Tool Collectors Association and the Early American Industries Association, I have never read nor heard of a joiners' hammer being used to adjust molding planes or to set up cap irons.

I researched several books, including Jacques-André Roubo's *L'Art du Menuisier* and Volume II of Ken Roberts' *Wooden Planes in 19th-Century America*. These seem to indicate that if this type of hammer was not at first made for the purpose of starting small nails or "pins," it's use for such was very common and goes back at least 150 years.

—Bob Baker, Mattawan, Mich.

Re: Allen E. Gillmore's "Quick tip" that ultraviolet light can show up glue spots (*FWW* #66, p. 10), some woodworkers might be able to pick up one of the lights—free. Chevrolet dealers had a big promotion earlier this year—a "key" included with certain Proctor & Gamble products would make you an instant winner of a car or truck if it fluoresced when brought to the neighborhood Chevy dealer. Every dealer was provided with an ultraviolet light to check things on the spot, and many of the dealers are discarding the lights now that the promotion is over. It's worth a try—my daughter called around and managed to get one for me.—*Tom E. Moore, Madison, Va.*

In *FWW* #65, Richard Starr enumerated many reasons not to buy a new handplane. Straight off the shelf, new planes simply aren't worth the trouble it takes to tune out their shortcomings.

I've found antique shops and flea markets far better places to shop for edge tools than hardware stores. There's no question that such tools were better made in the early part of the century, before woodworkers began to rely on portable power tools. An old plane, saw or chisel found at an antique shop or flea-market stall is almost certain to be a better buy than the brand-new "equivalent." The older tool may not look nice, but it will be of higher quality, and far easier to tune up. It will also very probably be cheaper. *—Stephen Wiswall, Laconia, N.H.*

Woodworking journalist

To join *Fine Woodworking* staff as assistant or associate editor. We're looking for an energetic idea person with experience in a cabinet or general woodworking shop, plus job experience as a writer or editor or proven deftness with the English language. Drawing and photographic abilities and formal woodworking training are an asset. Send resume and photos of recent work in wood to: Personnel Manager, The Taunton Press, 63 S. Main St., Box 355, Newtown, CT 06470.

James Kassner, Jr.'s article on vacuum jigs in *FWW* #66 was interesting and presented a method for increasing the productivity in woodworking shops. However, some safety hazards were not addressed. The major concern is that the workpiece will not be sufficiently clamped by the vacuum if the flow in the system is impeded by blockage caused by chips or dust.

Several things that may reduce this hazard are to: install multiple runs of tubing between the jig cavity and the manifold; install filters over each opening in the cavity (several layers of felt would do and could be periodically replaced); ensure that the holes in the jig cavity are the smallest in the system (to prevent particles from lodging elsewhere, restricting air flow); or to install a separate, inexpensive vacuum gauge connected to an opening in the jig cavity—marked with red and green bands, the gauge would indicate whether the required vacuum was present in the cavity.

—Roger Crabtree, Moncks Corner, S.C.

As one who has been partial to cherry for more than 20 years, I very much enjoyed Jon Arno's article about the wood in *FWW* #66. However, I take exception to his referring to cherry as "much prized among Colonial cabinetmakers." Although it was the preferred wood of certain craftsmen, notably the Chapin brothers of Connecticut, it was still a substitute for mahogany, which accounts, I think, for the dark stain on so much cherry.

Wallace Nutting, in Volume III of his *Furniture Treasury*, has this perverse comment: "A vogue for this wood in furniture is difficult to understand, as it is only a poor cousin of mahogany and was of course used in the early days only on account of its cheapness." *—Miles Karpilow, Oakland, Calif.*

We were glad to see the John Grew-Sheridan article (*FWW* #65) about the inaugural edition of *The Guild*. We would like to make a few points that were not included in his coverage of how *The Guild* is working for woodworkers.

As Grew-Sheridan points out, the book is distributed to 10,000 professionals in the design trades. The fact that 83% of the woodworkers who advertised in the inaugural edition received inquiries within seven months of receiving *The Guild* shows that it is being used. Of course, some artists have had better responses than others. Preliminary response shows varied results. The artists getting the best responses are those who create wall hangings and architectural glass.

We've found that designers and architects already have well-developed sources for furniture. This is fine for those who are on the list of established sources, but it makes the entry of the new and the unknown (i.e. craft artists) much more difficult. We believe it will take more time for designers and architects to refer to *The Guild* in selecting furniture for their clients.

People who have used advertising stress one thing above all else: Advertising must be persistent to work effectively. It is not a hit-and-run business—it is a continuum.

We've stepped up our supplementary marketing. The book itself is only a part of the marketing services that Kraus-Sikes Inc. provides to its advertisers: We have also hired a public relations firm to publicize *The Guild* and the artists in it; we

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exhibit the work of *Guild* artists at national conventions and trade shows attended by designers and architects; and we have created a slide show around the work in *The Guild* that is presented to designers and architects around the country. These "extra-curricular" activities have convinced us that while the book works on its own, it works better when supplemented by articles in trade magazines and personal appearances.

We believe *The Guild* is the most efficient, affordable route to the national design market available to craft artists today. And because our high standards will be rigorously adhered to, *The Guild* is both a presenter and endorser of the work within its covers. *—William M. Kraus and Toni Fountain Sikes, Kraus Sikes Inc., New York, N.Y.*

As an avid reader of *Fine Woodworking* and a part-time furniture designer and builder, I found the article on "Coping with Sash" in the May issue to be interesting and in keeping with the quality your magazine has established. But as a high-school woodworking instructor, I was displeased to see the sloppiness in regard to safety shown in the photographs.

In the smaller photograph, where the molding is being shaped with the use of a featherboard, the operator's fingers are much too close to the shaper cutters. A second featherboard could be mounted above the workpiece to provide the required downward pressure. This would require maneuvering around the second featherboard, but it is much safer.

In the large photograph detailing rabbeting, the operator's fingers are again too close to the blade. I realize that safety devices sometimes make it difficult to illustrate an operation, but students often copy examples of woodworking practices—whether or not they're safe.

It only takes one mistake to be injured for life. A better representation of safety practices from woodworking publications also makes my job easier because I have less explaining to do when I use an article as an example.

—Walter D. Hebern, Modesto, Calif.

Readers of *Fine Woodworking* are among the finest craftspeople in the United States and the world. Demand for unusual exotic woods is created by these woodworkers, and because of these demands, our tropical forests are rapidly disappearing. Woods such as cocobolo, bocote, ebony, koa, rosewood, purpleheart, African blackwood, zebrawood and more are supplied by companies advertising in this magazine. There are countless examples of deforestation that have caused the tropics to turn to desert. We as woodworkers need to stop using these exotic woods and instead rely on our native trees. This is the only solution that will help prevent the tropical forests from disappearing: Boycott tropical wood.

—Elisa Mitofsky, Thetford Center, Vt.

This is by way of a warning to all the readers of Jim Cummins' article on bandsaws in your March issue. You recommend buying a blade 1 in. shorter than normal for tension purposes. Don't do it until you've measured and assured yourself that a blade shorter than normal will fit on the saw with the top wheel in its lowest position.

A 79-in. blade would not fit my Sear saw, and the Lennox Co.—quite rightly—would not exchange the blade.

—Ronald T. Hackin, Yorba Linda, Calif.

Since the bandsaw business still seems to be very much alive, I thought I might relate my experience with an Inca 10-in. model. After many attempts to get the ¼-in. bimetal blade up to tension, I finally had to develop an alternative mounting to that recommended by Inca. The blades for their saws are supposed to ride with the teeth over the edge of the wheel. However, as the proper tension was reached, the blade always popped off the wheel with a rather loud noise. I finally decided to mount the blade with the teeth on the wheel, as with other saws, and with this mounting there's no problem getting up to tension. The saw works fine, but I wonder if there will be any damage to this saw by using this more conventional blade position. I've noticed that there's considerable out-of-roundness in the Inca wheels, and I wonder if other Inca users have had similar problems.

—Wayne Mitzner, Baltimore, Md.

I take exception to the assertion by Rich Preiss (*FWW* #62, p. 14) that bronze and cast iron are oil-permeable. The bronze bearings referred to are almost certainly sintered from bronze powder and are referred to as "self-lubricating" or "oil-filled." Substitution of cast-bronze bearings for sintered bronze bearings will cause premature bearing failure. In restoring classic woodworking machinery, I've seen such bearing failure, owing to incorrect substitution of bearing material, time and again.

Cast iron has been known to be an inherently lubricious bearing surface for a long time. Once it was thought that its lubriciousness was due to its graphite content, but this old belief has been superseded by a theory that cast iron's heterogeneous structure provides an interspersing of soft and hard materials, similar to bearing metals and bronzes.

—Cameron Brown, San Juan Bautista, Calif.

In the January/February issue of *FWW*, David Sloan wrote an article on lathe chucks in which he mentioned the new Multistar Duplex chuck. He gave only the head office address in England for the purchase of this chuck.

I'd like to inform your readers that the Multistar system and all of its accessories are available in Canada from Treen Heritage Ltd., P.O. Box 280, Merrickville, Ontario, K0G 1N0, (613) 269-4251. Multistar products have proven popular here in the past year, and have sold very well in England for more than two years. *—Kemp McMeekin, Treen Heritage Ltd., Merrickville, Ontario, Can.*

This is a comment on a tool that seems to have disappeared from the market and I wonder why—namely, the 3-ft. boxwood rule. I purchased one about 20 years ago, a Lufkin, made in England. I have an older U.S.-made Stanley. There are a few 3-ft. folding rules on the market now, but they're more suitable for use as clubs because they are sized incorrectly.

I was taught by my father about 60 years ago that one could use the boxwood rule as a set of measuring blocks. When folded, the Lufkin and Stanley rules were 1 in. wide and ⅜ in. thick; unfolded, they were ½ in. wide and ³⁄₁₆ in. thick. With these rules, a setback or overhang could be done by a sense of touch for four different measurements.

—Reid H. Leonard, Pensacola, Fla.

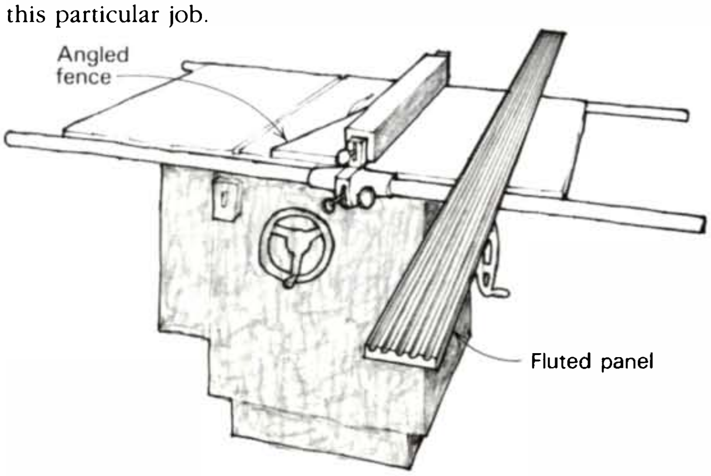
I've read with some amusement the brouhaha over the role of lye in staining cherry. We old-timers *never* used lye as it is sold commercially. I use a solution which is made by pouring boiling water over a bucket half-full of hardwood ashes. Take a plastic pail, such as drywall compound comes in, and half-fill it with ashes. Pour boiling water over the ashes to just about fill the pail. It will bubble and spit, so don't get too close. Let the bucket stand for 72 hours and decant off the clear liquid. Your chemists will tell you that you have just produced a lye solution or a reasonable facsimile thereof. It's the only stain I've found that will match a piece of new cherry into a 200-year-old tabletop. I've used this potash solution for years and have never had any trouble with finishes doing funny things. And I've used them all—varnish, oil, polyurethane and lacquer.

—Charles Riordan, Dansville, N.Y.

edited and drawn by Jim Richey

Making fluted panels on the tablesaw

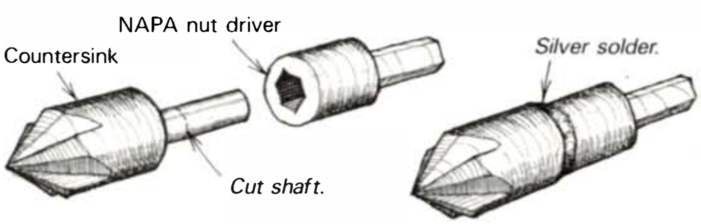
When I needed two 7-ft.-long fluted panels for the front entrance of my house, I made this simple angled fence and cut the flutes on my tablesaw. The fence is simply a wedge-shaped piece of plywood screwed to a plywood channel that press-fits on the rip fence. The angle of the plywood to the blade will determine the shape of the flutes, with a small angle producing deep, narrow flutes and a larger angle producing shallow, wide flutes. I found that an angle of 13° was about right for this particular job.



To cut the fluted panels, fix the angled fence on the rip fence and set the blade depth at about ⅛ in. It will take four passes, raising the blade ⅛ in. each pass, to cut the flute to its final depth of ½ in. After one flute has been completed, move the rip fence over, lower the blade and start another.

—*Wayne A. Kulesza, Chicago, Ill.*

Quick-change countersink

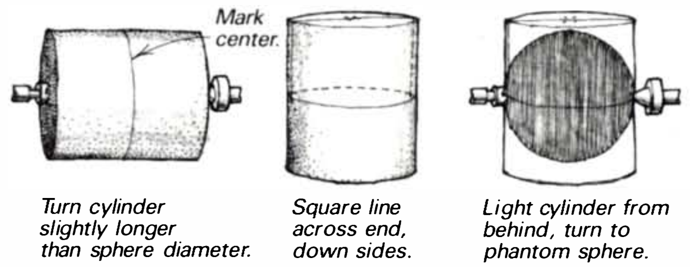


I use a lot of countersunk drywall screws in my cabinet work, but I couldn't find a countersink with a six-sided shaft to fit my magnetic bit holder. As a result, I wasted a lot of time chucking back and forth between countersink and driver.

To solve this problem, I made a fast-change countersink by silver-soldering the shortened shaft of a common countersink into a NAPA nut driver. The driver's shaft easily slips into the magnetic bit holder. —*Harry Sommers, Coeur d'Alene, Ida.*

Turning spheres

While chatting at a meeting of the Guild of Oregon Woodworkers, I learned that I turn spheres differently than do most other turners. First, I turn a short cylinder with the grain running along the long axis. I turn the cylinder slightly longer than the diameter of the finished ball, then mark around the center of the cylinder with a pencil. Next, I square across one end and down each side to give me the location of two new turning centers. I chuck the cylinder in the lathe on these new centers and hang a light behind the turning. With the light turned on and the workpiece spinning in the lathe, the outline of a phantom sphere appears through the workpiece. I turn to this phantom line with a skew, being careful to avoid kickback, then sand and finish. If you don't have much experience with a skew, you may want to do most of the work with a gouge, then finish carefully with a skew.



This approach leaves tiny defects that can be filled and sanded where the centers have dented each side. Reduce these defects by using a small spur center and a ball-bearing center.

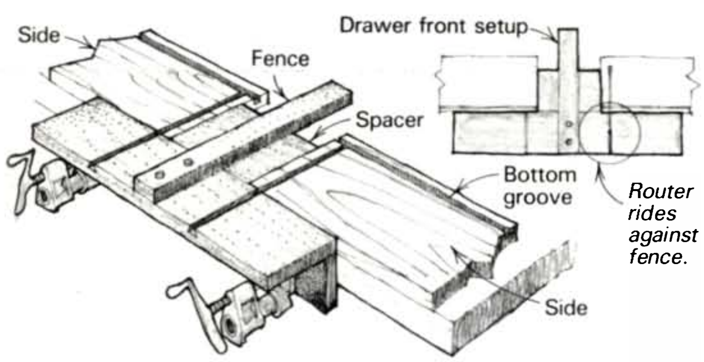
—*Bill Fox, Salem, Ore.*

Jig for sliding dovetail housings

I use a simple but effective jig to cut housings for sliding dovetails in drawer construction. The jig consists of an L-shaped shelf, a fence to guide the router and a spacer board screwed to the fence from the bottom. The jig is clamped to the front of the workbench from underneath with pipe clamps and is carefully adjusted so the height of the shelf matches the thickness of the drawer stock.

The jig is designed so that housings are cut ½ in. from the end of the workpiece. If necessary, adjust the size of the spacer to locate the housing farther from the edge. The grooves for the drawer bottom are cut in the drawer front and sides before the jig is used.

To use the jig, butt two sides up to the stop as shown, with the grooves at the far side of the drawer stock. Move the router in from the front of the jig, and stop the cut at the groove. To cut the housings in the drawer front, place the front so it faces in the opposite direction, with the bottom groove in front. Rout through the groove, stopping the cut for the housing at the desired distance from the top edge (usually ½ in. or so). This way, the sliding dovetail is not exposed at the top edge of the drawer's front.



To rout the male dovetails, I use a tall fence on my router table with the router attached to the back of the fence and the bit running parallel to the table. I recommend cutting one side of the dovetail on all the pieces, then resetting the fence and cutting the other side with the same face against the table as before. The principle of always working relative to one face will ensure that all dovetails will be the same size.

—*Barrie Graham, Arundel, Quebec*

Velvet drawer bottoms

The standard approach to lining the bottom of jewelry box drawers is to cut a piece of felt to size and glue it in place. I prefer velvet's rich feel over felt, but the cut-and-paste approach doesn't work as well with this material.

To solve the problem, I install the velvet bottom *before* assembling the drawer. I apply a light, even film of Titebond or Elmer's glue on an oversized plywood drawer bottom. I lay the

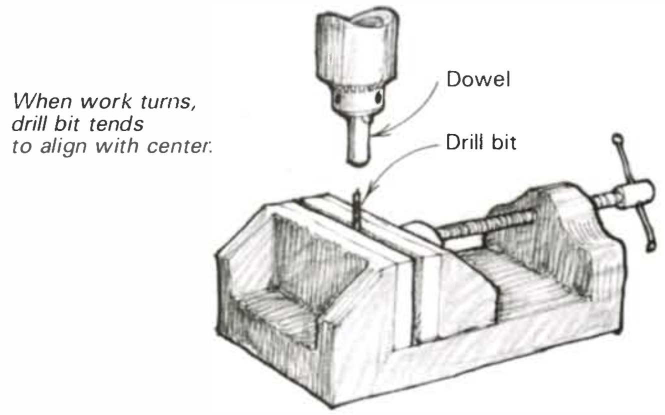
velvet on the glue-wetted surface, smooth out the wrinkles and—when the glue has dried—cut the bottom to size. If you cut the bottom to size before the glue sets, the wet threads in the velvet tangle in the saw and create a mess.

The rest of the assembly is as usual, except you need to cut the bottom grooves in the sides of the drawer wider by 1/16 in. or so to accommodate the extra material.

—David Miller, Annville, Pa.

Quick tip: I store assorted grits of sandpaper in a large, alphabetically indexed, accordion-type office file folder. The pockets are easily re-labeled to indicate various grit sizes, and are large enough to accept a full pack at a time. They even hold 10-in.-dia. sanding discs. *—Rod Short, Anchorage, Alaska*

Drilling centered holes in dowels



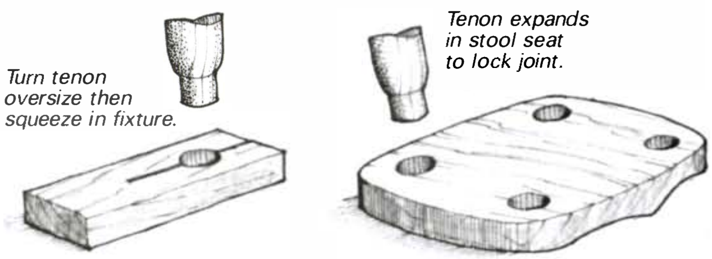
When you need to drill a longitudinal hole in a small dowel such as Jeris Chamey's box hinge (*FWW* #62), try this. Chuck the dowel in the drill press and hold the drill bit in the drill-press vise. When you lower the dowel on the bit, it will self-center and provide a quite accurately centered hole.

If your drill-press vise doesn't have a vertical slot milled in the jaws, here's how to align the bit. First, tighten the fluted end of the bit in the chuck with just enough pressure to hold it without damaging the flutes. Then, grip the shank of the bit with the vise. Release the chuck and the drill will be vertically aligned, ready to drill the workpiece.

—Bob Grove, Portland, Ore.

Quick tip: When using a saber saw on a delicate surface, such as when installing a sink in a countertop, the saw's base can cause scratches. As a cure, I made two removable, soft skids for the base of my saw, using magnetic strips with felt glued to one side. *—Marco Vaïs, Montreal, Quebec*

Making tight leg tenons



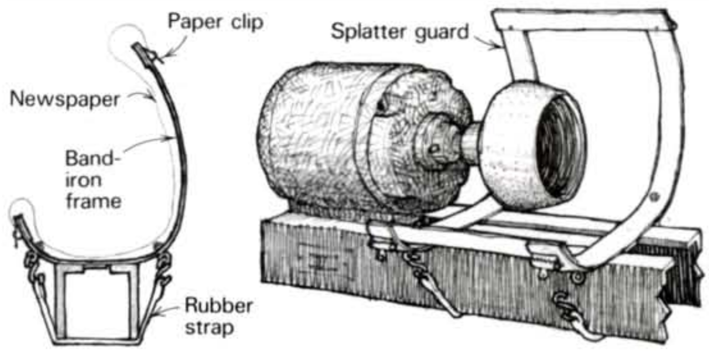
I make Windsor stools with legs that have tenons turned at the top to fit blind holes bored in the stool seat. These leg joints take a lot of stress, so I take pains to ensure the leg joint is tight. First, I turn the tenon slightly oversize, so its diameter is about 1/64 in. too big for the hole. Then, before assembly, I compress the tenon with the fixture shown in the sketch, so it fits into the hole in the seat. Later, because of the moisture in the glue, the leg will expand and lock itself in the socket.

The compression fixture is a maple board drilled with the same size hole as the tenon, then slotted halfway with a sawkerf. To compress the tenon, I insert it in the fixture and squeeze the fixture in a vise. I rotate the leg 90° and squeeze it with the vise again. Although the leg's diameter may only be reduced about 1/64 in., it should be sufficient. It's advisable to score the tenon lengthwise before gluing to allow excess glue to escape. *—John Taylor, Golcar, Huddersfield, Eng.*

Quick tip: To prevent sawdust and chips from flying all over the shop, I mount old roll-up window shades to the ceiling at strategic locations to act as deflection shields. Cleanup is easy with broom and shovel. *—Don Henschel, Shelton, Conn.*

Turning splatter guard

There are several advantages to finishing a turned bowl or spindle on the lathe. But one big disadvantage is that the finish sprays all over the lathe and the wall behind. When I finally got tired of taping newspaper behind and on the lathe, I enlisted the help of Dr. Bill Riddle, the metals instructor at our school, to build the finishing shield shown here.



We welded together pieces of 1/8-in. by 1½-in. band iron for the shield's frame. The piece of band iron welded to the bottom serves as an index to locate the shield between the lathe's ways. We riveted a No. 2 Boston paper clip to each corner to hold a sheet of newspaper spread inside the shield. Finally, we attached two rubber tie-down straps to the rear of the shield. These straps are pulled under the lathe bed and hooked into rings on the front of the saddle to cinch the shield down.

—Jerry Brownrigg, Alva, Okla.

Quick tip: If you make your own knives and chisels, an excellent source for steel is broken sword blades. If there's a fencing club nearby (perhaps at the YMCA), ask them to save their broken foil blades for you. The blades are excellent steel and work well for small tools. *—Bob Vernon, Ann Arbor, Mich.*

Hiding hairline cracks in wood

Like many other craftsmen, I've been through the mill trying to find a suitable material for patching cracks, holes and other imperfections in wood projects. I finally hit upon a terrific solution: acrylic modeling paste—the kind artists use for thick, built-up effects. It's available at any well-stocked art supply shop. You can color the paste to match any wood, using commonly available acrylic artists' paints. The paste will go into hairline cracks and can be piled up about 1/8 in. thick without cracking. It carves, sands and machines like wood. What's more, it will take any finish.

—John Stockard, Milledgeville, Ga.

Here's how to repair and fill a hairline crack that mars an otherwise usable piece of wood. You'll need fast-penetrating cyanoacrylate glue and extra-thick cyanoacrylate glue. Both are

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1609	OFFSET BASE LAM TRIMMER	112
1609K	TRIMMER INSTALLERS KIT	156
1920RK	3/8 CORDLESS DRILL	78
1158VSR	3/8 VAR SPEED REV. DRILL	54
11212VSR	3/4 SDS ROTARY HAMMER	174
11202B	1 1/2 ROTARY HAMMER	339
11203B	1 1/2 ROTARY HAMMER WITH STOP ROTATION	365
1198VSR	1/2 VSR HAMMER DRILL	114
3268	HEAT GUN	49
1942	HEAVY DUTY HEAT GUN	57

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GREAT FOR SMOOTHING, WOODTURNING, RESTORATION, FINISHING ROUNDED ITEMS AND HARD TO REACH PLACES. ALUMINUM OXIDE ABRASIVE IS ALSO EXCELLENT FOR DEBURRING AND POLISHING METAL. JUST CUT OFF A STRIP THE LENGTH YOU NEED, LOOP IT AROUND THE PART, THEN PULL IT BACK & FORTH...ROLLS ARE 75 FEET LONG AND 1" WIDE. GRIT 80, 150, 240.

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ITEM # 6511

2 SPEED SAWZALL
SALE **$118**

ITEM #	DESCRIPTION	SALE
0228-1	3/8" DRILL 3.3A 0-100RPM	$ 84
0234-1	1/2" DRILL 4.5A MAGNUM	99
0244-1	1/2" DRILL 4.5A MAGNUM	99
1676-1	H. DUTY HOLE HAWG W/CASE	225
3002-1	ELECTRICIANS RT ANGLE KIT	165
3102-1	PLUMBERS RT ANGLE DRILL KIT	172
5455	7"/9" POLISHER 1750 RPM	118
5535	7" POLISHER 2800 RPM	125
6012	1/3 SHEET ORBITAL SANDER	99
6014	1/2 SHEET ORBITAL SANDER	106
6065	7"/9" SANDER GRINDER	114
6226	2 SPEED BANDSAW W/CASE	249
6366	7-1/4" CIRCULAR SAW WITH ACCESSORIES	104
6508	VARIABLE SPEED SAWZALL W/CASE	122
6750-1	DRYWALL DRIVER 0-4000	83
6753-1	DRYWALL DRIVER 3.5A	72
8975	HEAT GUN	49

makita

ITEM # 6093DW

3/8 CORDLESS DRILL VARIABLE SPEED REVERSIBLE
$122

ITEM #	DESCRIPTION	SALE
BO4550	DUSTLESS FINISHING SANDER	$ 44
DA3000R	3/8 ANGLE DRILL REVERSIBLE	119
9503BHKIT	4 1/2 SANDER GRINDER KIT WITH CASE	74
410	DUST COLLECTION UNIT	238
632007-4	9.6VDC BATTERY	27
632002-4	7.2VDC BATTERY	25

11 PC. WOOD CARVING SET

FITS COMFORTABLY IN YOUR PALM WITH THE BLADE HELD BETWEEN THE INDEX FINGER AND THUMB TO GIVE YOU A VERY CONTROLLED CUT. DESIGNED FOR WOODBLOCK CARVING, FURNITURE-MAKERS AND DECOY CARVERS.

$24
ITEM # 11WCS

THE DISTINCTIVE LACQUERED HARDWOOD HANDLES ARE SHAPED TO FIT THE PALM OF YOUR HAND SNUGLY, AND THE FINGERS GUIDE AND CONTROL OF THE RAZOR SHARP CARBON STEEL BLADE.

7 PC.PREMIUM BRAD POINT DRILL BIT SET

DOUBLE SPUR BITS PREFFERRED BY CABINETMAKERS. EXTRA LONG SPURS WHICH CUT WOOD FIBERS CLEAN AND FAST. FAR SUPERIOR AND LAST 10 TIMES LONGER THAN ORDINARY BRAD POINT BITS. SET INCLUDES SIZES: 1/8", 3/16", 1/4", 5/16", 3/8", 7/16" AND 1/2".

SALE **$18** SET OF 7
ITEM # 7PBPD

5 PC. DUAL-AUGER WOOD BITS

DUAL-AUGER WOOD BITS ARE THE ONES TO CHOOSE WHEN SPEED IS YOUR TOP PRIORITY. THEIR NEW SINGLE CUTTER AND SPUR DESIGN ASSURES FAST, CLEAN BORING, AND REMOVES STOCK IN MUCH LESS TIME THAN STANDARD AUGER BITS. VINYL STORAGE POUCH INCLUDED. 3/8", 1/2", 5/8", 3/4", 1".

ITEM # 5DAWB
SALE **$28**

HITACHI

ITEM # C10FA

DELUXE 10# MITER SAW
SALE **$264**

ITEM #	DESCRIPTION	SALE
TR12	3HP ROUTER WITH ALL ACCES.	$184
C6DA	6 1/4 CORDLESS CIRC. SAW	99
C15FB	DELUXE 15" MITER SAW	364

PORTER+CABLE

ITEM #330

SPEED BLOCK FINISHING SANDER
SALE **$51**

ITEM #	DESCRIPTION	SALE
352	3x21 DUSTLESS BELT SANDER	$118
360	3x24 DUSTLESS BELT SANDER	178
362	4x24 DUSTLESS BELT SANDER	189
555	PLATE JOINER	166

ITEM # 06DC

6" DIAL CALIPER
IN WOODEN CASE

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0-6"x0.001" STAINLESS STEEL

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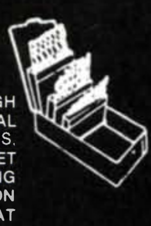
- LOCK FOR REPETITIVE SETTINGS
- CONVENIENT THUMB ROLL MAKES MEASURING QUICK & EASY
- SATIN CHROME FINISHED

ITEM #	DESCRIPTION	SALE
12DC	12" DIAL CALIPER 0-12"x0.001"	$78
06VC	6" VENIER CALIPER STAINLESS STEEL .001	18
12VC	12"VENIER CALIPER 0-12"x0.001	48

15 PC. COMBINATION FILE SET
ITEM # 15CFS
SALE **$18**

SET INCLUDES: **5 JUMBO NEEDLE FILES** MADE OF HARDENED ALLOY FILE STEEL WITH CUT PRECISION EDGES. THE PERMANENTLY ATTACHED HANDLE ALLOWS YOU BETTER CONTROL & EASE OF USE OVER STANDARD NEEDLE FILES. **10 DOUBLE ENDED RIFFLER FILES** FOR ADDING FINE DETAIL, OR CLEANING UP AFTER A RASP OR POWER BURR. YOU'LL BE IMPRESSED BY THE SMOOTH CLEAN FINISH LEFT BY THESE RASPS. THE SET WORKS EQUALLY WELL ON WOOD, PLASTICS, OR METAL.

29 PC. DRILL BIT SET



INDUSTRIAL QUALITY M-2 HIGH SPEED STEEL BITS IN FRACTIONAL SIZES 1/16" THRU 1/2" by 64THS. WITH 3/8" REDUCED SHANK. SET INCLUDES A HANDY CARRYING CASE FOR EASY ORGANIZATION AND QUICK LOCATING OF THAT NEEDED BIT.

ITEM # 29RS
SALE **$18**

ITEM # 19MB
19 PC METRIC 1MM-10MM
SALE **$22**

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Emglo

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- COMES WITH PRESSURE SWITCH, ON/OFF SWITCH & AIR LINE REGULATOR

ITEM # AM39HC4
SALE **$265**

ITEM # AM77HC4
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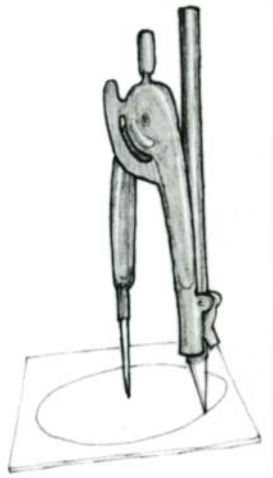
commonly available at hobby and model shops. If the crack is closed, hold it open with a knife. Apply the fast-penetrating glue first, which will be sucked deep into the crack by capillary action. Then apply the heavy-bodied glue, which will follow the thinner glue into the crack. Open and close the crack a few times to distribute the glue. If the crack is open, force wood dust into it with a spatula or an artists' palette knife and mix it with the glue. Clamp the wood if needed. Two hours is enough drying time. *—John W. Wood, Tyler, Tex.*

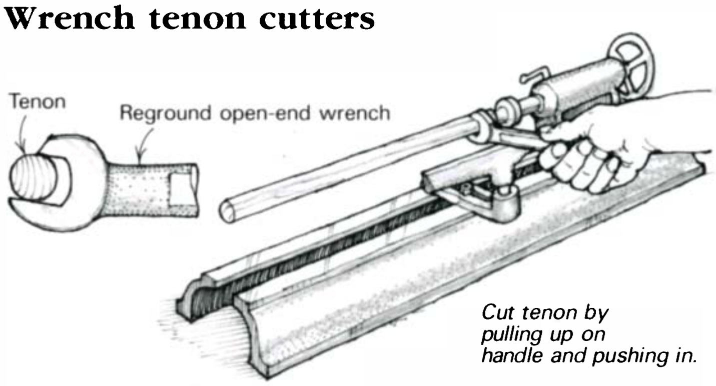
Quick tip: Rubber fingertips, available in several sizes at office supply stores, are ideal finger protectors when a project requires hand-sanding. In addition to saving skin, they help the sandpaper last longer and prevent oily fingerprints on light-colored woods. *—Dennis Schorpp, Monroe, Wash.*

Cutting felt circles



Recently, I made a jewelry chest containing a number of trays with compartments created by drilling spaced holes with a 2⅛-in. Forstner bit. This left me with the problem of cutting numerous 2⅛-in. circles from sheets of self-adhesive felt for lining the cavities. I solved this problem by replacing the pencil in my 8-in. bow compass with a standard X-Acto knife. With this setup, I was able to easily cut the felt circles in a few minutes. *—Douglas B. Hammer, Solon Springs, Wis.*

Wrench tenon cutters



Here's a quick production method for turning tenons: You can make a precision tenon cutter by modifying a high-quality open-end wrench of the same size as the desired tenon. First, carefully grind and sharpen the top jaw at an angle, as shown in the sketch, to provide a cutting edge. Add a handle to the tool if you like. Next, turn the stock to within ⅛ in. of the desired tenon diameter. Then, with the lower lip of the tenon cutter riding under the spindle, pull up on the handle and push in. The cutting action will stop when the tenon is sized—much like a go/no-go gauge. If the tool cuts tenons that are too small, file a bit off the lower lip. *—Cecil Gurganus, Todd, N.C.*

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.*

Finishing multi-colored laminations

Is there a finish that will adhere to oily woods as well as non-oily woods, and preserve the natural wood color? I've made a large walnut serving tray, inlaid with a picture assembled from mahogany, Brazilian rosewood, Ceylon ebony, wenge, end-grain walnut and white birch.

—George Stevens, Winnipeg, Manitoba, Can.

Michael Dresdner replies: All that's needed to finish a combination of oily and non-oily woods is a barrier coat that adheres well and provides a compatible base for the top-coat finish. My favorite barrier coat is vinyl sealer, made primarily of vinyl pellets dissolved in toluene. Most lacquer companies now offer a vinyl sealer, so one brand or another is available from any good finishing-product supplier.

Vinyl sealer is very clear and light in color, so it won't "yellow" woods like maple. The toluene solvent gives it complete bonding with lacquer, and it's compatible with many top coats, including several types of varnishes. Vinyl sealer also has the added advantage of being a superb moisture barrier. Your best bet (especially with oily woods) is to scuff-sand or scrape the surface immediately before finishing to produce an oil-free surface. The longer an oily wood sits after sanding, the more oil will ooze to the surface.

Your success in preserving the wood colors will depend largely on the wood and the conditions to which it will be exposed. If you use butyrate or water-white lacquers, you can avoid the amber tint common with some lacquers. However, many highly colored exotics lose color over time due to bleaching from ultraviolet rays, reactions to various finishes, oxidation or the breakdown of the natural color components in the wood. I'd recommend that you add an ultraviolet inhibitor to the finish. I use a product called Tinuvin, manufactured by Ciba-Geigy (3 Skyline Dr., Hawthorne, N.Y. 10532), a white powder that dissolves completely in lacquer thinner, leaving no cloudiness or color. A tiny bit goes a long way.

[Michael Dresdner is an instrumentmaker and finishing specialist in Zionhill, Pa.]

Riving knives for tablesaws

I've read about using a splitting knife or a riving knife when ripping on a tablesaw. What do these knives do?

—Sol Malkoff, Maitland, Fla.

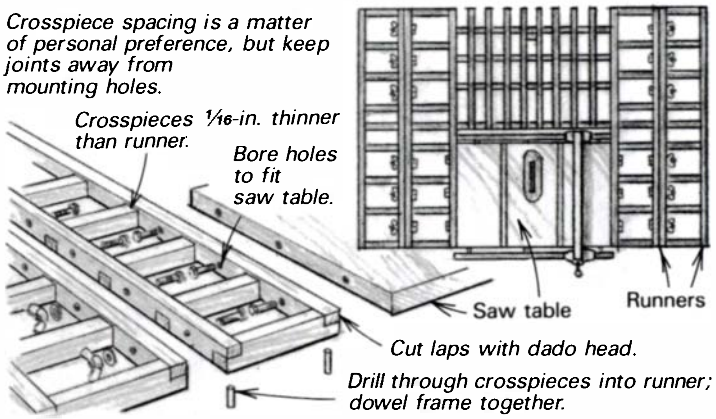
Richard Preiss replies: A splitting or riving knife is simply a device to keep the sawkerf from closing on the blade as a board is ripped. Depending on the species, the thickness of the wood and how it was dried, there can be a strong tendency for a board to close back on itself, pinching the blade before the rip cut is completed. The splitter keeps the kerf open on the outfeed side of the cut, virtually eliminating kickbacks from pinching. And it's generally safer than jamming a screwdriver in the kerf, as some workers do. Most new saws come with a splitter as standard equipment. If you don't have one, check with the manufacturer. You could also make a knife out of sheet metal or plywood that's slightly thinner than the sawblade you're using and adapt it to your machine.

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

Grid expands saw table

While reading Hans Sporbeck's article on pin routing (FWW #61)***, I noticed there was an interesting extension table attached to his tablesaw. I assume he made the table himself, and I was wondering how.*** *—R.L. Marcotte, Penfield, N.Y.*

Hans Sporbeck replies: Most of the saws I've worked with have bolt holes in the sides of the table for adding extensions. I just capitalized on these bolt holes to add extensions cut from 1-in.-thick, well-dried maple. The width of each piece should match the thickness of the apron on your saw table. To ensure that all the pieces would be identical, I ripped all the components at the same saw setting, first cutting the runners that extend from front to back, then cutting the crosspieces. The crosspieces should be about 1/16 in. thinner than the runners so the stock won't catch as you run it across the table. Don't make the extensions too wide—I like 12-in.-wide units. Because of the way the holes are bored, you can always bolt narrower units together to expand the table, if necessary. You might add a leg to support larger extensions.



After cutting the runners, clamp them to the table and mark the locations of the holes so they can be drilled accurately. Turn the rails around and drill the same holes on the other ends. This double set of holes enables you to attach either end of the extension to the saw. It also lets you clamp the side grids to the middle grid bolted to the back of the saw, which adds to the rigidity of the extensions. After boring the holes, use a dado head to cut the lap joints for joining the runners to the crosspieces, being careful to keep the joints away from the bolt holes. To assemble the extension, I first built the frame of each grid by drilling all the way through the end-of-frame crosspiece and into the ends of the runners, so I could dowel and glue the pieces together. Make sure you keep everything flat and square. The remaining crosspieces can be glued and screwed or tacked in place after the frame is glued together. When I'm working with a large piece and need to mount a fence on the grid, I use a Clamp 'N Tool guide manufactured by Tru-Grip Clamps, Griset Industries, P.O. Box 10114, Santa Ana, Calif. 92771.

[Hans Sporbeck is an amateur woodworker in Pewaukee, Wis.]

Do screws mean poor workmanship?

The Woodcrafters Club of Tampa enjoyed having Tage Frid judge our recent woodworking competition. He left us with a problem though. During the judging, he made several comments about competitors using screws. Since then, there have been many lively discussions about what Frid meant, and our 100 members are just about equally divided into three camps. Some think he objects to screws; others think he accepts them for certain applications; others say he has no objections to screws at all. Who's right?

—Charles G. Mullen Jr., Tampa, Fla.

Tage Frid replies: Personally, I'm against using screws in the major components of handcrafted furniture. Sure, screws are okay for attaching drawer runners or the back to a cabinet that will be placed against a wall, but they're no substitute for good joinery. For one thing, it's often more difficult to align the pieces exactly when using screws, and it takes longer than using a simple tongue-and-groove or spline construction.

Because wood will always move in thickness and width (depending on the humidity in the area), screws used to join pieces together eventually work loose or crack the stock. I've made some armchairs where the front legs and arms were joined with

through mortises and 1½ in. by 1½ in. tenons. When I made the chairs, the joints were flush, but now the tenon is 1/32 in. above the arms during the winter heating season and 1/32 in. below it during the summer. Even on this small scale, you can see movement of about 1/16 in. If you use screws instead of mortises and tenons, the piece is more likely to fall apart. Incidentally, the Tampa club's guidelines on craftsmanship allowed screws, so I didn't penalize anyone for using them.
[Tage Frid is professor emeritus of furniture design at the Rhode Island School of Design in Providence.]

Hewing stairs in green wood

I'm hewing treads for a spiral stairway from green oak logs, and the wood has been splitting. The treads are 38 in. long, 8-in. by 10-in. at one end tapering to 2½-in. by 14-in. at the other end. I don't want to use PEG, but I've heard that, years ago, workers sometimes soaked green wood in brine or in mineral oil to solve similar splitting problems. Will either of these methods help me? —George S. Graham. Lithia, Fla.

Bruce Hoadley replies: The brine soak is an age-old method for drying wood. The soak puts a heavy concentration of salt into the surface layers of the wood, which helps hold moisture at or near the surface. This drastically slows the rate at which the internal moisture diffuses to the surface and is lost, thereby helping to prevent checks. The method isn't fool-proof, though, and may have some undesirable side effects. The brine residue may hasten the corrosion of hardware and fasteners and interfere with glue bonding and finishing.

Soaking the log in mineral oil would probably also slow the drying process, which of course helps to minimize checks. Unless the logs you're working with are more than 18 in. in diameter, you'll have to work with pieces that include the pith, and radial cracks will be very likely, no matter what you try. Also, your description of the treads makes me think that a lot of endgrain is exposed, which creates problems when drying. If you dry the wood too fast, moisture will pass through the endgrain more than the long grain and the piece will crack. If you slow the drying down to avoid the cracks, the process takes forever. Rather than work with these green logs, I'd suggest you find and work with some salvage timbers that are already dry.
[Bruce Hoadley is professor of wood technology at the University of Massachusetts at Amherst.]

Smaller blades for more power

I've heard that running a 9-in. blade on a 10-in. tablesaw will mean more power and more RPMS. Is this true? —H. Duane Bartlett, Detroit, Mich.

Jim Cummins replies: Running a smaller blade on a saw increases power simply because of the law of mechanical advantage. The torque is greater as you approach the center of the blade. The speed of the blade may seem higher because the blade will not bog down so much in heavy cuts. Actually, the speed of the blade at the teeth is slower than with a 10-in. blade, but this doesn't cause problems.

Another way to seemingly increase power is to change pulley sizes to slow the saw down, but my favorite method is to go to a blade with fewer teeth, especially when ripping. A thin-kerf blade also uses less power, because it's removing less wood.
[Jim Cummins is an associate editor of *Fine Woodworking*.]

Alcohol-proof sealer for wine goblets

I'm looking for a non-toxic, alcohol-resistant finish for wooden wine goblets I'm making. —Alan Kaepplinger, Cary, Ill.

David Lory replies: The best finish I've found for wine goblets and other utensils is No. 100 clear gloss epoxy from the Peterson Chemical Corp., 704 S. River St., Sheboygan, Wis. 53081. The ingredients in the finish are approved by the Food and Drug Administration for use on utensils. The only restriction I've found in nine years of using the finish is that you can't wash it in a dishwasher, although warm soapy water is okay. For best results, make sure your goblets are dry before applying the finish, or the epoxy will bubble and discolor. When I turn green wood, for example, I store the bowls for several weeks in a room with 30% to 40% humidity, then bake them in a 150°F oven for five to seven hours. For maximum penetration, I thin the first coat 10% to 20% with No. 711 epoxy thinner. I apply five or six more full-strength coats, sanding lightly with 180-grit white silicon-carbide paper between coats. The epoxy seems to go on most easily and harden best when it's applied in a relatively warm 80°F room. For a natural satin finish, I sand the last coat lightly with 320-grit silicon-carbide paper. Finally, I buff the finish by hand with #00, #000 and #0000 steel wool. Make sure you apply the finish in a well-ventilated area.
[David Lory is a woodturner in Platteville, Wis.]

Quest for morado

A few years ago, a friend in Los Angeles bought some wood that resembled cherry, but was denser and had a beautiful red/brown color that was darker than most cherry. As I recall, he called it "masada," which dealers don't list. Could it have been morado? —R.K. Winkleblack, Arroyo Grande, Calif.

Jon Arno replies: Tracking down an exotic wood can often turn up a morass of names, because of differences in terminology between countries, local loggers, importers and lumber dealers. My references list morado as the local name commonly used in Panama and Venezuela to describe purpleheart. If morado is left unfinished, it will often lose some of its vivid purple color and turn a reddish brown, but I doubt your wood is purpleheart. You might, however, check out some of the many Central and South American species of dalbergia marketed as rosewood. I've seen some Bolivian rosewood called morado. These woods are very hard, and some have a dark cherry-like appearance.

The only masada I know of was a mountain fortress mentioned in the Bible. There's a wood called mersawa, cut from several species of the genus Anisoptera, native to Southeast Asia. The lumber industry markets the denser, dark reddish-brown species under the name dark red meranti. I'd say the meranti group is your best bet. For more information on sources, contact the International Wood Collectors Society (IWCS): Mr. Robert Bartlett, 2913 3rd St., Trenton, Mich. 48183.
[Jon Arno is a woodworker and amateur wood technologist in Schaumburg, Ill.]

Readers exchange

. . . The Meguiar's Mirror Bright Polish Co., Inc., makers of the Mirror Glaze compounds mentioned in Beau Belajonas's article on marbleizing wood in *FWW* #65, has a new address. It's: 1 Newport Place, Suite 375, Newport Beach, Calif. 92660. *—Joan Carberry, Newport Beach, Calif.*

. . . While trying to find a collet for an old Stanley router, I discovered that Bosch makes some parts that will fit old Stanleys. I got the collet I needed from White Tool and Supply, 3047 Atlantic Ave., Brooklyn, N.Y. 11208. *—Hugh Cosman, Long Island City, N.Y.*

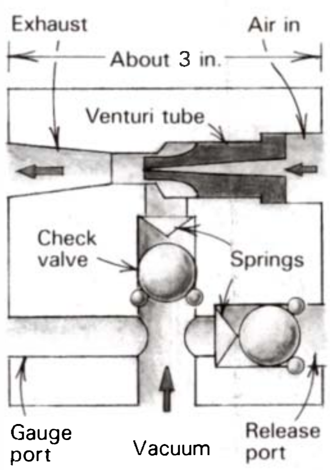
. . . I recently purchased a Boice Crane Lathe that I believe was manufactured in Toledo, Ohio, during the 1940s. Does anyone know of an owners' manual for these lathes or a source of parts? *—Terry Caveny, Edmonton, Alberta, Can.*

Send queries, comments and sources of supply to Q&A, Fine Woodworking, *Box 355, Newtown, Conn. 06470. We attempt to answer all questions but, due to the great number of requests received, the process can take several months.*

Vacuum clamps from compressed air—For operations like pattern routing and shaping or machining parts too small to be mechanically clamped, the vacuum hold-downs described by James Kassner Jr. in *FWW* #66 are a practical solution. But if you don't want to invest in a vacuum system, you can generate vacuum from compressed air instead. Claude Graham of Jacksonville, Fla., reports that a California company sells a line of vacuum clamping equipment designed around a venturi system. The venturi is housed inside a small aluminum cylinder, and when compressed air is squirted through the venturi's tapered tube, a vacuum is created. The venturi and its compressed-air hose can be mounted directly to a vacuum jig then positioned on a machine or worktable. Graham's vacuum setup is controlled with a foot-operated valve.

The venturi device—as well as an extensive line of vacuum hold-down equipment—is available from Safranek Enterprises, 4005 El Camino Real, Atascadero, Calif. 93422, (805) 466-1563. The venturi itself, which Safranek calls a pump, sells for $179, and the adapter to connect it to the jig costs $25. The optional foot valve sells for $82.50. Safranek's venturi requires about 3 cfm of air at 85 psi to produce 16 to 19 inches of mercury. This provides about 7 lb. of pressure per square inch. The system doesn't have as much air flow as a standard vacuum pump; although it works when holding most plywood and other furniture-grade materials, it won't reliably hold porous materials, such as particleboard underlayment.

The mailbag has produced yet another manufacturer of venturis and holding jigs. Ed Thibodeau of Pinchney, Mich., described an $83 venturi that generates 21 inches of mercury at 1 cfm using 3.6 cfm of compressed air at 40 to 50 psi. It incorporates a safety check valve (see drawing) that holds the vacuum if the air pressure fails. The device can be fitted with a vacuum gauge, as well as a muffler. The maker is Stilson Products, 34775 Commerce Ave., Fraser, Mich. 48026, (313) 294-3800.



Bending wood—In his article on bending green wood (*FWW* #64), Drew Langsner focused on traditional methods, using materials that are at-hand and working in a low-tech manner. This approach once made a lot of furniture and essential farm tools, but woodbenders don't have to stick to the old ways unless they want to. William F. Rohlin of Jackson, Mich., wrote to say that his best success bending Windsor arms has come when using air-dried white ash. As long as grain runout doesn't exceed 5%, sawn wood works fine. Instead of using steam, Rohlin soaks his bending stock in a plastic pipe filled with boiling water for about 45 minutes per inch of thickness. He finds this gives him about 15 minutes working time for bending around a form similar to Langsner's.

Rohlin advocates the use of a tension strap when bending, especially after he did some research in the *Wood Bending Handbook* (available from Woodcraft, P.O. Box 4000, Woburn, Mass. 01888, for $9.50 postpaid). Briefly, a tension strap is a length of metal that runs around the outside of the stock during the bend, putting the wood under compression so it won't split. The strap allows much tighter bends than would be possible with unsupported wood. For example, based on 1-in.-thick stock, unsupported ash won't bend tighter than about a 13-in. radius, but a tension strap will let you bend it to a radius of a little less than 5 in. Other woods are even more dramatic: The figures for cherry are 17 in. and 2 in.; for white oak, they're 13 in. and an astonishing ½ in. The tension strap can't perform miracles, however—some woods just don't want to bend. Teak, hemlock and Douglas fir are among the most troublesome—they'll all break at about an 18-in. radius, even when supported.

There are a number of reusable and adjustable tension straps shown in *FWW on Bending Wood* (The Taunton Press), but I'm not sure that the low-tech method I use most of the time has ever made it into print. From some leftover aluminum flashing, I cut a strap a little wider than the stock, and about 4 in. longer. When the wood comes out of the steamer, I lay it on the aluminum strap and bend the extra length around the ends of the stock, securing it with C-clamps. This has worked fine for bending light-duty basket handles and the like. You can reuse the aluminum a few times, but I bend wood so rarely that I usually toss it. Also, it's the only use I've found for surplus flashing, and it gives me a sense of satisfaction to feel that I'm gradually using it up. If anybody out there has some other ideas, I'd be glad to hear of them. Co-editor Dick Burrows, by the way, has just come up with the first—he built the air ducts for his homemade forge with surplus flashing and duct tape, but he admits that he still has some flashing left over. "How much do you want?" he asked.

Dressed up—Last issue's cover of Michael Podmaniczky sawing a tenon prompted a few readers to comment that he was dressed rather formally for woodworking, and that the picture looked somewhat staged. The truth is that Podmaniczky's job as a conservator at Winterthur requires him to be in and out of formal meetings most days, and he dresses the part. To protect his clothes, he usually wears a smock in the Winterthur shop, which gives him a medical air that we didn't think would look quite right on the cover. But, hey, give us credit for one thing—we made him take off his tie and put his badge in his shirt pocket.

Jaws—Myer S. Freshman's mention that three-jaw chucks can be knuckle busters ("Letters," *FWW* #63) prompted Rich Kjarval of Chicago, Ill., to tell us that he has devised a partial solution. He wraps a length of ordinary white Velcro tape around the projecting jaws. The light color makes them much more visible when the lathe is spinning and, in the event a mishap occurs in spite of the precautions, the tape is bulky enough to soften the blow. To get the Velcro to stick to itself, simply glue a piece of "hook" Velcro to the back of a length of "loop" Velcro. You should be able to buy the tape in any sewing store.

Faux follow—The article on faux finishing in *FWW* #65 prompted a letter from Ken Coleman, Director of the Craft Students League at the YWCA of the City of New York (610 Lexington Avenue, New York, N.Y. 10022). He informs us that the League runs a number of classes on faux finishing, in addition to the woodworking courses mentioned in the "Events" column.

Done in a workmanlike manner—That's just what William Morgan of St. Petersburg, Fla., tells us our electrical wiring is not. A retired electrician, he bristled with indignation at the photo of the magnetic switch on p. 58 of *FWW* #64. The grounding conductors (green wires) should have been attached to single-purpose grounding screws specifically designed for the purpose, not to the magnetic switch's mounting screw.

Moreover, the power line is the wrong sort for the box. Instead of round residential wire, we should have used flat cable with an approved glandular/compression fitting. This fitting prevents damage to the wire's insulation and also seals the box against sawdust, which could present a fire hazard. □

Jim Cummins is an associate editor of Fine Woodworking.

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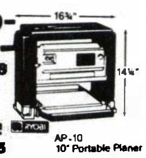

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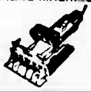

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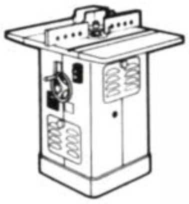

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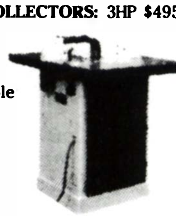

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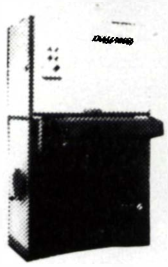

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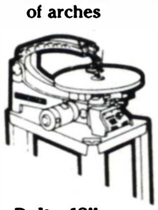

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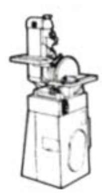

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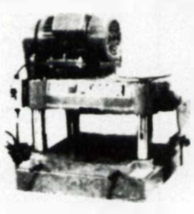

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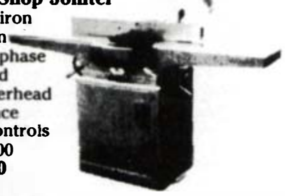

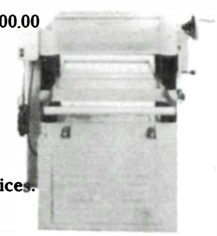

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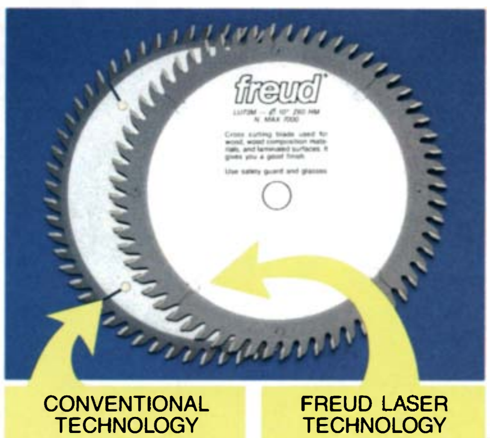

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Model		List	Sale
MR 222/S5	Ash Hdles.	26.60	21.00
MR 444/S5	Polypropylene Hdles.	34.40	27.00
MR 373/S5	Splitproof Hdles.	44.70	35.75
MR 377/S5	Boxwood Hdles.	56.50	45.00
MR 370/S5	Trad. Rd. Ash Hdles.	30.85	24.70

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#1000	Self-Centering	33.95	23.95
#2000	Self-Centering w/Bushings	42.95	31.95
#04-059	Stanley Dowel Jig	46.95	28.95
	Dowel Crafter Jig	44.95	34.00

LEIGH DOVETAIL JIGS

Model	List	Price
D1258-12	299	235
D1258-24	359	265
TO 514	149	120
TO 514L	219	165

DELTA BENCH TOP TOOLS

Model		List	Sale
23-700	Wet/Dry Grinder		120
23-680	6" Bench Grinder ¼ H.P.	65	55
23-880	8" Bench Grinder ½ H.P.	104	89
11-950	8" Bench Drill Press	130	105
14-040	14" Bench Drill Press	262	220
40-500	15" Hobby Scroll Saw	110	90
28-160	10" Bench Band Saw	166	138
17-900	16½" Drill Press	332	265
40-150	15" Scroll Saw 1.6 AMP	165	135
31-050	1" Belt Sander 2.0 AMP	69	65
31-460	4" Belt/6" Disc Sander ⅓ H.P. 4 AMP	165	135

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120C	100	21.00
150C	100	21.00
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280A	100	17.00

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Item No.	Description	Diam.	Teeth	List	Sale
LU72M010	Gen'l Purp.	10"	40	68.58	34
LU82M010	Cut-Off	10"	60	86.40	44
LU84M011	Combination	10"	50	74.51	37
LU85M010	Super Cut-Off	10"	80	110.88	62
LM72M010	Ripping	10"	24	64.85	34
DS 306	6" Dado			139.00	92
DS 308	8" Dado			170.00	105
PS203	Gen'l Purp.	7¼"	24	27	17.50
PS303	Plywood	7¼"	40	33	20.50

MAKITA CORDLESS

Model		List	Sale
6002DWK	⅜" Drill Kit 2 Spd. Rev. 7.2v	178	91
6070DW	⅜" Var. Spd. Rev. 7.2v	108	57
6071DWK	⅜" Var. Spd. Rev. w/removable batt.	180	102
4300WD	Jig Saw	188	99
5081DW	3⅜" Saw Kit	212	95
5600DW	6¼" Circular Saw	284	125
9035DW	Finishing Sander	168	73
6010DWK	⅜" Cordless Drill Kit	174	88
6010SDW	⅜" Cordless Drill	94	45
8400DW	⅜" Hammer Drill	224	105
DA3000DW	⅜" Angle Drill	218	98
6010DL	⅜" Drill w/Flashlight	188	89
6012HDW	⅜" 2 spd Driver Drill w/Bat & Metal Case	208	98
OK1002	⅜" Drill w/Flursnt Lt.	176	90
6710DW	Cordless Screwdvr Kit	176	84

Model	MAKITA BATTERIES	List	Sale
7.2 Volt		40	27
9.6 Volt		44	29
10.8 Volt		99	66

MAKITA TOOLS

Model		List	Sale
5007NBA	7¼" Saw w/Elec. Brake	186	114
5008NBA	8¼" Saw w/Elec. Brake	212	130
B04510	Sander	92	43
9900B	3" x 21" belt sander	234	119
99248	3" x 24" belt sander	222	130
9924D8	3" x 24" b/sand. w/bag	248	130
9035	⅓ sheet finish sander	96	48
90458	½ sheet finish sander	186	90
9045N	¼ sht lin. sand. w/bag	190	105
4200N	4⅜ circ. saw 7.5 amp	182	93
5201NA	10¼ circ. saw 12 amp	438	215
4300BV	v/sp jig saw 3.5 amp	234	117
4301BV	orb v/sp jig saw 3.5 amp	248	125
JR3000WL	2 sp recip saw w/cse	198	120
JR3000V	vs recip saw w/case	208	110
LS1000	New 10" Mitre Box	396	198
9820-2	Blade Sharpener	288	159
410	Dust Collection Unit	410	269
3705	Offset Trimmer	218	115
1900BW	3¼" planer w/case	198	93
1100HD	3¼" planer w/case	328	160
9207SPC	7" Sander-Polisher	250	140
36018	1⅜ hp router	218	115
3700B	½ hp trimmer	162	82
9501B	4" Grinder Kit	119	55
B04530	6" Round Sander	98	48
DA3000R	⅜" angle drill	212	129
DP4700	½ v/sp w/rev 4.8 amp	178	92
HP1030W	⅜ v.s.r. hammer drill w/cs	168	98
6300LR	½" angle drill w/rev	288	152
8419BB-2W	½" s sp. hammer w/cs	268	150
2708W	8¼" Table Saw	348	209
GV5000	Disc Sander	108	53
6800DB	2500 rpm 3.5 amp	146	79
6800DBV	0-2500 rpm 3.5 amp	156	89
6801DB	4000 rpm 3.5 amp	146	79
6801DBV	0-4000 rpm 3.5	156	89
2030n	12" planer/jointer	2580	1475
2040	15⅝" planer	2180	1195
1805B	6⅛" planer kit w/case	498	265
JV1600	var. speed jig saw	178	89
JV2000	var. speed orb. jig saw	198	100
5005BA	5½" circular saw	192	98
5007NB	7¼" Circ. Saw	158	94
9503BH	4½" sander-grinder kit	166	95
4014NV	var/speed blower	168	79
DP3720	⅜ drill Rev. 0-1800 rpm	99	47
6510LVR	⅜ drill Rev. 0-1500 rpm	144	65
6013BR	½" Drill rev. 6 amp	208	100
5402A	16" Circular Saw - 12 amp	542	315
3612BR	3 HP Plunge Router	338	172
9401	4x24 belt Sander w/bag	288	160

SKIL SIZZLERS

Model		List	Sale
5510	(551) 5½" Circ. Saw	130	78
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	252	135
5865	(825) 8¼" Worm Saw	277	149
3810	10" Mitre Saw	349	169
7565	Palm Sander	69	37

SKIL BRAND NEW MODEL 2735-04
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499.00

28-283F 14" Band Saw w/enclosed stand & ¾ H.P. motor
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43-122 Lt. Duty Shaper w/stand & 1 H.P. motor
499.00

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- An excellent all-purpose blade

Model#	Diameter	#Teeth	List	Sale
73-756	6-1/2	36	26.90	14.80
73-717	7-1/4	18	11.72	6.45
73-737	7-1/4	24	14.92	8.20
73-757	7-1/4	40	27.40	15.10
73-758	8	40	39.90	21.95
73-759	8-1/4	40	40.66	22.35
73-739	9	30	29.52	16.25
73-769	9	60	64.40	35.40
73-740	10	32	30.98	17.00
73-770	10	60	64.90	35.75

JORGENSEN HAND SCREWS

Model	Jaw Length	Open Cap.	List	Sale	Box of 6
#5/0	4"	2"	11.59	7.25	39.15
#4/0	5"	2½"	12.45	8.10	43.75
#3/0	6"	3"	13.36	8.50	45.95
#2/0	7"	3½"	14.36	8.95	48.35
#0	8"	4½"	15.97	9.95	53.75
#1	10"	6"	18.25	11.35	61.25
#2	12"	8½"	20.94	13.60	72.95
#3	14"	10"	26.56	16.75	91.35
#4	16"	12"	34.55	23.75	128.25

BRAND NEW BY JORGENSEN

STYLE 35 — Alum Bar Clamps

Model	Jaw Length	List	Sale
3524	24"	23.45	13.95
3536	36"	25.16	14.95
3548	48"	27.62	16.50
3560	60"	30.77	18.50
3572	72"	33.26	19.95

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SFN1	Finishing to 1¾"	349	269
SFN2	Finishing to 2½"	529	398
SN2	Sheathing - Siding, etc.	525	395
M2	All Purpose	440	330
SN4	Const. Framing, etc.	635	485
LS2	Moulding & Trim	325	259
LS4	Moulding & Trim	330	265

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Model EY561B features Jacobs keyed chuck ⅜" 7.2 volt 2 speed — 300 low - 880 high torque in low - 104 in lbs 5 position clutch. 1 hour charger complete w/case - battery - charger
List Price 179.00 Special Sale 119.00

JORGENSEN BAR CLAMPS

STYLE 37 — 2½" Throat ¼" x ¾"

Model	Jaw Length	List	Sale	Lots of 6
#3706	6"	7.88	5.50	29.70
#3712	12"	8.73	5.95	32.13
#3718	18"	9.64	6.95	37.53
#3724	24"	10.54	7.35	39.69
#3730	30"	11.76	8.25	44.55
#3736	36"	12.85	8.95	48.33

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Model		List	Sale	Lots of 12
#50	for ¾" Black Pipe	11.23	7.15	79.00
#52	for ½" Black Pipe	9.36	6.10	67.50

••MAKITA NEW TOOLS••

Model		List	Sale
6092DW	Cordless Driver Drill Kit 2 Spd.-var. spd. rev. w/o clutch complete w/case	208	106
6093DW	Cordless Driver Drill Kit 2 Spd.-var spd. rev. and 6 stage torque setting complete w/case	224	119
6891DW	Cordless Drywall Screwdriver Kit 0-1400 R.P.M.-Lt. weight - 2.9# complete w/case	204	109
3620	1¼ H.P. Plunge Router 7.8 amp-24,000 R.P.M complete w/case	166	89
4302C	Electronic Jig Saw orbital, var. spd. 6 amp.	256	139
5077B	7¼" Hypoid Saw (similar to worm drive) 13 amp-4,300 R.P.M	250	133

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Model	WORM DRIVE SAWS	List	Sale
3050	6½" 12 amp - 4600 rpm	247	169
3051	7¼" 13 amp - 4300 rpm	232	135
3052	8¼" 13 amp - 4300 rpm	247	169
	BUILDERS SAW CAT		
3030	7¼" 13 amp - 5800 rpm	155	100
3035	8¼" 13 amp - 5800 rpm	175	125
3034	7¼" 13 amp - 5800 rpm	162	110
3047-09	7¼" Super w/elec. Brake	249	159
3048-09	8¼" Super w/elec Brake	264	169

BLACK & DECKER CORDLESS

1920	⅜" Rev. H.S Drill Kit	174	99
1921	⅜" Rev H.S Drill	135	84
1930	⅜" Rev. H.S. Drill Kit w/cs	181	103
1940	⅜" Rev. High-torque Drill Kit	174	99
1941	⅜" Rev. High-torque Drill	135	85
1950	⅜" Rev High-torque Drill Kit w/cs	181	105
1970	⅜" Rev. High-torque Scrudrill w/cs	188	117
1975	⅜" Rev High-torque Scrudrill	162	105
1980	⅜" Rev. Adj. Clutch Scrudrill Kit	184	100
1985	⅜" Rev. Adj Clutch Scrudrill	158	98
2901	⅜" Rev H.S. Clutch Scrudrill	192	118
2931	⅜" Rev High-torque Clutch Screwdriver	192	118
5930	⅜" Hammer Drill Kit	199	124
5921	⅜" Hammer Drill	169	110

NOTE: IF YOU PURCHASE A #1940 - #1950 OR #1980 B & D CORDLESS RECEIVE A
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BOSCH TOOLS

		List	Sale
1581VS	Top Handle Jig Saw	225	129
1582VS	Barrel Grip Jig Saw	126	119
1942	Heat Gun 650°-900°	99	69
1272	3x24" Belt Sander	259	159
1272D	3x24" Belt Sander w/bag	274	169
1273	4x24" Belt Sander	274	169
1273D	4x24" Belt Sander w/bag	289	179
11212	Bulldog ¾" SDS Rotary Hammer	329	175
1920VSKR	Var/Sp Cordless 2 Spd.	169	79
1196VSRK	⅜" hammer drill v.s	190	109
1198VSR	½" hammer drill - 2 sp v.s.	199	119

PORTER CABLE TOOLS

Model		List	Sale
630	1 H.P. Router — 6.8 AMP	150	93
690	1½ H.P. Router — 8 AMP	194	114
691	1½ H.P. Router D-Hdle.	218	129
536	1½ H.P. Speedmatic Router	300	184
518	3 HP Router 5 Speed	490	323
520	3 H.P. Router 15 AMP	460	298
309	Trimmer 3.8 AMP	130	84
310	Trimmer 3 AMP	190	124
312	Trimmer Offset Base	205	133
319	Trimmer — Tilt Base	215	138
695	H.D. 1½ H.P. Router/Shaper	278	190
696	H.D. Shaper Table	149	104
351	3 x 21 Belt Sander w/o Bag	189	125
352	3 x 21 Belt Sander w/Bag	199	115
360	3 x 24 Belt Sander w/Bag	280	185
361	3 x 24 Belt Sander w/o Bag	260	175
362	4 x 24 Belt Sander w/Bag	295	198
363	4 x 24 Belt Sander w/o Bag	280	185
587	7¼ Speedtronic 14.5 AMP Saw	199	125
315-1	7¼ Top Hdle. 13 AMP	166	96
617	7¼ Push Hdle. 13 AMP	166	96
346-1	6½" Top Hdle. 12 AMP	161	100
368-1	8¼" Top Hdle. 13 AMP	176	110
314	4½" Trimsaw 4.5 AMP	180	109
548	X-H Duty Bayonet Saw	235	155
9548	X-H Duty Saw w/case	255	169
9629	Recip Saw v/sp 8 AMP	204	133
9627	Recip Saw 2 Speed 8 AMP	193	124
666	⅜" H.D. v/sp Drill	165	115
620	⅜" H.D. 4 AMP 1000 R.P.M.	124	85
621	⅜" H.D. v/sp 0-1000 R.P.M.	130	78
320	Abrasive Plane	129	89
126	Porta-Plane — 7 AMP	265	179
9118	Porta-Plane Kit	299	186
653	Versa-Plane — 10 AMP	399	265
9652	Versa-Plane Kit	419	275
7545	V.S. Drywall Gun H.D.	163	110
505	½ sht pad sander	180	100
7511	⅜" v. sp. drill 5.2 amp	164	102
7514	½" v. sp. 0-750 H.D. drill	169	104
666	⅜" H.D. v/sp. T hdle 4A	165	110
303	Paint remover	220	145
304	7" disc sander 4000 rpm	175	110
305	7" disc polisher 2000 rpm	175	110
367	3¼" plane 6.5 amp	187	120
537	1½ HP router d hdle	315	189

X TRA SPECIAL BY PORTER CABLE

		List	Sale
9118	Porta Plane Kit	299	185
7548	Top Handle Jig Saw	199	119
7648	Barrel Grip Jig Saw	199	119
330	Bloc Sander ¼ Sheet	90	52

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MODEL		LIST	SALE
0210-1	Cordless Drill - 2 Speed - 9.6 Volts 4 Position Clutch	195	119
0212-1	V.S.P. Cordless Drill	229	130
0214-1	Cordless Drill - V.S.P. 7.2 Volts	195	119
0222-1	3/8" V.S.R. Drill	165	97
0228-1	3/8" V.S.R. Drill	145	78
0234-1	1/2" V.S.R. Drill	179	105
0244-1	1/2" V.S.P. Magnum Drill	179	115
0375-1	3/8" Close Quarter Drill	195	125
1001-1	1/2" D. Hdle. Rev. Drill	207	125
1107-1	1/2" D-Hdle. V.S.R. Drill	222	145
3002-1	1/2" Rev. Electricians R.A.D. Kit	290	185
3102-1	Plumbers Rt. Angle Drill Kit	295	165
3107-1	Plumbers Rt. Angle Kit V.S.R.	305	195
3300-1	Electrician Rt. Angle V.S.R.	279	185
1676-1	H.D. Hole Hawg w/cs 2-sp.	375	249
1660-1	H.D. Compact Hole Shooter	239	159
5344	1 1/4" VS Rotary Hammer Kit	714	435
5348	1 1/2" VS Rotary Hammer Kit	768	460
5397-1	3/8" Hammer Drill Kit V.S.R.	227	155
5371-1	1/2" Magnum - 2-sp. V.S.D. Kit	313	210
5660	1 1/2 H.P. Router	299	185
6145	4 1/2" Sander-Grinder	149	95
6065	7"-9" Sander-Grinder	199	120
6012	1/3 Sheet Sander 5 amp.	179	115
6014	1/2 Sheet Sander 5 amp.	189	120
6165	12" H.D. Chop Saw	329	209
6170	14" H.D. Chop Saw	349	219
6232	Band Saw 4 3/4" w/case	452	305
6305	H.D. 6 1/4" Cordless Circular Saw 12 Volts - 3400 R.P.M.	239	169
6366	7 1/4" Circular Saw w/C.T. Blade and Rip Fence	187	105
6368	Same as above except includes case	216	125
6377	7 1/4" Worm Drive Saw	275	165
6507	Sawsall V. Sp. Complete w/cs.	219	129
6539-1	Cordless Screwdriver 2.4 Volt - 190 R.P.M.	103	66
6750-1	Drywall Gun 4.5 amp. 0-4000 R.P.M.	141	90
6753-1	Drywall Gun 3.5 amp. 0-4000 R.P.M.	125	79
6747-1	Drywall Gun 4.5 amp. 2500 R.P.M.	141	100
8975	Heat Gun - 2-Temps.	81	59
8977	Heat Gun - Var. Temp.	108	73

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Full-bodied without being boxy, Laskin's guitar has roots stretching back to both the classical instruments of Spanish luthier Antonio de Torres and the Central-European steel string tradition.

Building a Steel String Guitar

An overview of the fine points

by William "Grit" Laskin

There exists, especially among artisans, a general acknowledgement that musical instrument making is a singular endeavor, a category unto itself in the craft world. An instrument must please the eye, must be constructed so as to withstand perhaps many hundreds of pounds of pressure, must be playable with proper ease and, above all, must have the ability to produce tonally subtle, refined musical sounds that can reach the back of a hall unamplified.

A tall order? Perhaps.

If, however, it was an insurmountably difficult job to produce a good musical instrument, I wouldn't attempt to help you do just that. So, resist those thoughts of "too tough" or "I'm really just into furniture" and read on.

This is the first part of a three-article series in which I intend to guide you through the building of a superior steel string guitar. I can't provide you with every detail for each minute step in the process—for that, I'd need an entire book. What I *will* do as we move through each stage is focus on guitarmaking's trickier and most troublesome processes. Short of brief mentions, I'll leave the description of the more routine procedures to the authors of several fine, comprehensive texts that exist on the subject (see "Further reading and suppliers," p. 49).

Part one of this guitarmaking series of articles—the one you're reading now—will examine general theories of guitar design in conjunction with the needs that guide selection of materials. As you'll soon see, the two are greatly interconnected. By the close of part one, I'll have brought you to the very first assembly stages dealing with the soundboard, or top, and the back.

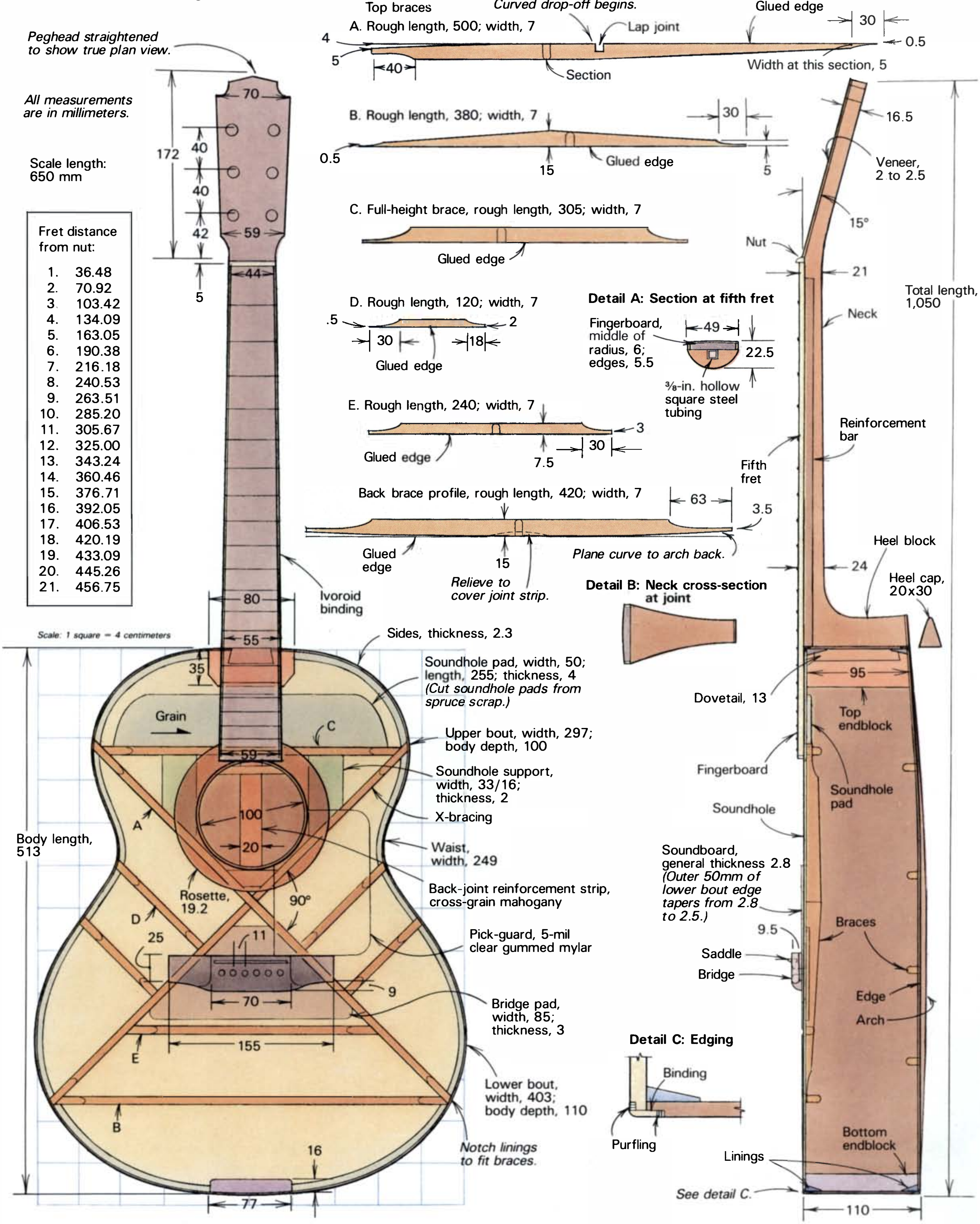
In part two, we'll bite into the meat of guitarmaking. This will include bending the sides, assembly and completion of the frame (the glued-up sides, interior blocks and linings), a brief look at the top, the how-to of achieving seamless purfling joints and the critical dovetail neck joint.

By part three, we'll be ready to look at those murky territories known as *action* and *set-up* (playability, string height, etc.—what is often called the "feel" of an instrument).

I realize that most woodworkers have no intention of becoming professional luthiers, but some of you might. So, similar to the way one must learn to add and subtract before attempting calculus, I strongly suggest doing as I did: begin by following your

Photos: Brian Pickell

Fig. 1: Measured drawings Laskin steel string, ©1987



Fret distance from nut:	
1.	36.48
2.	70.92
3.	103.42
4.	134.09
5.	163.05
6.	190.38
7.	216.18
8.	240.53
9.	263.51
10.	285.20
11.	305.67
12.	325.00
13.	343.24
14.	360.46
15.	376.71
16.	392.05
17.	406.53
18.	420.19
19.	433.09
20.	445.26
21.	456.75

instructor's designs to the letter. Later, as your workmanship and skill at instrument making are honed, there will be time to indulge in all the wild and crazy ideas that you can't wait to turn into reality. The guitar in this series is the result of a 16-year synthesis of my teacher's ideas (which had evolved from those of *his* teacher), my own experimentation and the absorption of ideas from many sources. The experimenting, changing and redesigning processes—the rethinking and pushing of the limits—are the real challenge and attraction of a life in the trade.

With every step of construction, an instrumentmaker asks: how will this material/dimension/location/angle affect the sound? And how will it affect the instrument's ability to withstand its string tension in the long run? Maintaining the balance between these two properties—strength and sound production—is our ultimate goal.

The shape—If you glance at the scaled drawings, the first thing you're likely to notice is the shape of the body. Though mine is a large-bodied guitar, it doesn't have the squared-off look of a type known as a *dreadnought*. The dreadnought was developed by C.F. Martin and Co. earlier in this century to produce a very popular deep-sounding, bass-heavy guitar.

In general, big, deep instrument bodies respond better to lower sound frequencies and smaller, shallower boxes (as the bodies are also called) do a better job on higher frequencies. I'm interested in a guitar with a balanced sound—equal volume and quality to both the treble and bass. Hence, my guitar differs from a dreadnought in that it has a tighter waist, rounder lower bout, curvier lines and marginally shallower depth. These features grew from classical guitar styling, but the shape is distinctly my own and like no other.

In my guitar, all of the various physical elements are intended to exist in tandem with each other to produce the loud, very clear, balanced sound I desire. Another maker experiments similarly until all of the design elements click together in the way he or she desires—and so it goes throughout the trade. And, it's important to note, there's no single physical aspect of the instrument that doesn't affect its sound.

When you have a chance, strum a chord on a guitar and, while it's still sounding, lightly touch the tip of the peghead. You'll feel that it, too, is vibrating. In fact, every part of the instrument responds to vibration. As a consequence, each part receives—and, to varying degrees, returns—those vibrations, thereby affecting the total collective sound wave that moves the air, ultimately hitting your eardrum. That description may be somewhat simplified, but I feel it is an important concept to grasp on the road to gaining what one might label a holistic sense of the guitar. By "holistic" I mean never losing sight of the instrument as a whole, either as a single physical thing or as an object inseparable from its function.

If you do this, it won't come as a surprise when you read about someone clamping weights to a guitar's peghead and dramatically increasing sustain (the duration of the musical tone once the string is plucked). Or when you learn that a finish that's too heavy or of the wrong substance can negate many of the valuable sound qualities that would otherwise have been present. Or when you hear the difference even a one-centimeter change in the string length can make to the projection, brilliance and volume of the sound. All of these things, incidentally, will happen regardless of how the body was constructed.

I should say a word here about the metric system, which will be used for the guitar plans throughout. Out of deference to readers in the United States, I seriously considered converting my measurements to inches. This proved extremely clumsy—the distance of this guitar's vibrating string length, 65cm, is 25.59 in., or a hair less than 25$\frac{19}{32}$ in.; what figure should I give? Furthermore, it soon became obvious that, with all the rounding up and rounding down required, working in inches was not the way to build this particular guitar. The reason is that its design springs from a European tradition, embraced from Spain through Germany—it was conceived in and evolved in the metric system. I realize that many excellent guitars are built in inches, but to try it with this one would be to buck a strong head wind all the way.

Materials—In addition to this guitar's dimensions, the materials it's made of influence its sound. Each part of the guitar has a distinct role to play—some more important than others—in terms of sound or strength. The properties intrinsic to each part's particular species of wood should match its required function.

As near in time to us as the middle of the last century, a Spaniard by the name of Antonio de Torres was single-handedly responsible for standardizing the elements of guitar design, much as Stradivari did for the violin. The steel string guitar, though today a very different instrument than a nylon-strung classical, is the result of adapting Torres' pioneering designs to strings of much higher tension and dissimilar sound qualities. To function well under the differing demands of steel strings, guitars were given steel neck reinforcement rods, a larger body and an X-shaped inner top bracing of triple the mass that Torres' guitar used. Yet the overall design concept is still Torres'. So, too, are the choices of materials for the various parts of a guitar.

For the soundboard, Torres did not face a difficult choice. The spruce and pine family had already proven their worth in numerous other stringed instruments—harpsichords, viols and early guitars, to name just a few. Other woods, such as Western red cedar, redwood and softer mahoganies, are among the variables that modern makers sometimes use in place of spruce. Cedar, in fact, has become as common as spruce for classical guitar tops.

As to precisely why the structure of a certain softwood is its ticket to superior performance as a soundboard, there has yet to emerge a conclusive theory. Physicists, acousticians and luthiers the world over have been grappling with that puzzle just long enough to begin forming better questions.

Our next order of business is with the other major segments of the sound box—the back and sides.

Many varieties of hardwoods and softwoods—rosewood, maple and cypress among them—were the side and back choices of guitarmakers even before Torres. It was from his work, however, that we saw rosewood predominate. (This excludes traditional flamenco guitars which, to this day, are built of Spanish cypress.)

The material selected for the back and sides of the guitar must play two major roles. One is to provide reflective surfaces with a minimum of dissipating absorption of vibrations. This quality is crucial in providing projection and volume. Second is the planned shaping of tone color. Rosewood, with its particular combination of brittle hardness, density and weight, gets high marks in both of these categories. Musical properties of guitars that you might hear described as "mellow clarity," "brilliant trebles" or "deep yet clear bass notes" will more often than not be emanating from a rosewood body.

Of the more than 200 different rosewoods around the world, only two or three species have been found suitable for guitars—so far, that is. The first and longest-reigning king was Brazilian rosewood. Its distinctive black and brown grain patterns shone from beneath the finish of the vast majority of high-quality instruments up until the early 1960s. At that point, Brazil surprised the guitarmaking community by placing an embargo (still in effect) on its large rosewood lumber. Having over-harvested its rosewood forests for decades, Brazil simply decided that it was time for the millwork and veneer-making profits flowing into other countries to be diverted back home. As a result, only thin furniture veneer and small, low-grade lumber pieces now find their way to export.

Guitarmakers and players cried and tore their hair and thought the sky had fallen. But, when the dust settled, the guitar world had shifted to another qualitatively similar and eminently available rosewood: East Indian.

The rosewood from East India may not be as pretty as Brazilian, but, aside from being slightly less brittle (and, therefore, less prone to cracking), its properties of weight, strength and density are almost identical. Hence, East Indian rosewood easily produces a guitar equal to one of Brazilian rosewood. Don't let anyone tell you different.

The third rosewood, used occasionally as an alternative, is the orange-brown African bubinga. It's the only other major rosewood with a hardness and density suitable for making guitars. When East Indian rosewood is embargoed or no longer available because of over-harvesting—and that day will come—I predict that guitars will be made with bubinga.

For necks, the ideal wood is not too heavy and not too dense, is strong for its weight and is generally stable. A good mahogany from tropical America fits the bill. Maple is also a good choice, as would be any of the softer hardwoods that meet the criteria.

In this part of the instrument, stability is of utmost importance. If the neck wood responds too easily to fluctuating climatic conditions, as will a dense rosewood or ebony, the neck will be like a tree in the breeze, bending backward and forward at the beck and call of the changing seasons. The fingerboard/neck angles are so critical to the instrument's playability that they must be set onto reliable, stable materials you can count on (as much as is possible) to stay put. One other important property of the neck is the effect it has on sustain. Think back to the idea of attaching a weight to the peghead, mentioned earlier. A neck of increased weight or density has the same effect.

A typical steel string guitar has a metal truss rod inside it and heavy, geared machine heads, both of which add greatly to the weight of the neck. This fact, plus the inherent nature of steel string wire, serves to equip the normal steel string guitar with good sustain from the start. For this reason, enhancing sustain is unnecessary. Were we building a more sensitive classical guitar, where simply substituting curly maple for mahogany would produce noticeable sustain gain, I would have altered our materials list accordingly.

Glued mostly to the neck and partly to the guitar top is what's known as either the fretboard or the fingerboard. Because this is the part of the guitar that gets the most wear—the digging and scraping action of your fingers and nails as they reach for and press the strings, plus the holding of the fret wire—the fingerboard must be made of a hard material. The two universal wood choices for this job are ebony and rosewood, both of which can be found on Torres' guitars. Obviously, the better choice is the denser and harder of the two: ebony. It's also, to my mind, the more sleekly attractive of the two.

The earliest ebony of commerce came from Ceylon in East India. When production there dropped, various African species, the best being gaboon, took up a little of the slack. Today, the scales have tilted slightly back, and Ceylon ebony is once again the easiest ebony to obtain in good quality.

Ebony has, in addition, become the traditional wood for steel string guitar bridges. A hardwood of some type is a necessity here, as much as for the fingerboard, because the bridge has to cradle the saddle—the thin, notched strip that the strings run over—and offer a securing point for the strings. Above that, a correctly sized dense wood acts as the ideal driver of the soundboard by the way it naturally transfers the vibrations it receives from the strings and saddle.

Finally, we're left with the nut and saddle—the points at which the strings are in physical contact with the instrument at both ends of the established string length.

Since ancient times, hard substances such as ebony, shell, bone, ivory, metal or stone have been employed as the underpinners and guiders of strings on musical instruments. The need was for a material with the hardness to maintain its edges under tension

Further reading and suppliers

Many of the books listed below can be ordered from: Bold Strummer Ltd., 1 Webb Rd., Westport, CT 06880, or Books About Wood, R.R.#3, Owen Sound, Ontario, Canada N4K 5N5. Check a local library for the availability of out-of-print books.

Steel string guitars

The Steel String Guitar: Construction And Repair by David Russell Young. Chilton Book Co., Library Services, Chilton Way, Radnor, PA 19089; 1975.

Steel String Guitar Construction by Irving Sloane, E.P. Dutton, New York, NY 10016 (out of print).

The Steel String Guitar by Donald Brosnac, Panjandrum, Los Angeles, CA 90025 (out of print).

Classical guitars

Classic Guitar Construction by Irving Sloane. Sterling Publishing Co., Inc., 2 Park Ave., New York, NY 10016; 1966.

Make Your Own Classical Guitar by Stanley Doubtfire. Victor Gollancz, London, 1981; reprinted by Schocken Books, 200 Madison Ave., New York, NY 10016; 1983.

Classic Guitar Making by Arthur E. Overholtzer, Brock Publishing Co., Chico, CA 95927 (out of print).

General

Guitar Making: Tradition and Technology by William Cumpiano and Jon Natelson. Rosewood Press, 85 North Whitney St., Amherst, MA 01002; 1987.

Guitars: Music, History, Construction and Players—From The Renaissance to Rock by Tom Evans and Mary Anne Evans. Paddington, London, Eng., 1977.

Guild of American Luthiers, 8222 South Park Ave., Tacoma, WA 98408. Quarterly publication and data sheets on guitarmaking.

Journal of Guitar Acoustics, back issues available from Rosewood Press, 85 North Whitney St., Amherst, MA 01002.

Suppliers

A & M Wood Specialty, 358 Eagle St. North, Box 3204, Cambridge, Ontario, Can. N3H 4S6.

Eastern Mercantile, Box 153, Frederickton, N.B., Canada E3B 4Y9.

Euphonon Co., Box 100, Orford, NH 03777.

Exotic Woods Co., Box 32, Haddon Heights, NJ 08035.

International Violin Co., 4026 W. Belvedere Ave., Baltimore, MD 21215.

International Luthier's Supply, Box 580397, Tulsa, OK 74158.

Luthier's Mercantile, Box 774, 412 Moore Lane, Healdsburg, CA 95448-0774.

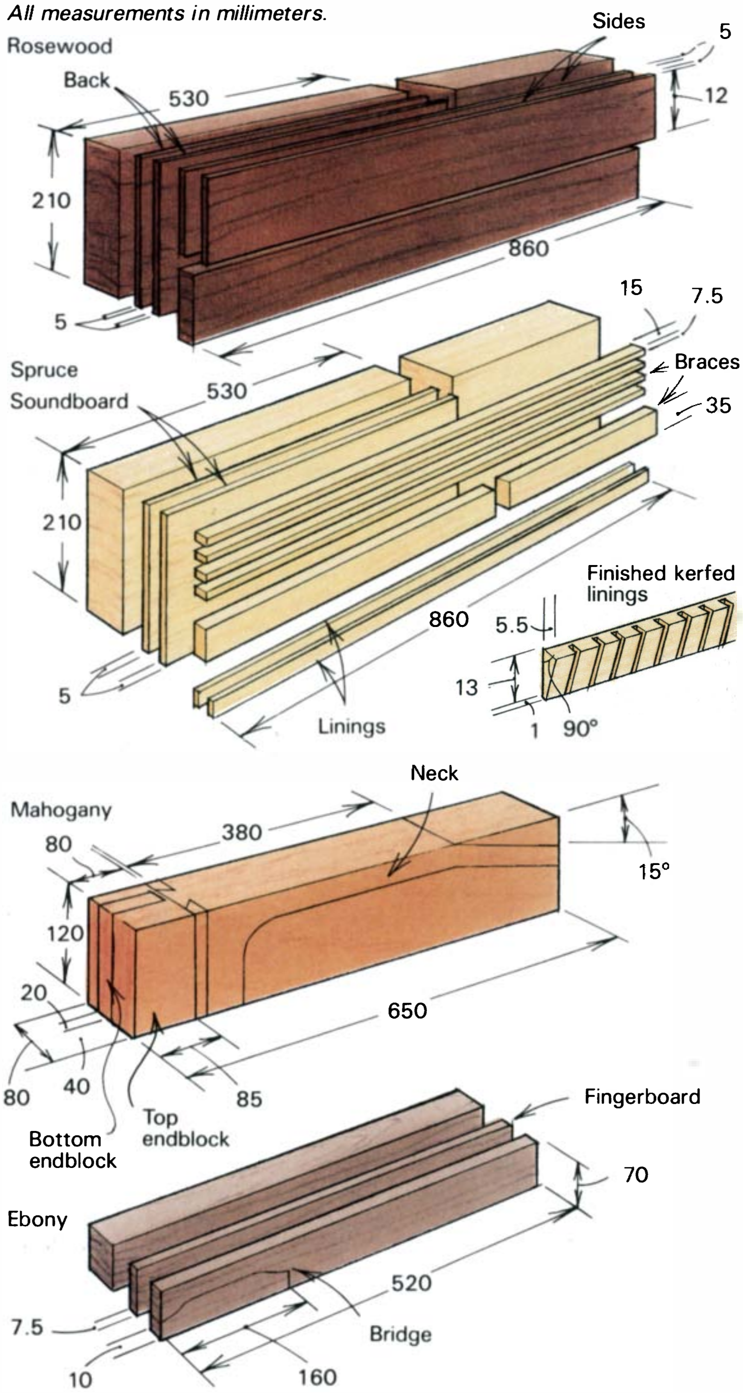
Martin Guitar Co., Box 329, Nazareth, PA 18064.

Stewart-Macdonald, 21 North Shafer, Box 900, Athens, OH 45701.

Unicorn Universal Woods, 4190 Steeles Ave. W., Unit 4, Woodbridge, Ontario, Can. L4L 3S8.

Fig. 3: Grain orientations

All measurements in millimeters.



and through thousands of string changes. Ideally, that material should also be easily workable for accurate shaping. Those needs were best met, historically, by bone and ivory. Ivory is nicer to work with—if you have no qualms about using a material that's "harvested" from an endangered species—but bone will do, as will some man-made materials, such as Corian and Micarta.

A direct result of the nut's and saddle's locations at the start and end of the scale length (the musically active span of the strings) is that they affect the initial vibration on its way to the rest of the instrument. When the nut and saddle are of softwood, they tend to dull the sound. Conversely, when they're made of a metal such as brass or steel, the sound takes on a harshly bright edge. Bone and ivory are in the middle ground, delivering a tone clear and ringing, yet round and warm. Try for yourself the various substances I've described. Experiment with any guitar at hand and you'll easily hear the differences, practiced ear or not.

Cutting strategy—The next consideration is bandsawing the wood to rough size. The accompanying illustrations are generally self-explanatory. Slice from your lumber as shown in figure 3, to the dimensions marked, which provide allowance for further shaping. Note that the idea in most cases is to begin with quartersawn wood (with the annual rings running reasonably close to 90° to the wide faces of the board) to produce quartersawn pieces. I'll discuss the reason for this shortly.

A mid-size bandsaw (14 in. or smaller) will have a difficult time cutting 8½-in.-deep rosewood stock. The easy way out is to obtain matched, rough-sawn pairs of backs and sides from a luthier-supply company, and I'd recommend this approach to anyone without bandsaw experience. If you want to try sawing your own parts, however, I suggest searching out a large saw to tackle the work. Perhaps a high-school woodshop or a local commercial shop will allow you time on one of their machines. The 8½-in. spruce stock is another matter. My own saw is a 15-year-old 14-in. Rockwell/Delta with a height extension that enables me to cut stock almost 12 in. deep. I've also installed a 1-HP motor and, via pulleys, slowed the blade to about one-third its standard speed. With these amendments and a ¾-in., three-tooth-per-inch blade, a small saw cuts spruce guitar tops easily enough.

It's valuable though not absolutely necessary that the backs, sides, fingerboard and bridge be quartersawn. But for the neck, and especially for the top, quartersawn wood is a must for its stability and strength. It's equally important that the top wood has a minimum of grain runout (grain that angles away from the surface of the soundboard). A top with more than a little grain runout will be physically weaker than one with none and, it's generally accepted, will result in poorer sound.

The easy method of avoiding runout is to wedge-split your spruce before bandsawing. Split off a large chunk, joint or plane two adjacent surfaces flat and square for stability against table and fence, then saw. This is as close as you can come to following the wood's own grain movement. The surface may be naturally wavy when split, but flattening those waves—a necessity for cutting—is doing little or no harm.

For the top, back and sides, you'll need to end up with what are called "book-matched pairs"—two consecutively cut pieces that, with bottom edges touching, are allowed to fall open like a book, one to the left, one to the right.

The neck blank, as shown, is cut from one piece. It's very practical, however, to make a jointed neck, with the glue joint at the heel block. This is a good compromise between economy and convenience. You'll find necks assembled out of as many as six pieces, and as few as one. The determinants are usually lumber dimensions and cost. Obviously, cutting a one-piece neck blank—peghead slant, heel and all—wastes the most wood. At the other end of the scale are necks built up out of 1-in.-thick lumber. The heel becomes a sandwich of four or five pieces, while the peghead slant is achieved by a 15° angled joint. The style of neck assembly you choose is of little consequence. All have been time-tested and found to be more than strong enough for the job. A separated neck joint is rare. If you do follow the two-piece method, endeavor to cut the heel block from the same board as the neck piece, and the same section of the board if possible. You'll have a better match of grain and color this way.

The remaining elements—the fingerboard, bridge, peghead veneer, endblocks, lining and bracing material—are straight, slightly oversize blanks of wood at this stage. Cut them out as shown and place them aside in a dry, well-ventilated spot.

Now, I think, is the best time to discuss a subject that can make or break your guitar, regardless of the care you take in every other respect. I refer to moisture content and humidity.

Wood shrinks and swells as it absorbs and loses moisture. If a guitar is built from wood that's too wet, it will shrink and crack when the weather becomes dry. A guitar built from wood that's too dry will swell when the humidity goes up and may buckle, though this is less of a danger. The trick is to dry the wood just enough, so that it'll be stable in the conditions the guitar will exist in. With rare exceptions, the desirable dryness will be that of a normal home as heated in winter—6% to 8% equilibrium moisture content (EMC).

Stack the wood somewhere in the living area of your home for a month or more. Place stickers between the pieces so that air can circulate. Blow a fan across the stack if you wish, to speed the drying process, although this is not absolutely necessary. It's a good idea to weigh a piece of the various species of wood periodically; when the wood ceases to lose weight, it has arrived at the correct moisture level, and you can proceed with construction.

Without further digression, then, here are our first steps in the assembly process.

To begin, I suggest you make a simple exterior mold for the guitar body. This will be your reference template when bending the sides, as well as the clamping jig for numerous stages of constructing the box. Using the dimensions taken from figure 1, I recommend following the mold-building method described in David Russell Young's book, *The Steel String Guitar: Construction And Repair* (Chilton Book Co., 1975).

I have one amendment to Young's mold design. Rather than using screwed-on end plates to hold the two halves of the mold together, I suggest adding a small extension in the lower bout (see photo, right). When your mold halves are complete, glue them together at the upper bout only. Long clamps, stretching across the mold and applied with minimum pressure, should secure this joint. Then, drill a hole through the added extension that's large enough to loosely take a long bolt. Install the bolt with a washer and wing nut on one end. You now have a mold that can be partly opened. By loosening the wing nut and slipping a small wedge into the opened gap between the mold halves, you'll gain a ¼-in. opening—enough to allow a guitar body to easily slip out.

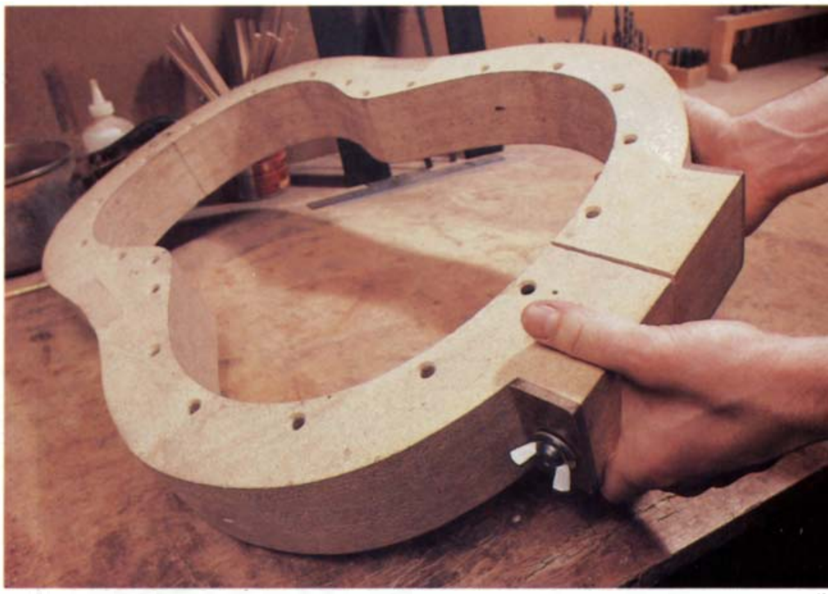
I'll now leave you with one actual assembly step. Don't forget, however, that before you do this step or any of those that will follow, your woods must be given proper stabilizing time.

Joining the back and top—Before joining, the pieces of the back and the top should be brought to nearly their final thickness—around 4mm is good. If you have access to a thickness sander, that's the best method. A planer is liable to chip, especially on the rosewood. If you have the stamina, handplaning is your other option. The spruce will be easy enough, and can be planed with the grain. Rosewood will demand some elbow grease, but planing *across* the grain will make the job immeasurably easier.

You want these joints to be both perfect and, particularly on the spruce top, invisible. The easiest way I've found to make an accurate joint is with a well-set-up jointer. Accurately handplaning these edges is tricky, even for the experienced craftsperson. When using a jointer, move across the blades slowly and evenly. Don't settle for a joint that's less than perfect.

There are a number of common methods for clamping backs and tops. Pictured at top right is what I consider the most straightforward, since it requires no jigs. Trim the two halves of the top and back into slight wedges by removing some material from the outside edges. Place them tightly together on your

Guitar tops, as well as backs, are usually made of two pieces book-matched along a centerline joint. The joint can be glued by tapering the pieces, then gently tapping them into a matching pair of cleats that are fixed to the bench to form a wedge-shaped recess. A weight prevents the wood from buckling upward.



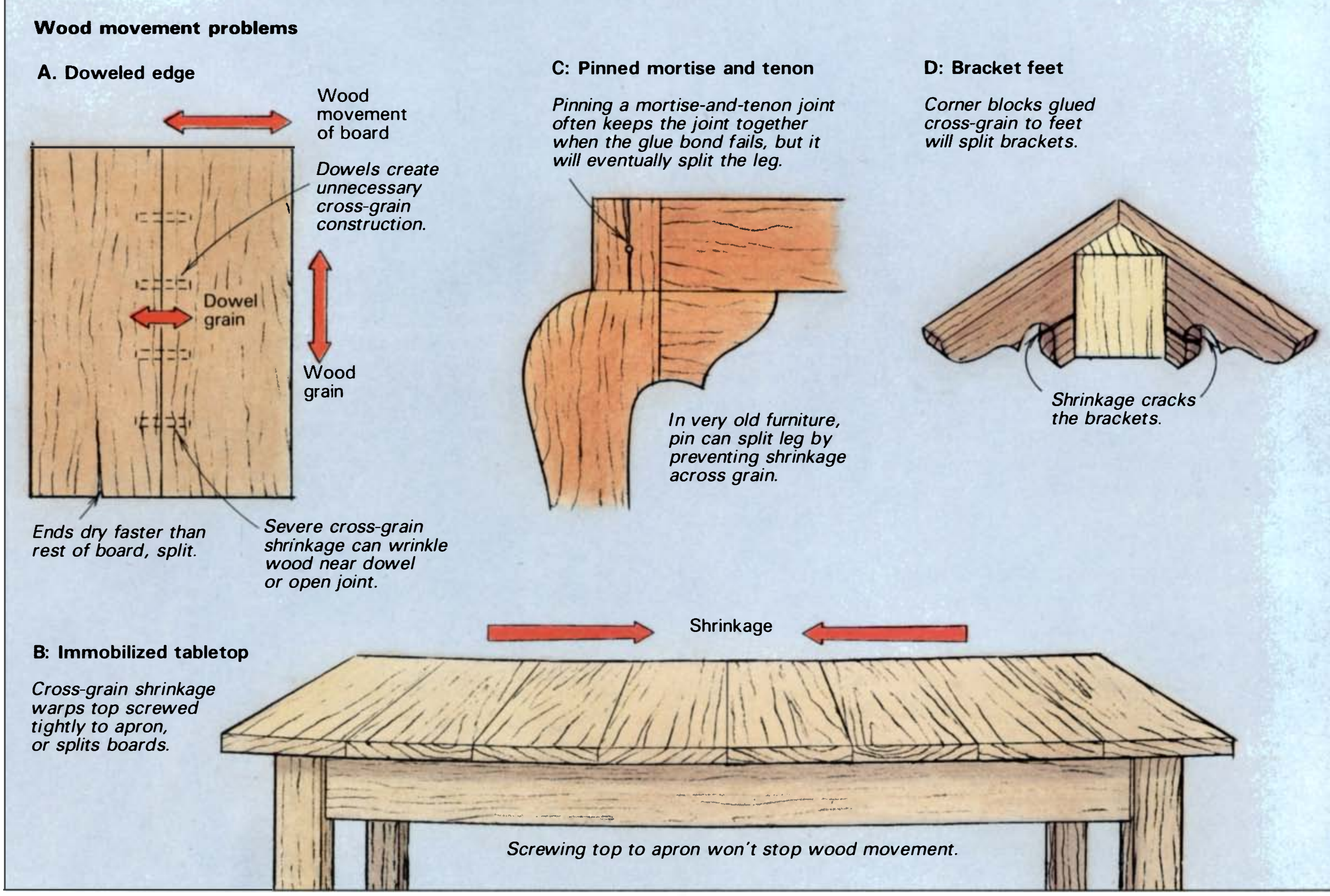
To ensure symmetry and uniformity, guitars are usually built in a mold. Laskin's mold can be loosened at the bottom so the sides can be slipped out without damage.

bench and nail or clamp sturdy wooden strips along the outer edges. Run glue along your joint, place wax paper beneath and a weight on top, then push the top/back into the strips to wedge the glue joint tight. Leave the work clamped for one hour. When unclamping, remove the weight last. If you intend to put some sort of decorative strip in the center of the back, the joining procedure is still the same.

For this and all other gluing on the guitar, use an aliphatic resin glue such as Titebond or Elmer's Carpenter's Glue. For discussions of the relative merits of hide glues—an alternative for certain guitar joints—I suggest checking the texts I've recommended under "Further reading and suppliers."

Until part two, I'll leave you with one last bit of advice. Carry this in your mind throughout the building of this guitar: Be patient. That was the most valuable lesson of my apprenticeship. I learned that certain jobs for which one normally might have set aside an hour to accomplish in truth took half a day or more to do well. Think of the musician practicing year after year to master an instrument. A few more hours of your time at each stage of construction is a painless counterbalance to that effort. You'll never regret it. □

Grit Laskin's shop is in Toronto, Canada. Part two of this series is slated to appear in the March/April issue of Fine Woodworking.



Coping with Failing Joints

Wood movement is more destructive than abuse or neglect

by Bob Flexner

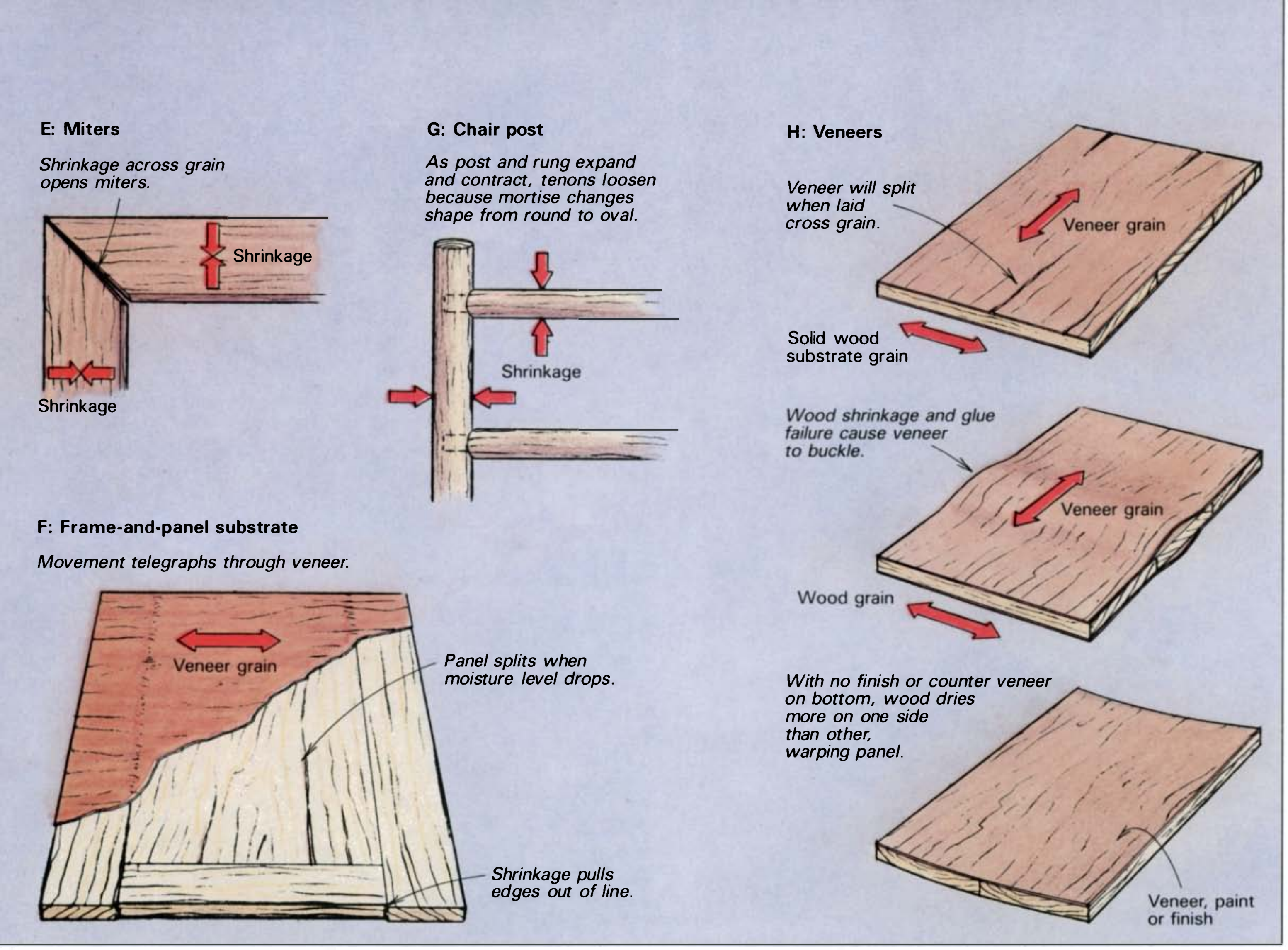
I hate to admit it, but when I began building furniture 12 years ago, I didn't fully understand the nature of wood. To make joints stronger and last longer, I used 4-in.-long, ½-in.-dia. dowels to join chair and table rails to thick legs. I routinely used dowels when edge-joining boards to make tabletops, and pinned every mortise and tenon. Friends of mine were gluing and bolting butcher-block tops together, assuming the long steel rods would help prevent the joints from separating. One friend was churning out oak dining tables, each with a 5-ft.-dia. solid top screwed tightly to a square frame "so it wouldn't move." After about a year, the tops bowed up like plywood left in the sun.

Waiting to see if your furniture will hold up over time is an unreliable way to learn—you might not live long enough to see the failures. Old furniture, on the other hand, provides most of the information needed to predict where problems will arise. Except for breakage caused by rough treatment, neglect, bad design or just plain bad workmanship, the failures in old furniture occur almost universally in the joints, as shown above.

The common explanation for these joint failures is that the glue has given out. This is true, of course: The glue has aged, lost its flexibility and no longer holds as well. But that's not the whole story. The glue holds fine where wood was joined edge-to-edge. Look at all the glued-up tabletops and panels that have survived for hundreds of years.

Most of the failures occur where wood is joined at right angles, since this configuration stacks the force of wood's natural, mois-

Drawings: Lee Hov



ture-related movements against the holding power of the glue. This wouldn't be such a problem if the shrinkage during dry periods and swelling during the damper months occurred uniformly in all directions. But, the movement is in one direction only: across the grain. There's virtually no movement along the grain. When boards are joined at right angles, the contrary shrinkage and expansion stresses the glue joint and causes it to eventually fail.

This failure will occur even quicker if the furniture is subjected to drastic humidity changes, such as when furniture is moved from a very damp to a very dry climate (or vice versa), or when old furniture is put into a building with central heat for the first time. Paint or finish won't eliminate this movement; they can only slow it down. You can see this in any building with painted wooden windows and jambs. In spite of the paint, they stick in the spring and summer when it's damp. And, in the drier winter months, they shrink and let the cold in.

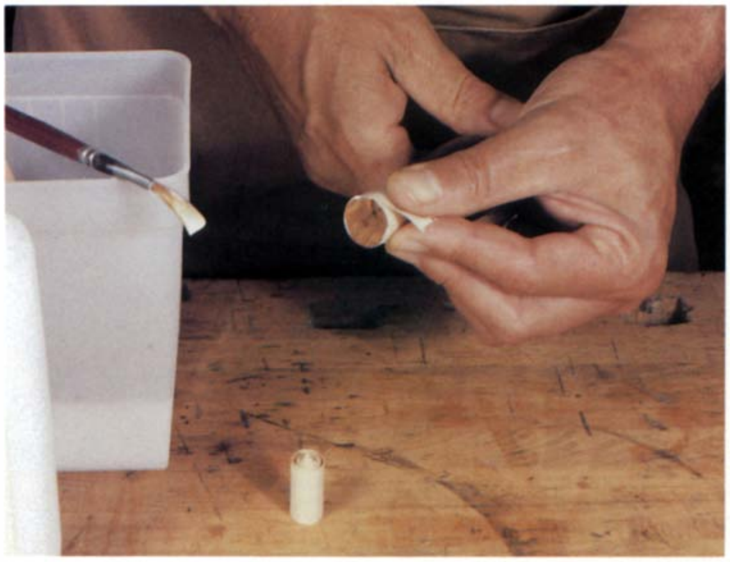
There is, in short, no known way to bond wood together in cross-grain directions and expect it to survive in everyday use for more than 50 to 100 years. Everything we build or repair will come apart sooner or later. Realizing this is very critical. Furniture doesn't become antique because it's built so well that it never has problems. It becomes antique because it's built so that it can be easily repaired when the inevitable problems occur.

There's no reason to believe that any of the new synthetic glues now on the market will maintain their elasticity and bonding strength well enough to make failures less inevitable. In fact, the almost universal approach of choosing glue for strength misses the point of why furniture survives. Glue strength isn't critical if the glue is at least as strong as the wood, and almost all the commercial wood glues are. A woodworker or restorer should pick a glue that can be removed easily and with little damage to the joints, so that the furniture can be reglued effectively in the future. It's wiser, therefore, to build or repair with future repair in mind than with hopes for permanency.

I'll illustrate the point by discussing repairs of some common furniture problems. When a joint comes apart without any of its parts breaking, the obvious solution is to glue everything back together. Unfortunately, these "reglued" joints often fail within a couple of years, usually because of the old glue left in the joint. Despite warnings on the glue bottle that the wood must be clean, many workers spread new synthetic glues over the old glue, and clamp the joint back together. For a good glue bond and a long-lasting repair, it's absolutely critical that you have clean wood and tight wood-to-wood contact in the joint.

When using synthetic glue, you must remove all the old glue, which will have sealed the wood surface enough to prevent the new glue from penetrating. The best method is to use a solvent. If you scrape or sand the glue off, you'll have to remove quite a bit of wood to eliminate all the glue-sealed pores, which will result in a weaker, looser joint. Most often, the proper solvent is hot water, vinegar or a vinegar/hot water mixture. These solvents will quickly melt hide glue, which is found on almost all pre-World War II furniture. And with the help of kitchen scrubbers such as Scotch-Brite pads, hot water and vinegar will remove white and yellow glue from tenons and mortises. Be sure to let the wood dry thoroughly, at least overnight, before regluing. Most other glues are more difficult to remove, but you can try lacquer thinner on contact cement and hot-melt glue. Acetone

A loose tenon can be built out to fit its mortise by gluing on a piece of veneer or a strip of wood. Clamp the piece down with a wooden block protected from glue squeeze-out by wax paper.



After being pulled tight to squeeze out excess glue, the curled plane shaving will hold its shape without clamps.

will sometimes dissolve epoxy or various super glues. No common solvent will remove plastic-resin glue. I chisel off the glue, then sand or scrape away any residue. Whenever glue is scraped off, the joint must be built out to give tight contact.

I use the above procedure to clean all mortise-and-tenon joints, whether they're rectangular, square or round. The biggest glue-removal problems occur with all synthetic glues. They're so much harder to remove than hide glue that I've stopped regluing with the synthetics out of concern for the person who will someday repair my work. Also, the great amount of water or other solvent needed to lift a synthetic glue can't help but damage the joint. In contrast, hide glue allows me to eliminate the cleaning step almost entirely, since new hide glue will bond well to old hide glue. The hot-water solvent for the new hide glue also dissolves the old hide glue, so the two glues melt together and become one. No other common glue that I know of has this characteristic. Clean out the old hide glue *only* when you find dirt, finish or deteriorated hide glue (which will be powdery) in the joint.

Most 20th-century furniture is made with dowels, however, and this requires a slightly different procedure, because dowels connect pieces of wood together with two separate bonds. Regluing one half of the joint doesn't guarantee a strong joint since the bond holding the other half of the dowel might fail in the near future. For this reason, unless the piece is old and valuable enough to warrant reusing the original dowels, I replace them.

Sometimes the dowels can be removed easily with pliers—tapping the end of the dowel with a hammer first will help break the glue bond. But, often, the bond won't give and the dowels must be drilled out. In nine cases out of ten, the dowel will remain in the rail that has the same grain direction, and will separate from the leg where the grain direction runs at right angles to it—further evidence that contrary wood movement rather than weak or old glue causes failures. To drill out the dowel, first saw it off just above the surface of the wood. Take a brad-point drill bit $\frac{1}{16}$-in. smaller than the dowel diameter and drill down the center of the dowel. Peel the last bit of dowel away from the sides of the hole with a $\frac{1}{8}$-in. chisel, taking care not to damage the original hole. Then, clean out the hole with a drill bit matching the hole's original diameter. If there's still glue in the hole and you're regluing with a synthetic, you can wash out the old glue with solvent, or scrape it off with a needle-nose file. Scraping here doesn't damage the hole any more than the solvent.

Now and then, you'll find a tenon that doesn't fit tightly in a mortise. Filling these gaps with glue will lead to early failure. Thick glue becomes brittle and will crack under stress. You can prove this by pouring glue onto a piece of paper, letting it dry for a couple of days and bending the paper back and forth in the middle of the glue glob. If the glue is still fresh, it may bend a few times before cracking. When it's fully cured, however, it'll crack immediately. Similarly, thick glue won't withstand much wood movement or stress in a furniture joint. Tight wood-to-wood contact is critical for a strong bond—you can't glue air!

To build out a tenon, glue a thin piece of wood onto its side. For a rectangular or square tenon, use a piece of veneer of the same species of wood, or cut a thin piece from a thicker board. You want to fill the gap exactly, but if you can't get an exact fit, use a thicker-than-necessary patch and trim it down to fit the mortise. If the first patch is too thin and you have to add another, you risk weakening the joint because each additional piece makes air pockets and joint failures more likely. To ensure a good bond when attaching the veneer, clamp it tightly with a flat block of wood as shown at left, inserting wax paper between the patch and the block to prevent them from sticking together.

For a round tenon, plane a curl off a straight-grained piece of maple, cherry or other dense wood. You can control the thickness of the curl by adjusting the depth of your plane. Again, aim for too thick rather than too thin, and sand to fit. Coat the tenon with glue and wrap the curl once around, overlapping it just a little (see bottom photo, left) and tearing off the remainder. Pull the curl tight with your fingers and leave it—the curl will hold this shape without clamping. When the glue is dry, sand away any glue your fingers may have left on the surface.

Repairing loose veneer is a simpler process. Veneer comes loose because its movement is opposite to that of the surface to which it's glued, because it's been exposed to too much moisture or, most commonly, a combination of both factors. If you're using hot hide glue on an old piece that hasn't previously been repaired with synthetic glue, you need only slip a little fresh hide glue in under the veneer with something thin, like a scrap of veneer or a knife, and press it flat. Before clamping, squeeze out any excess glue so you won't have a ridge where the new glue meets the old, and use wax paper between the veneer and the flat block under the clamp.

If you're using white or yellow glue, or if the veneer has been previously glued with synthetic glue, you must remove the old glue first. The easiest way I've found is to fold a piece of 100-grit to 180-grit sandpaper in half or thirds and slide it back and forth between the veneer and the core wood while pressing on the veneer (see top photo, facing page). Continue until both sides are clean. Blow out the dust and insert the glue or inject it with a syringe. Finally, squeeze out any excess glue and clamp the veneer flat. On curved surfaces, you'll need to shape a wood or Styrofoam caul to hold the veneer to the substrate while the glue dries.

You can use commercially available "liquid hide glue" (Franklin International, 2020 Bruck St., Columbus, Ohio 43207) to reattach veneers originally held with hot hide glue. This product is hide glue mixed with a gel depressant that enables it to be used straight from the bottle at room temperature. But liquid hide glue weakens when exposed to warm, humid weather, so it isn't a substitute for hot hide glue. It's usually strong enough, though, to hold veneer and—if it's heated first to around 140°—it'll melt together with old hide glue, making a bond with strength somewhere in between that of either type of hide glue used alone.

In my work as a restorer, I often see loose joints repaired with a nail, screw, iron bracket or other metal device. Often, these metal devices demonstrate a great deal of creativity, and many of them must have taken hours and hours to fashion. Seldom, however, have I seen one that has kept the furniture sturdy very long or failed to create additional problems. Metal doesn't respond to humidity changes the way wood does. The metal rods my friends were using, for instance, to hold the butcher block construction together ceased to have any effect after the first swelling crushed enough of the wood fibers so that the rod would never again be tight. Nails or screws through mortise-and-tenon or doweled joints do nothing to correct the failed glue bond and lead to the same type of damage that occurs with pinned joints.

To remove glue from under loose veneer, fold sandpaper in half and slide it back and forth while pressing lightly on the top surface of the veneer.

In conclusion, furniture glue joints fail because of contrary moisture-related shrinkage and expansion of the wood in the joints. There's no way to prevent this when you have cross-grain construction. The long-term damage can be minimized, however, by considering wood movement when building or repairing furniture, and by using glue that will cause the least amount of damage when regluing inevitably becomes necessary. □

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

Sacrificing strength for design

by Walter Raynes

In the last ten years, I've restored quite a few pieces of pre-1840 furniture built in Baltimore, Philadelphia and other major cabinetmaking centers of the United States. The designs of these pieces are often stunning, although the furniture itself is frequently badly damaged. It would be easy to attribute this broken condition to poor craftsmanship or normal wear and tear, but I think there's a more significant reason—the 18th-century cabinetmakers were striving for a visual effect, and they intentionally pushed wood to its structural limits. I can imagine the maker saying to himself, "I know it's weak, but it looks good and that's what I want."

This approach to furniture construction leads to what I call "acquired defects," to differentiate them from inherent defects like those Bob Flexner describes in his part of the article. The line between the two categories often blurs, but I think the division makes sense to those of us who look at furniture from primarily a cabinetmaker's point of view. I began to organize my thinking this way, largely through the influence of J. Michael Flanagan, curator of the Kaufman Collection of American Furniture exhibited recently at the National Gallery of Art in Washington, D.C.

For the 18th-century cabinetmaker, joinery was not an end in itself—it was a way to get a look. Thomas Chippendale was what we'd call today a trend-setting designer. He published catalogs of his designs and was influential in setting the style of the period. He liked chairs with ornate, delicately pierced backs and slender, curved crest rails. Because of the popularity of Chippendale's designs, cabinetmakers resorted to sawn crest rails containing major sections of weak, short grain. The crest rails, not much bigger than a man's thumb, were further weakened when mortises were cut into them.

Weak cross grain on the crest rail of this old chair is prone to breakage, especially when it's mortised to accept the tenon of the chair back.

Despite the constraints of design, cabinetmakers still were using what appeared to be the best technology available to them. They used dovetails, for example, because they were the best means available for joining wood, not because they were artistic. Sometimes they cut exceptionally fine dovetails, which indicated their high level of skill, but the joints were only a means to achieve the design they wanted. For the most part, design considerations meant that there was little, if any, exposed joinery.

Considering the environment in which it was intended to be used, the furniture held up well—despite structural weaknesses. Furniture was built in shops with basically the same environment as the homes in which it would eventually be housed, so it wasn't exposed to the drastic changes of humidity that came with the development of central heating. Many of the breaks we're repairing today have probably occurred since the introduction of central heat. The furniture that was just plain bad probably went into the fireplace not too long after it was built.

The late-18th-century Philadelphia chair shown at left is a good example of the problems created by design constraints. You can see two breaks in the short grain of the crest rail. I suspect the two breaks parallel the mortise that houses the splat tenon. The rail was already weak because of the short grain, and was weakened even more by cutting a mortise into it. It was the look the maker was after, so he had to live with the construction—potential weaknesses and all.

The splat and the crest rail also set up a cross-grain construction that may cause problems. The splat will expand and contract across the grain, but the long grain of the crest rail will restrain it. The delicate areas of the pierced splat are bound to break, as shown in the top left photo on p. 56. In addition to the possible effects of cross-grain construction, the pierced splat is also weak from a purely structural standpoint. The short-grain areas are subject to breakage, just from normal use. Once again, however, the maker created the look he wanted and allowed design to take precedence over construction.

Even when they weren't pushing the lim-

The long grain of the crest rail restrains the normal cross-grain movement of the pierced back, increasing the chances of breakage in thin, decorative elements.

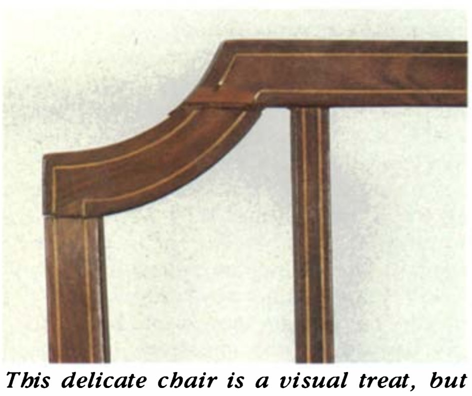
Large splits shouldn't occur in floating-panel doors. But the back side of this door reveals that either glue used to attach the decorative veneer panels or shellac applied to the door locked the panels in place. Normal wood movement then split the panel.

its of a material, the 18th-century makers made mistakes. The chair leg shown in the photo at right is a good example. Instead of picking a straight-grained piece of wood, the maker chose one with grain running off at an angle. A short-grained section like this is highly subject to breakage under the stress normally found in a chair. This piece was inherently weak, and the maker should have known better. Perhaps he just ignored the problem because he didn't want to waste the wood or couldn't afford to spend the time to make another piece.

Economics had to be an issue. The early cabinetmakers in major urban centers had to be competitive, and they couldn't lavish their time on details for which people wouldn't pay. The break in the bottom photo is a good example. The problem could have been avoided by making two joints, just about where the breaks occurred, but the maker probably didn't feel he could afford to spend time cutting two joints; instead, he took a chance on the short grain. Economics probably contributed to broken bracket feet where the damage was attributed to wood movement being restrained by the cross-grain footblocks in the corner of the bracket. John Shaw, a cabinetmaker from Annapolis, Md., is known to have used parallel-grain, laminated footblocks to avoid cross-grain problems. While some makers were surely unaware of Shaw's problem-preventing construction, others undoubtedly avoided its use for economic reasons—it was faster and therefore cheaper to simply glue the footblocks.

Veneer introduced another technical problem that modern workers often fail to take into account. There was no plywood or medium-density fiberboard for substrates. Makers had to use a solid-wood substrate or build a frame-and-panel or board-and-batten substrate, leaving all sorts of joints to move

Grain running off the end of this chair post indicates a weak area that almost certainly will be pulled apart by stress on the mortise and tenon joining the rail to the post.



This delicate chair is a visual treat, but the narrow, short grain in its curved elements is prone to breakage.

and telegraph through the veneer. While veneers offered a way to avoid unpredictable moisture-related problems of highly figured woods, as well as an economical way to use the material to achieve a look, the substrate often moved enough over time to damage the overlying veneer.

The veneers themselves could contribute to a failure. The door in the photos above is a well-done frame-and-panel assembly. But it cracked—something that shouldn't happen with a floating panel. Look on the other side of the door, however, and you'll discover the problem is one of favoring design over structure. To get the look he wanted, the maker put two layers of veneer on one side of the frame and panel to form the oval decoration. Apparently, enough glue or finish seeped between the panels and the oval overlay to lock the panels in place. Shrinkage eventually caused the cracks.

The breaks and splits we see in period furniture today in no way detract from the skill, care and abilities of the original makers. And the designs continue to be a triumph. When you see a break in an old piece, it doesn't mean there's anything wrong with it, or that you shouldn't take the greatest care with its restoration. It's only logical that you'd find this type of damage—broken crest rails, cracked or shrunken slats and broken chair legs—especially on late-Federal pieces. In fact, if you didn't find evidence of this type of damage, you should feel uncomfortable about the claimed age of the piece. □

Walter Raynes builds and restores furniture in Baltimore, Md. Photos by author.

Thirty-Two-Millimeter Cabinets

A one-man shop adapts the European system

by John Masciocchi

For six years, I've had my own small shop and made everything from custom furniture to *shoji* screens. Cabinets have been the mainstay of my business—especially Euro-style cabinets with their characteristic clean lines, continuous facades and concealed hinges. Until recently, I constructed my cabinets with traditional face frames and standard dado and rabbet joinery—processes that were cumbersome and unprofitable.

In hopes of finding a better way to make these attractive cabinets, I visited the Charles Grant Company, a large shop in Portland, Ore., that employs a German-developed cabinetmaking process known as the 32mm system. The beauty of the 32mm method is that it completely standardizes cabinet construction and hardware mounting, and it allows you to do all the work—from cut out to installing hinges and drawer guides—*before* the cabinet is assembled. The flat panels of 32mm cabinetry are easier to machine, handle and store; they can even be shipped flat for assembly on site. Furthermore, the cabinet materials are processed by machines expressly designed for 32mm cabinetry. I watched with glee as a small crew in the 30,000-sq.-ft. shop turned out as many precisely made, high-quality cabinets in a day as I might make in a month.

I was even more excited to learn that employing the 32mm system doesn't necessarily demand exorbitantly expensive machinery or a grand scale of production. By adapting the same construction practices used in large cabinet factories to my limited resources, I've found that I can profitably use 32mm's advantages in my 1,800-sq.-ft., one-man shop. These streamlined methods, coupled with the subcontracting of some of the more involved processes, mean that each cabinet job requires less time, allowing me to invest my energy in the design details that ultimately sell my work.

Much of the 32mm system's efficiency comes from the highly economical way in which Euro-style cabinets are constructed. Traditional American-style cabinets consist of a simple plywood box, joined by dadoes or tongue-and-groove joints, with a solid-wood face frame nailed and glued to the front edges of the plywood. The face frame does three things: it stiffens the carcase against racking; gives the plywood a finished look; and provides a mounting surface for door hinges. Some shops make the face frame after the carcases are built; some make it before. In either case, however, face-frame cabinets require two distinct stages of construction; normally, doors and drawers come last and are made only after the cabinets themselves are assembled.

Euro-style cabinets, on the other hand, don't have face frames. A typical case is built of cabinet-grade plywood, veneered particleboard or fiberboard covered with plastic laminate; normally, the edges are banded with the same material that covers the panel. Instead of using dadoes or tongue-and-groove joints, the top and bottom panels of European cabinets are doweled into the carcase sides and/or fastened with special knockdown fittings. To keep the frameless cabinets from racking, a plywood panel is then let into grooves at the back of the cabinet.

Clean, fully overlaid doors and drawer fronts give Euro-style cabinets an austere, seamless look that accrues from the efficiency of 32mm construction methods.

The 32mm system was developed in Germany about 50 years ago to streamline cabinet production. Incidentally, there's nothing mystical about 32mm as a dimension: it's simply as close together as the spindles on the multiple-drill boring machines would go. In place of conventional joinery, the 32mm system depends on a series of accurately placed holes—8mm-dia. "construction" holes for the dowels and knockdown fasteners that

Photo this page: Jim Piper; drawing: Joel Katzowitz hold the cabinets together, and 5mm-dia. "system" holes for drawer slides, hinges, shelf pins and any accessories to be installed inside the cabinets. European manufacturers make an amazing assortment of hinges, drawer slides, pulls, mounting brackets, knockdown fasteners, slide-out baskets and so on (see "Euro-style hardware," right), all designed to conform to the diameter and spacing of these holes.

In its most refined form, 32mm cabinetry requires a huge investment in specialized equipment. A thoroughly equipped shop might have a sliding-table panel saw, an automatic edgebander, a computer-driven multiple-spindle boring machine, a hinge-boring and setting machine and a pneumatic case clamp. But some makers here and abroad have introduced smaller, less expensive machines that can make 32mm accessible to even a one-man shop. You don't have to employ the entire system to reap many of its benefits: My investment in special equipment and tooling—basically a multiple-spindle boring attachment for my drill press and a hinge-boring and setting machine—totaled less than $2,000.

Since I don't have a fully equipped shop, my 32mm methods aren't entirely orthodox. Instead of the usual stretchers at the top of base cabinets (see figure 1), I find it more efficient to use a solid-plywood top for the carcase. Some 32mm shops rely entirely on dowels for case construction, using pneumatic case clamps for assembly. In these shops, construction holes are bored by a machine whose multiple spindles first bore the cabinet sides and then pivot to the horizontal to bore the ends of cabinet tops and bottoms. Fixed stops and fences ensure perfect hole alignment. Since my shop lacks this equipment, I subcontract the boring on larger jobs, then assemble the cabinets with assembly screws that are basically knockdown fasteners specially designed for plywood and particleboard carcase work. If I need to add a partition, a stretcher or a fixed shelf later, I bore construction holes myself with a special 5mm/7mm stepped drill, then drive in an assembly screw. On smaller jobs that aren't worth subcontracting, I use a nail gun to tack the cabinet parts in place, then drill for and drive in assembly screws.

After designing a set of cabinets, I begin by preparing a complete cutting list for each cabinet, including all of the carcase parts, doors, drawers and kickplates. I note boring instructions for each part, then map the parts out for best yield. Next, each part is marked with a cabinet number, cutting list part number and dimensions. The cutting list also provides accurate information for estimating costs and purchasing materials.

Next, I cut the panels into cabinet parts on a 12-in. sliding-table panel saw with a scoring blade that neatly cuts through delicate surface veneers or composition materials without much tearout. As parts are cut, they're numbered and labeled for edgebanding and boring. I label the parts on their edges—that way, the marks won't need to be sanded off later and they can also be read when the panels are stacked.

Edgebanding comes next. For a small shop with neither the space nor the capital for an edgebander, subcontracting this operation is an alternative. I don't have an edgebander, so I almost always farm out the work to a shop that glues, applies, flush-trims and bevels the edgebanding of my choice. Transporting the cut panels takes time, but automatic edgebanding is five to ten times faster than work done by hand.

The all-important tasks of layout and boring are next. Here again, systemic advantages of 32mm come into play. European companies make jigs and fixtures for laying out parts and positioning hardware. One of the most useful is the Blum "Magic

Euro-style hardware

Cabinet suspension fitting (1) mounts to the inside of upper cabinets with two screws and hangs on a metal rail attached to the wall. Adjusting screws on the front of the fitting allow for up-and-down and in-and-out motion, enabling adjacent cabinets to be accurately aligned. Fasteners such as those shown left to right in (2)—assembly screws with snap-on cover caps, two-part system hole connector screws and cam-locking knockdown fasteners—help make cabinet assembly fast and precise. The concealed hinge (3) has a compound action that simultaneously lifts doors out and away from the cabinet face. Different models are designed to open to 90°, 120° or 180°, or to accommodate special situations, like 45° corner cabinets. Adjustable plastic feet (4) allow a cabinet installed over an uneven floor to be accurately leveled; a screwdriver hole at the top allows each foot to be raised or lowered, and a plastic clip snapped into a kickplate kerf provides quick mounting. Smooth-operating metal drawer guides (5) ride on nylon-rimmed ball-bearing wheels and come in lengths from 12 to 24 inches. With regular guides (bottom), the carcase half mounts on the system holes while the other half lines up with the bottom of a drawer and screws into the side. New models (top) combine drawer sides and guides, and need only be fitted with a front, back and bottom. *—J.M.*


1


2


3


4

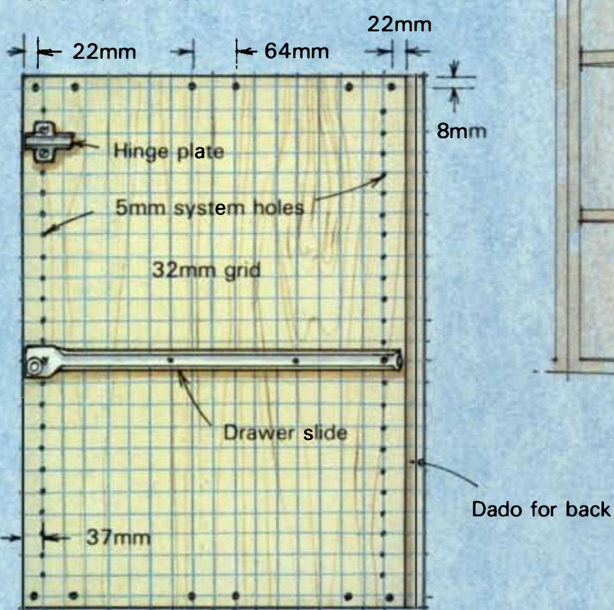

5

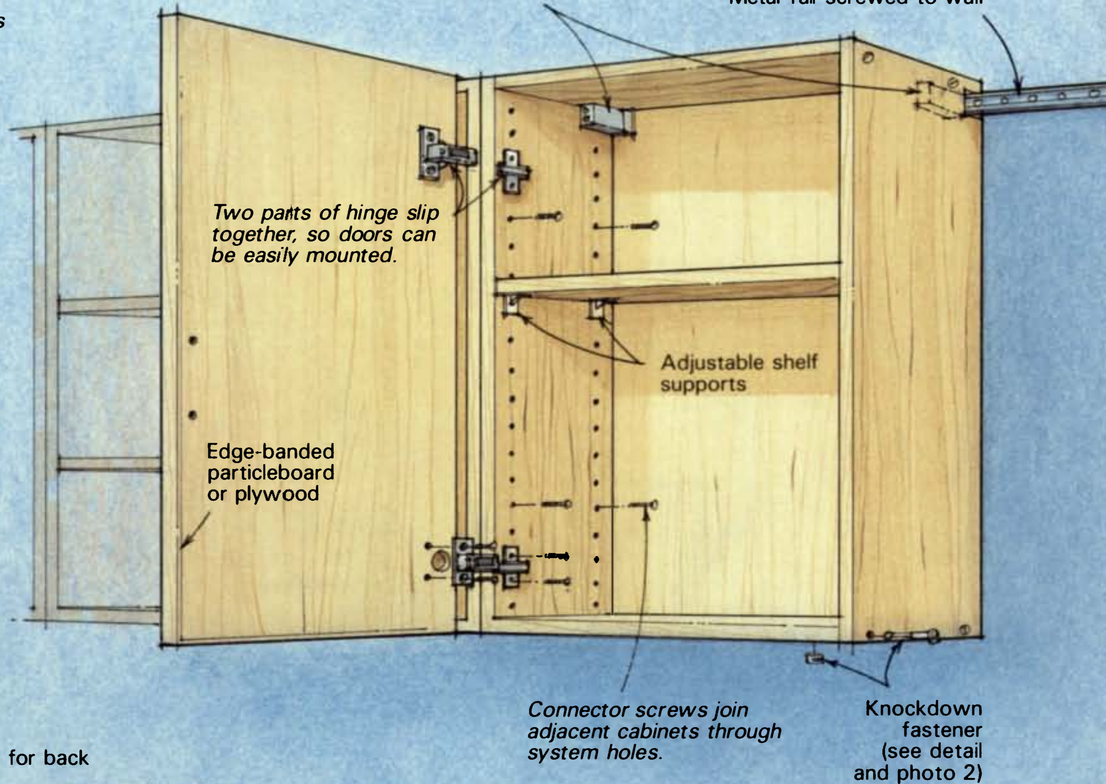
Fig. 1: Conventional 32mm

Although Masciocchi employs only certain aspects of the 32mm system, the drawing illustrates orthodox 32mm methods.

This layout grid of 32mm squares illustrates location of 5mm system holes on a boring pattern that matches all European hardware, including hinges and drawer guides.

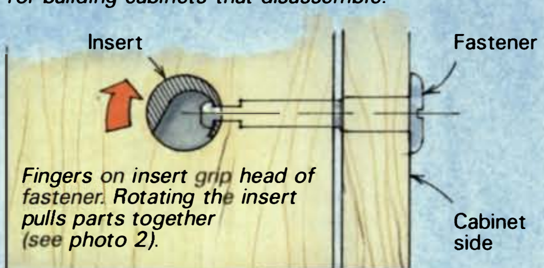
Typical intervals for spacing of 8mm construction holes





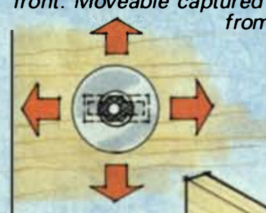
Knockdown fastener

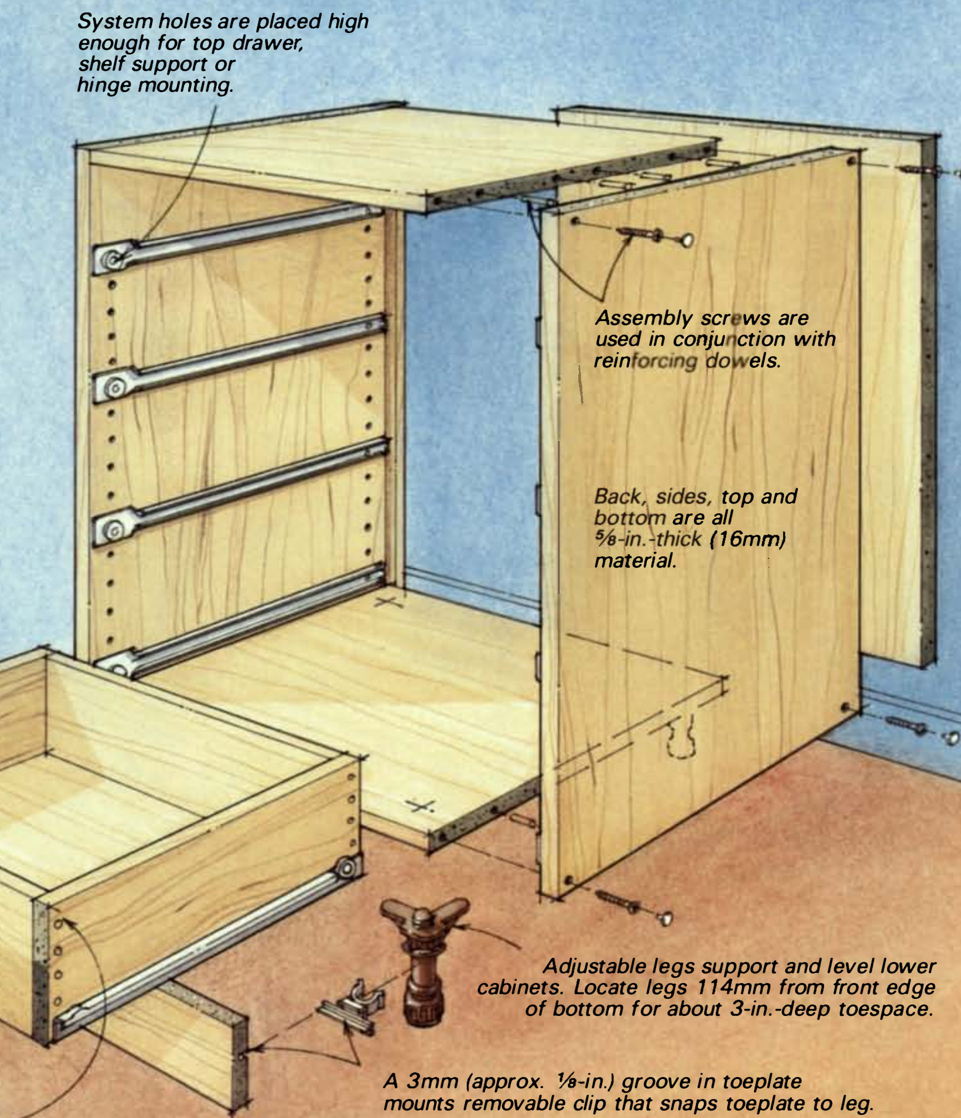
Special 15mm holes in top and bottom panels for the locking half of the fastener are used in conjunction with regular construction holes for building cabinets that disassemble.



Drawer-front adjuster

Plastic insert fits in hole on back side of drawer front. Moveable captured nut inside allows screw from drawer to be loosened for adjustment of drawer-front position.





Computerized cabinetry

by Sandor Nagyszalanczy

Practically everything about the 32mm system of cabinetmaking is tailor-made for automation and computer-assisted manufacturing. So when I visited the Kochman Brothers' partially automated cabinet shop in Boston recently, I wasn't too surprised when we spent more time looking at a computer screen than at cabinets or machines.

Bill Kochman, formerly a computer troubleshooter, and his brother Jim, an experienced woodworker, set up shop about 11 years ago to make 32mm-system cabinetry. They were reasonably successful, but things didn't really take off until they invested in the kind of sophisticated 32mm machinery that makes it possible for even a tiny shop to build an enormous volume of casework. While 32mm will work at any level of involvement, the Kochmans believe that a shop shouldn't bother getting into the method unless the owners are willing to automate.

The Kochmans started with a basic ensemble of 32mm machinery to complement their regular equipment. For about $35,000, they bought: a sliding-table panel saw; a horizontal/vertical, 21-spindle boring machine; an edgebander; a hinge-boring and setting press; and a hydraulic case clamp. Later, they added a seven-spindle automated milling machine and a small network of computers to perform both computer-aided design (CAD) and computer-aided manufacturing (CAM). In the first year of computerized operation, the shop's productivity doubled. Last year, the Kochmans' business grossed close to $1 million—a prodigious output for a shop of only 3,000 square feet and five people. I found it hard to reconcile the Kochmans' success with the fact that their shop had fewer machines than the average one-man furniture studio.

Computers connected to machines clearly improve productivity, but they also fundamentally alter the way work is done. Rather than handling the design and construction of each cabinet separately, the computer is programmed with all the possible cabinets and cabinet parts the shop produces, standardized and stored in digitized memory. Employing a complement of off-the-shelf and custom-programmed software and six personal computers (IBM PCs and an Apple Macintosh), Bill Kochman simply enters general information, such as choice of wood and style of doors, on a keyboard. He then specifies the type of cabinet and the dimensions of each. Moments later, the computer spits out finished drawings and plans, an itemized cut list and a cost estimate. If any specs change, he can produce an entirely revised plan—while the client waits.

The fun begins when the CAM system feeds all this data to "Big Al," the Kochmans' Italian-made, seven-tool Alberti computer-numerically controlled (CNC) milling machine. This machine handles all panel-boring and routing tasks with flawless accuracy, maintaining 0.5mm tolerances and allowing for minute variations in plywood thickness. Kochman says the computer can handle layouts and machining that are "so complex to do normally, you wouldn't bother." He also advises anyone planning to do 32mm cabinets without CNC control to buy boxes of 5mm and 8mm plugs "to cover up all the system holes you'll drill in the wrong places."

Kochman's dependence on computers eliminates tedious layout work, but it places a burden on him to be dead-accurate with his initial dimensions and measurements. The computer won't specify cabinet parts that won't fit together into a finished case, but the manufacturing process is so devoid of manual setup that mistakes turn up only at the very end of the process, when the cabinet won't fit into the kitchen. In fact, the only task in the shop that requires human regulation and measurement is setting the rip fence to cut plywood and particleboard panels to size. Even that will change when the shop gets its new CNC vertical panel saw, now being custom-built in Japan.

Although all of this automated efficiency reduces labor costs and makes a 32mm shop potentially more profitable, it doesn't result in inexpensive cabinets. When all is said and done, the high cost of 32mm equipment must still be recouped.

After seeing John Masciocchi's and the Kochmans' shops, I was impressed but also sensitized to the shortcomings of 32mm construction. Specifically, the *process* of making 32mm cabinets is more exciting and intriguing than the cabinets themselves. The system does one thing, and does it extremely well, but at the cost of aesthetic variety and individuality. The Kochmans have addressed this issue by designing a line of cabinets with frame-and-panel doors and curved carcase sides, trading some efficiency for aesthetic variation.

Bill Kochman says another failing of 32mm cabinets is the complex concealed hinges that swing the closely mounted doors. The hinges make the seamless look possible, but they often sag and need to be adjusted to keep the doors from banging into each other. Kochman told me about one furnituremaker he knows who employs some 32mm methods, but who uses standard barrel hinges instead of concealed ones to avoid this problem.

Is the woodworker of the future destined to become a digitized craftsman, spending more time running a computer than making sawdust? I expect to see a lot more of the kind of woodworking automation that the Kochmans are using, though I don't think CAD/CAM technology will force the traditionally minded, one-of-a-kind woodworker to trade in his or her tablesaw for a PC. Still, if you can stand the pace, it's one way to build a profitable woodworking business. □

Sandor Nagyszalanczy is an assistant editor at Fine Woodworking.

The key to automated 32mm production is the CNC milling machine. Its computer memory stores the complex patterns that allow the machine to perform hundreds of different boring and routing operations on cabinet parts.

Wand" (part number 65.400.01), a jig for laying out holes. With it, I'm assured that all of the holes are correctly positioned so the hardware fits and the shelves don't wobble on their pins. The Magic Wand also accepts snap-on fittings that aid in accurately positioning hinge plates and drawer slides.

I bore the long rows of 5mm system holes (set 32mm apart, of course) with my linear, multiple-spindle drill-press attachment (see photo, right). I set the drill-press fence so the system holes are set back 37mm from the edge—a dimension that corresponds to the mounting requirements of the drawer slides and the concealed hinges for the doors. Before mounting any hardware, the panels are finished—either by spraying them with lacquer, or by brushing finish on the solid-wood edgebanding I sometimes apply to plastic-laminate panels.

Doors and drawers come next. An essential component of 32mm cabinetry is the concealed hinge. These rather complex devices mount inside the cabinet and allow door edges to almost touch when the doors are closed, giving Euro-style cabinets their seamless look. Concealed hinges have a compound opening action that pivots each door away from its neighbor, thus providing plenty of clearance as the doors are opened. The best thing about these hinges is that they're adjustable via screws that move the door in all three planes. Each hinge consists of two parts: a mounting plate that fastens to the carcase, and a cup-and-arm arrangement that fits into a round 35mm mortise bored into the door. The mounting plate screws right into the system holes bored during the drill-press operation, speeding along the otherwise time-consuming process of positioning each hinge on the cabinet individually. On cabinet sides that don't otherwise need system holes, I use a separate jig to locate the hinge plates individually.

Now it's time to bore the mortises in each door for the hinges' cup-and-arm assemblies. First, I first transfer the centerline from the carcase side to the door and use it to set the stops on my Blum hinge-boring and setting machine, which mounts on a second, smaller drill press in my shop (see bottom photo, right). This clever machine bores a 35mm hole for the hinge itself and a pair of 10mm holes for the screws that hold the hinge in place. Then, a pivoting insertion ram automatically sets the hinge in place. The hinge screws are fitted with plastic inserts similar to plaster plugs that allow the ram to push—not drive—the screws into the door.

To mount the drawers, I use Blum bottom-mount slides (part number 230E) that require a ½ in. clearance on each side of the drawer. Thus, the drawers are 1 in. narrower than the inside width of the carcase; a separate drawer front, made of the cabinet's show wood, is screwed on later. The drawers themselves are simple boxes joined at the corners by nailed butt joints with a glued and nailed plywood bottom. Installing the slides on the carcase involves nothing more than locating the correct holes vertically and screwing the slide into the system holes. On a small job where it isn't economical to drill all of the system holes, I use another jig made by Blum ("Minifix," part number 65.220) to align the slides while I screw them in.

No matter how carefully the drawers are made and the slides are installed, minor adjustments must be made to align the drawer fronts after the cabinets have been assembled. This otherwise frustrating job is easily accomplished with the drawer-front adjuster shown in figure 1. This coupling device friction-fits into a hole bored in the drawer front. The front is then attached by screws driven from inside the drawer into the coupling, where a captured nut permits the front to be repositioned and properly aligned before it's tightened down to final fit.

The author uses 12 of the 18 drills on his line-boring drill-press attachment to quickly bore rows of system holes on cabinet sides. The drill press's ingenious band drive rotates alternating drills clockwise and counterclockwise, thereby eliminating the need for elaborate gearing to drive the multiple spindles.

A low-cost drill-press attachment does double duty by boring three screw holes simultaneously and then pressing the hinge in place on the cabinet door.

The real joy of 32mm is that all of these steps are done with the panels lying flat on the workbench. As soon as the hardware is installed, the carcases can be assembled, the doors hung, the drawer fronts attached and the final shop adjustments made. Since the panels are already finished (and have been since before the hardware was mounted), the cabinets are now ready to be hung. True to form, there are gadgets to speed installation, too, including leveling feet for lower cabinets and metal hanging rail systems for uppers. □

John Masciocchi is a furnituremaker, cabinetmaker and 32mm consultant in Portland, Ore.

Sources of supply

The following is a partial list of suppliers for 32mm hardware (H), machinery (M) and consultation (C):

Amerock Corp., P.O. Box 7018, Rockford, IL 61125-7018 (H).

Julius Blum, Inc., Blum Ind. Park, Highway 16—Lowesville, Stanley, NC 28164 (H, M).

Jon Elvrum, Woodworking Technology & Training, 10052 Gravier, Anaheim, CA 92804 (C).

Grass America, Inc., 1202 Highway 66 South, Kernersville, NC 27284 (H, M).

Häfele America Co., P.O. Box 1590, High Point, NC 27261 (H).

Hettich America Corp., Box 7664, Charlotte, NC 28217 (H, M).

Holz-Her U.S., Inc., Box 240280, Charlotte, NC 28224-0280 (M).

Holz Machinery Corp., 45 Halladay St., Jersey City, NJ 07304 (M).

Mepla Inc., P.O. Box 1469, High Point, NC 27261 (H, M).

Ritter Manufacturing, 521 Wilbur Ave., Antioch, CA 94509 (M).

SCMI Corp., 5933 Peachtree Ind. Blvd., Norcross, GA 30092 (M).

A Visit to Ligna

Some impressions from the world's largest woodworking fair

by Sandor Nagyszalanczy

The quality of German engineering and craftsmanship has always inspired me, whether it be in the form of cars or woodworking tools. So my excitement was understandable when, last May, I had a chance to visit the Ligna fair in Hannover, Germany. With nearly one million square feet of exhibits, Ligna is the world's largest woodworking machinery show (the International Woodworking Show of Atlanta, the largest American exhibition, isn't even half as big). Any of the 12 exhibition halls at this biennial event could have contained an impressive show on its own.

Ligna felt as much like an international festival as a machinery show, with companies from 26 countries showing their latest woodworking machinery under the silver canopy of dust-collector ducts. Think of a machine that has anything to do with cutting, planing, boring, shaping, sanding, joining or finishing wood, and it was there among the 1,087 exhibits.

While hundreds of different brands of hand tools and basic machines like tablesaws and jointers were on display, Ligna is primarily an industrial fair. For every shop-type router, there were 20 Sherman-tank-sized, semi-automated production machines designed for industry. The demonstrations alone consumed more lumber during the seven days of the fair than most small shops go through in a year.

Much of the large machinery at Ligna is sold to cabinet and modular-furniture factories that do European flat-panel processing. But, as I discovered in my travels through Germany, this affinity for machinery also extends to smaller shops. Unlike many small-shop American entrepreneurs, who often do their precision woodworking with bargain-basement tools, the shops I saw in Germany invariably use only high-quality equipment. German commercial woodworking shops, with their high labor costs (employers pay at least double what they'd pay in the U.S. for workers' benefits), must rely on more specialized production machinery to turn out maximum product in minimum man-hours. Even weekend woodworkers make serious investments in their equipment, often buying heavy cast-iron combination machines to make furniture or to do occasional millwork.

In addition to the usual array of basic machines, for instance, a typical three- to five-man, 1,800-sq.-ft. shop that builds kitchen cabinets has specialized tools for 32mm panel processing (see article, p. 57), including an automatic edgebander, veneering equipment and a huge thermopress for making custom laminated panels. An average equipment investment for a three- or four-man shop can total $150,000 or more. One seven-man business I visited in a small village in Luxembourg produced Chippendale-style furnishings in a shop equipped with no less than 56 machines. Besides multiples of basic machines, like bandsaws, other machines—shapers, for example—were permanently set up for doing specific tasks. An investment of this magnitude is possible in part because of the availability of low-interest (about 5%) loans, as well as the tax breaks allowed by the German government. But German businesses also invest far more of their own capital in equipment and take advantage of longer payback periods for their loans.

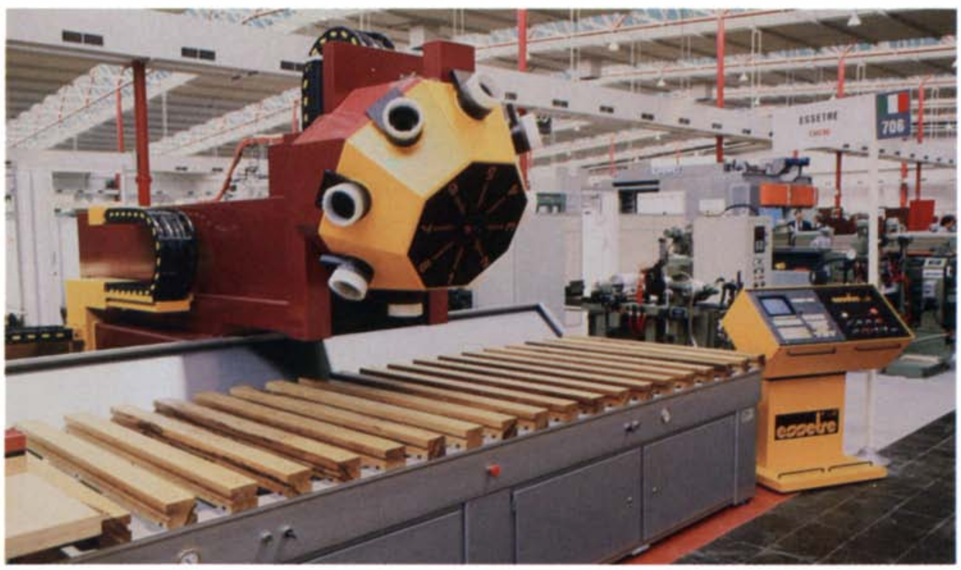
Setting up a woodworking business in Germany is a far cry from the way many of my fellow furnituremakers and I got started—with a little self-taught know-how and a few hundred dollars worth of tools in a garage with a shingle hung out front. German laws prohibit woodworkers from legally setting up shop until they've completed at least five years of education and apprenticeship and have earned an advanced degree in woodworking technology.

If I ever had any doubts about the seriousness of German woodworkers, those feelings were quelled after visiting a "Fachschule" (a school for technical training) in Hildesheim, just south of Hannover. Before a would-be woodworker can attend an advanced trade school like Hildesheim, he or she must complete a three-year apprenticeship, as well as classroom training one day a week, a final exam and a graduation project. Once at Hildesheim, students study an array of subjects ranging from wood technology to business accounting and the laws governing woodworking shops. Besides traditional methods, students gain experience with the most up-to-date equipment and computer systems. The day I visited, Hildesheim officials were preparing to install a new computer-numerically controlled (CNC) router.

While such arduous training gives a woodworker professional education and high salary potential (apprentices earn a starting salary of about $8 per hour), it also has its shortcomings. The work of German students and professionals that I saw was, for the most part, very conservative in design and construction and short on innovation. I got the distinct feeling that the Germans teach only what they consider to be the *right* way of doing things, rather than encouraging exploration with construction methods or aesthetics.

Not all German woodworkers adhere strictly to the system. Ulrich Hohmann, whose converted farmhouse shop I visited at the end of my trip, rejected the traditional system and went only part of the way through his training before starting his own, technically illegal furnituremaking business. Hohmann told me that ten years of required education tend to aim students more at the industrial goal of production efficiency than to encourage them to develop their own ideas about woodworking. I admired his independent attitude and the work he creates—modern furniture in an area dominated by the heavy-looking Bavarian style. His situation reminded me more of the woodworkers I know in

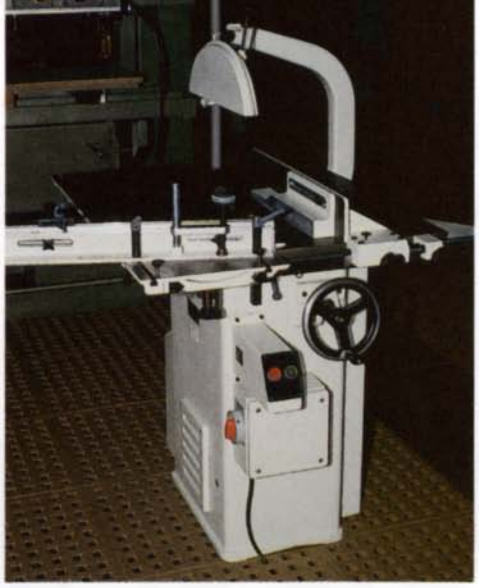
Above, miles of aisles led buyers and dealers from all over the world past the world's largest collection of woodworking machines at Hannover's biennial Ligna fair. Below, left: This conservatively styled yet cleanly crafted white ash secretary by Dirk Zühlke—part of a collection of graduating students' work on display at Ligna—is representative of current German work. Below, right: A colorful, multi-headed CNC router moves with computerized certainty in a shaping operation. Each router-like head contains a different cutter; when one shaping job is complete, the head rotates and the next routing or boring operation commences.



the United States than anything else I saw during my journey.

European manufacturers and machine/tool dealers come to Ligna for a variety of reasons. The bigger guys like SCM of Italy (known in the U.S. as SCMI) come to meet with their worldwide dealers and show off prototypes of their latest machines. Many companies offering smaller-scale machines or tools of interest to small-shop craftsmen or weekend hobbyists are there to sell equipment. But most companies come to make an appearance at Ligna because it's an important social function for the industry—what the Turin International Motor Show is to the automotive field.

Having become accustomed to their own high standards for equipment, the Germans would rather pay more for a tool than buy one that's compromised in quality. So it's not surprising that the Taiwanese, who have swept the U.S. markets with their copycat machines, hardly made a showing at Ligna. There's also a German law that disallows any item suspect of copyright infringement to be imported. One thing that did surprise me at Ligna was a dearth of American manufacturers; only 14 were listed in the fair's directory. As Todd Herzog, chairman of the Woodworking Machinery Manufacturers Association, explained, "American companies are at a disadvantage in the European market. It's too expensive to ship our machines overseas and too problematic to establish our own factories and service centers in Europe." But Dieter Pollmann, secretary of Germany's Mafell Corp., expressed



With speed and efficiency that are essential to factory production methods, the Schleicher automatic dowel inserter (above, left) shoots both dowels and glue through a gun, automating a messy, tedious job. At a small factory in Switzerland, a ten-man crew builds only about ten Reinhard tablesaws (shown above, center) each year. Miniaturists often buy them to produce micro-scale, ultra-precise work. The handcrank-driven stop on the Haffner cut-off saw (above, right) is electronically connected to a bright LED readout that tells the operator what size cut the stop is set for.

a harsher view: "American equipment is simply 50 years behind in technology. It's either not available or not competitive in the international market."

Large businesses that make tremendous investments in machinery don't want to buy high-production machines that aren't flexible enough to make a variety of different products and keep up with changes in consumer demand. This has spawned a whole new generation of multiple-tool CNC routers (see bottom right photo, p. 63) and shapers. Just about every other display at Ligna featured a new CNC router performing its robotized ballet, making mass-production items like drawer pulls or furniture parts. These electronically guided machines, developed originally for metalworking, typically cost upwards of $100,000. On the newer machines, computers allow rapid change of the pattern that the machine will cut, and mechanisms allow the user to select and change cutters automatically while the machine is running. Due to intense competition and rapid technological change, many companies develop a new CNC router model every year—just to keep up with the market.

More than one engineer I spoke with admitted that much of the automated wizardry was overdone, gimmicky, an attempt to sell high-priced electronics. After seeing endless aisles of robot machines turning out a thousand parts in the time a man could make ten, I thought of what I'd heard Rolf-Dieter Peschke, president of Ulmia (a manufacturer of hand tools and machinery, but no CNC devices), ask: "Who will buy all the products that these machines must produce in vast quantities in order to justify their expense?"

Though these computerized machines are far from practical for most of us, there are signs that electronic devices will play a larger role in small shops in the future. I saw several machines with electronic fences and stops that add speed and accuracy to cutting operations, like the miter-box-style cut-off saw by Haffner (see top right photo).

I saw dozens of factory machines designed to perform repetitive tasks with lightning speed, like the automatic dowel gun shown in the top left photo. "Trickle-down" technology often enables small shops to benefit from the mega-bucks spent by large manufacturers on developing machines for industrial use. For example, pressurized glue-applying systems were originally made for the production line, but are now affordable for even one-man operations.

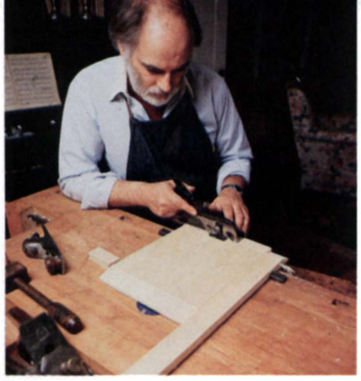
Ligna had the most extensive display of basic machines and power hand tools I've ever seen. Besides all the big-name U.S. imports like Bosch and AEG, there are hundreds of smaller, family-owned companies making their own lines of machinery and powered hand tools. These off-brand tools offer the European craftsman an enviable range of alternatives, but they never seem to show up in the U.S.—a real disappointment, since they're invariably of very high quality.

The best quality small-shop machines I saw at Ligna are built by Reinhard of Switzerland and, predictably enough, are made with watch-like precision. Their 10-in. tablesaw features a cast-bronze table insert, a rip-fence scale dovetailed into its rail and a rolling tabletop that slides as smoothly as hot skates on ice. While most of the high-quality European tools are significantly cheaper on their home continent, Reinhard tools aren't cheap for anyone—their smaller 10-in. tablesaw sells for about $10,000.

Innovations that I hadn't yet seen in the U.S. included an ingenious, German-made sanding system called W&V Sandex that features flexible-section belts that can be profiled for sanding a particular pattern of molding. Another German company, KWO, makes an extensive line of router bits and drills with replaceable blades that can be changed, rather than be resharpened. Routers are just as popular in Europe as they are in the U.S., and there were lots of specialized jigs for cutting joinery and doing complex template routing. Although most Germans prefer wooden handplanes, I admired the clever rethinking of basic handplane design by Rali of Switzerland. Despite the cheap-looking orange plastic handles, the plane's heavy sole (laminated steel strips, riveted together) and disposable blade inserts make it a solid, easy-to-use tool.

As I had expected, Ligna proved to be a real eye-opener, but the experience left me of two minds. On the one hand, I'm envious of the educational opportunities and high-quality tools and machinery available to German craftsmen. On the other hand, while all the high-tech machinery is impressive, I haven't any ambitions to adopt a high-production mentality. Ulrich Hohmann, the designer-craftsman I met in Southern Germany, summed up my feeling best when he asked, "What is the duty of man—to serve machines or to enjoy the pleasures of working the wood?" □

Sandor Nagyszalanczy is an assistant editor at FWW. *The next Ligna fair will be held in May of 1989. For more information, write: Hannover Fairs U.S.A., Inc., P.O. Box 7066, 103 Carnegie Center, Princeton, N.J. 08540.*



Blackburn uses commonly available planes like this Stanley No. 78 to raise panels.

Panel-Raising by Hand

Ordinary hand tools can cut it

by Graham Blackburn

Shapers are nice machines—fast and efficient. They're also noisy and dangerous. The same can be said for tablesaws. Both machines have far surpassed hand tools as the principal means of making useful items of wood on a commercial basis. Fortunately, hand tools still have a perfectly legitimate role in working wood, especially in small shops. They're readily portable, reasonably efficient and are easy to maintain. They're also safe and simple to use, and create hardly any mess. I still use hand tools on occasion to construct panel-and-frame assemblies for architectural woodwork and furniture.

Eighteenth-century joiners and cabinetmakers used a host of specialized panel-raising planes for this work, but, today, these planes are difficult to find, to use or to make. Fortunately, panels are just as easily made with the garden-variety planes available from most tool-supply houses. Granted, making raised panels with hand tools is time consuming. Occasionally, though, you may find this method easier than using machines. For example, I recently built a fireplace surround for an old house. It was constructed on site while the house was occupied. I didn't want to use circular saws and routers, which would have entailed a cleanup of greater magnitude than the job itself. By making room for a sawhorse and workbench, and by using only hand tools, the job proceeded efficiently—without totally disrupting the household routine.

With the design for the fireplace surround, overmantel and side panels worked out in advance, the job proceeded on a two-step basis. First, I made the frame for a particular section; then, I made the raised panels that were to fit in the frame. The application here is for architectural woodwork, but the same basic procedures apply to frame-and-panel furniture construction.

The framing members—stiles, rails and muntins—are first sawn to width and jointed true and square with a jointer plane before being surfaced with a smoothing plane. Mark the faces of each piece so that all future work can be referenced from the same surface. Next, I plow the grooves for the panels in the center of the stiles and rails. I chop the mortises in the stiles after the grooves are plowed using a chisel that's the same width as the groove. Proceeding in this order ensures that the mortises will be located in the center of the stiles and be properly aligned with the groove. I mark the rails for tenons, based on the mortises, then cut the tenons. Next, I get out my panel stock—I rip the stock to width, crosscut it and square up the panels.

An easy way to make panels that stand proud of their surrounding framework is to cut a ¼-in.-wide groove exactly in the center of ¾-in.-thick rails and stiles and use ¾-in.-thick panels that are beveled from the front only. This gives the work an extra depth that I find appealing. It's certainly not the only legitimate way to proceed, however. More ornate examples of paneling involving applied moldings or molded edges demand a more complicated, less modular approach—as do panels that are visible and finished on both sides, or paneling that incorporates glazing or integral doors.

To ensure accuracy in building the frame, make and assemble the outside frame members first, then measure between the members to derive the length of intermediate framing. I find it easier to cut the framing's tenons first then mark the mortises directly from them.

When all the joinery is cut, knock the whole frame together dry, and check for winding (twist) and flushness, bringing all to truth with judicious paring and planing where necessary. Strictly speaking, this final true-up shouldn't be necessary, but one of the advantages of frame-and-panel construction is that it is somewhat forgiving of the occasional less-than-perfect joint, especially for wall-panel applications.

Now comes the fun part: making the raised panels. The first job is to prepare boards of sufficient width, either by ripping wide boards or by gluing up narrow ones. This is a design consideration that should be worked out beforehand.

Remember that the panel's area equals the opening in the framing plus the total depth of the grooves (sides, top and bottom), less just enough to allow for expansion of the panel. You don't want the panel to fit in the frame so loosely that it will pop out when it contracts. Equally disastrous is a panel fitted so tightly that expansion bursts the frame apart. The relationship of the panel to the framing is a function of four factors: the kind of wood used; how the wood is finished; the size of the panel; and the deepness of the grooves. For example, pine will expand and contract more than mahogany, and a painted panel is more stable than an unfinished panel. Thus, it's difficult to give hard-and-fast rules about the amount of space to leave at the bottom of the groove. When working with well-seasoned white pine (stock that's been allowed to air dry for several months after purchase), I use ¼-in.-deep grooves and allow a total of 3⁄16 in. of excess width. In other words, there should be about a 3⁄32-in. gap at the bottom of the groove beyond the panel. It helps to design a panel with bevels that slope very gently—15° is about right, with 25° being the steepest bevel allowable—since the wood fibers will crush slightly as the panel swells, and a shallow sloping bevel will exert less force on the frame.

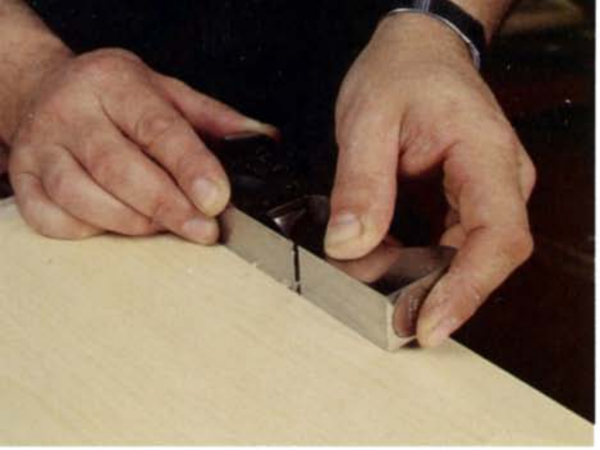
After the panels are ripped to width and jointed, crosscut them to length and square them up on a shooting board. You need to mark each panel in two places: on the face to be raised (to estab-

1. The face of the panel is marked with a cutting gauge, both with and across the grain. The rectangle left by the marks is the area to be fielded.

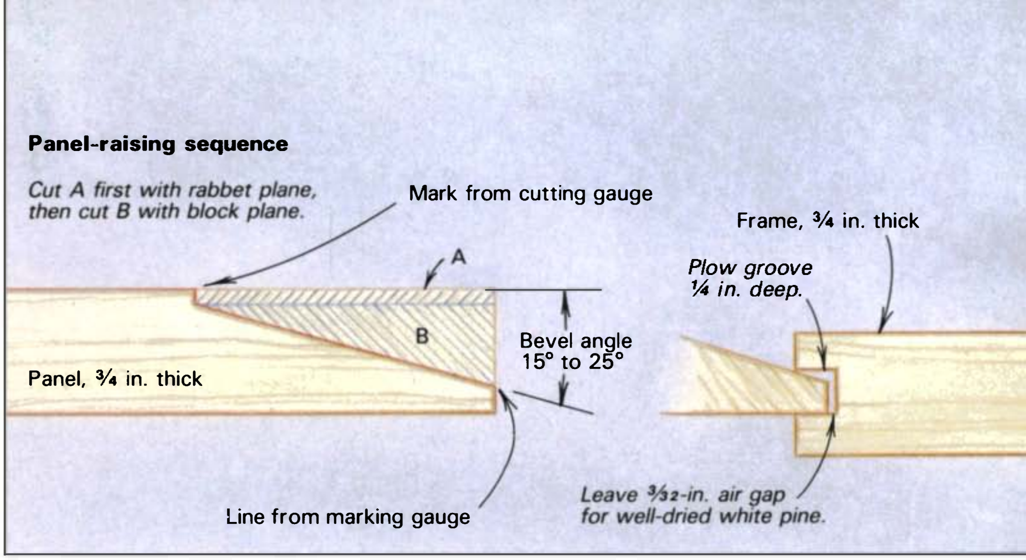
2. Stand the panel up in a vise and mark the edge that fits in the groove with a marking gauge. Set a marking gauge to the width of the groove and slide the gauge along the panel's back.

3. A rabbet plane cuts the perimeter of the raised field. The scrap clamped to the edge of the piece prevents tearout when planing across the grain.

4. The final rabbet is cut with the grain. Note the lines left by the marking gauge, darkened with pencil, visible at the panel's edge.



5. Clean up tearout at the field's shoulder with a shoulder plane laid on its side. The shoulder plane can also be used to trim the bevel, but a block plane works better.



lish the width of the bevel) and on the edge (to establish the thickness of the panel where it seats in the groove). Most panels—including the ones shown here—have bevels of equal width all around. The width of the bevel is a matter of personal choice and is often dictated by the width of the planes you're working with. To mark the panels, I set a cutting gauge to the width of the bevel and run the gauge along the perimeter of the panel. A cutting gauge is similar to a marking gauge, but it uses a small knife instead of a sharpened pin to score the wood. If you don't have a cutting gauge, substitute a marking knife and a T-square. The score marks created by the cutting gauge or marking knife form a rectangle in the center of the panel that will become the raised area. The tools also allow you to score the wood fibers both with and across the grain, ensuring a clean, crisp raised area.

Now, stand the panel edge-up in a vise and mark the edge of the panel that fits into the groove. Set the marking gauge to the width of the groove plowed in the frame and run the gauge along the *back* of the panel. (If you run the gauge along the front of the panel, the mark is relative to the wrong edge, and the panel will be too thick to fit in the groove.) Darken the scored line with a pencil. Marked in the proper manner—from the back—the panel will stand slightly proud of the surrounding framing. If you prefer the face of the panel to lie in the same plane as the framing, you'll have to make the panel out of thinner stock than the framing, or bevel the panel on both sides so the edge of the panel is centered relative to its thickness. If the back of the panel won't be visible, I'd go with panels made of thinner stock—beveling both sides of the panel would take an inordinate amount of time.

The panel is now ready to be raised, or "fielded." Position the panel on the bench so that you can raise the ends first, moving the plane across the grain. Clamp a piece of scrapwood the same thickness as the panel to one of the panel edges. This will prevent the plane from tearing out the edge as it cuts. It's important to plane the ends first, rather than the sides. This way, any tearout left from raising the ends of the panel will be cleaned up after raising the side bevels.

Set the fence on a steel rabbet plane so that the inside of the blade just touches the cut made by the cutting gauge, and turn the plane's spur out of the way. (The spur, meant to score the wood fibers when cutting across the grain, is unnecessary since the fibers have already been scored.) Set the plane's depth gauge to equal the height of the raised area—about 3/16 in. on the example shown here. Now, plane a rabbet—not a bevel—on the end of the panel. If the plane doesn't reach from the edge to the fielded area, plane the edge first and continue the rabbet up to the raised section, guiding the cut with a wooden fence clamped to the panel. The Stanley No. 78 rabbet plane shown here or its modern equivalent, the Record No. 778, are readily available. Other planes, such as the so-called universal and combination planes, work well, too.

After the rabbet is completed, work the sloping bevel from the corner of the rabbet to the marking gauge line on the panel's edge. The panel shown here has the bevel leading right to the edge of the panel. It's not impossible to plane a flat tongue on the edge of the bevel, but it's very difficult to clean up the juncture of the tongue and the bevel. The antique skew-angle block plane I use to work the bevel is well-suited for this job, but only one version of the plane—solid bronze and expensive—is still available (Woodcraft, 41 Atlantic Ave., Woburn, Mass. 01888; catalog no. 07021, $149.50). A regular well-sharpened block plane will work fine, but may require that you hold the plane slightly askew as you push it along, taking thin cuts and working with a little finesse. Work evenly, carefully extending each facet left by the plane until you have a continuous bevel to the marking-gauge line. When the bevel's completed, swap the panel end-for-end and work the other end in the same manner. When both ends have been cut, work the bevel on the sides. No scrap piece is necessary on the sides, since the plane shouldn't tear out wood when it's moving with the grain. The juncture of each bevel should be a straight line; this is a tell-tale sign that the bevels have been evenly raised.

After the panel has been completely raised, test the correctness of its edge thickness. To do so, slide a scrap of framing with the groove plowed in it around the panel's perimeter. Use a rabbet, shoulder or block plane to trim the edge of the panel where necessary, but be careful not to remove too much material. The shoulder plane is also good for cleaning up any irregularities or minor bits of tearout at the corners where the bevel meets the raised area.

All that remains is to actually fit the panel into the framing. When fitting very large panels, such as the central panel in an overmantel, it helps to pin the panel at the center of each end—to ensure equal expansion on both sides of the panel. Leave the rest of the panel free in its frame. Take care not to overtighten the clamps while gluing up the frame, lest you crush the joints and starve them of glue. Don't be too generous with the glue, either—it's liable to seep out of the joints and accidentally glue the panel in place. If you're really fussy, finish or paint both sides of the panels before gluing up the assembly. That way, no unfinished gaps will be left at the edges of the panel when it contracts during periods of low humidity. □

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

Shop-Made Sanding Drums

Cylinders turned true without a lathe

by Tim Hanson

A few months after I'd completed kitchen cabinets for our home, my good wife spotted a Parsons bench she admired, so I agreed to make one. Now, a Parsons bench has a lot of bandsawn curves and piercework designs in the back, all of which require sanding. After plenty of hard, slow work with a belt sander, I realized that what I really needed were some good-sized sanding drums I could mount in my drill press. You can buy these drums, but they're never the right size, so I started tinkering and came up with a method to make my own.

For precise work, a sanding drum's circumference needs to be exactly concentric to the arbor upon which the drum is mounted. To achieve this concentricity, I first mounted the arbor into a block of wood, then devised a way to turn the block perfectly cylindrical on my drill press (this could, of course, be done on a lathe instead). Rather than gluing the paper onto the drum or bothering with a sleeve, I designed a way to wrap regular sandpaper around the drum so it can be pulled tight and fastened. This method worked so well that I made an entire set of drums, ranging in diameter from 1¼ in. to 3⅛ in. One drum has a handle opposite the arbor end, so I can chuck it into a portable drill.

Here's how I make the drums: For a 2½-in.-dia., 5½-in.-long drum (this size uses exactly half of a 9-in. by 11-in. sheet of sandpaper), you need a 3-in.-sq. blank of wood. I've used maple, oak and poplar, but any hardwood will do. With a tablesaw, cut off the blank's corners to speed turning later. Next, thread a 6-in.-long, ½-in.-dia. machine bolt into a 13/32-in. hole bored 3½ in. deep into the center of the blank. Ream the hole ½ in. in diameter to the depth of the unthreaded portion of the bolt. Tighten the bolt until it just bottoms out. Good and snug is tight enough. To keep from stripping the hole, mark the hole depth on the bolt so you can tell when it bottoms.

To true-up the cylinder, I needed some sort of a cutting tool to mount on the drill-press table, so I ground the head of a 1½-in. drywall screw to a beveled edge, then honed the edge on an oilstone. It may not be fine tool steel, but a drywall screw is case-hardened and sharpens fairly well. I screwed my cutter into a block of wood at about a 20° angle, leaving ⅛ in. to 3/16 in. projecting. I then clamped the block to my drill-press table, which rotates to the vertical position, easily allowing the cutting edge to contact the spinning drum. If your table doesn't rotate, swing it to one side and clamp the block at the edge of the table, then swing the table toward the spinning blank to adjust the depth of cut. With the drill-press turning at 900 RPM, I cut about 1/64 in. per pass by raising and lowering the quill. My drill press has only 3½ in. of quill travel, so on a 5½-in.-long cylinder, I had to adjust the table's height to finish turning. When you've turned the drum down, finish the cylinder with a flat sanding block. Finally, drill a hole through the side of the drum and into the bolt for a 6D finishing nail that serves as a locking pin.

A friend of mine encountered chatter when he tried turning drums on his drill press, which is a good bit older than mine and has looser bearings and quill. We solved this problem by screwing another drywall screw right in front of, and 3/32 in. below, the cutter screw. The second screwhead is a few thousandths of an inch below the cutter, and it seems to brace the cutter against chatter in the same way a chip breaker works in a handplane.

The sandpaper locking pin can be made in one of two ways. For large drums, I use the cam-type pin made from a ½-in. dowel, as shown in figure 3. You can lock the paper on a smaller drum with the simple angled end pin, also depicted in the drawing. To make a cam-type pin, cut a slot for a screwdriver into the end of a dowel section. A ⅜-in. copper-tubing ferrule driven onto the end of the dowel will keep it from splitting when the paper is tightened. Now, with a backsaw, make a straight cut about ⅛ in. deep down the length of the dowel and use a chisel to carve the cam shape shown in the drawing. The pin fits into a ½-in. hole bored down through the drum. Locate the hole so you can leave 3/16 in. of wood between the drum's outer edge and the edge of the hole. Cut a slot for the sandpaper by angling a backsaw cut from the outside of the drum to the tangent of the ½-in. hole. Clean the slot up with sandpaper so it's 3/32 in. wide. To install sandpaper, cut a strip to length and tuck both ends into the slot, then insert the pin and turn it counterclockwise with a screwdriver to snug up the paper.

On small drums with no room for a ½-in. hole, use angled locking pins. For these pins, the hole must be about 1/16 in. larger than the dowel diameter, but the slot size is the same. Insert both ends of the paper, then use the angled end of the pin to crimp the paper as you slowly work the pin into the hole, turning it back and forth as you go. For paper changes, tap the pin out with a punch.

A sanding drum with a handle at one end is made the same way, except the shaft is pinned in the block before the cylinder is turned and a ⅜-in. steel rod rather than a bolt serves as the arbor. Set the nail well below the drum's surface so it won't foul your cutter. Figure 4 shows the details.

I operate the 3-in. drum at about 900 RPM. High speeds or lots of pressure burn the work or load up the paper. I use 40-grit for fast stock removal, 80-grit and 120-grit for finishing passes. That's another nice thing about making your own drums: You can choose any grit available in standard sandpaper sheets. □

Tim Hanson is a retired contractor and woodworker. He lives in Indianapolis, Ind.

Fig. 1: Sawing the blank

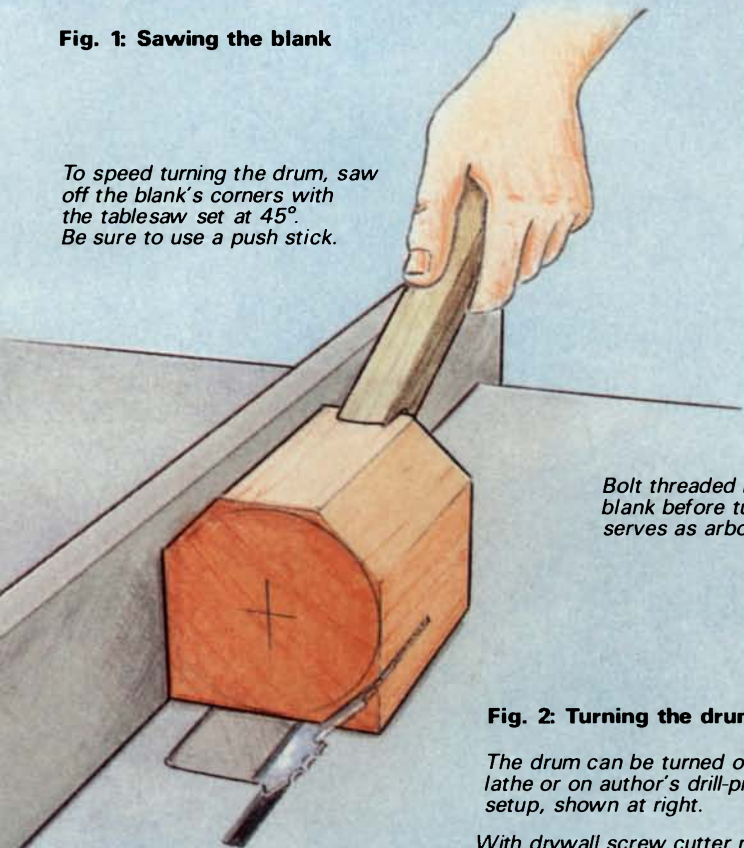


Fig. 2: Turning the drum

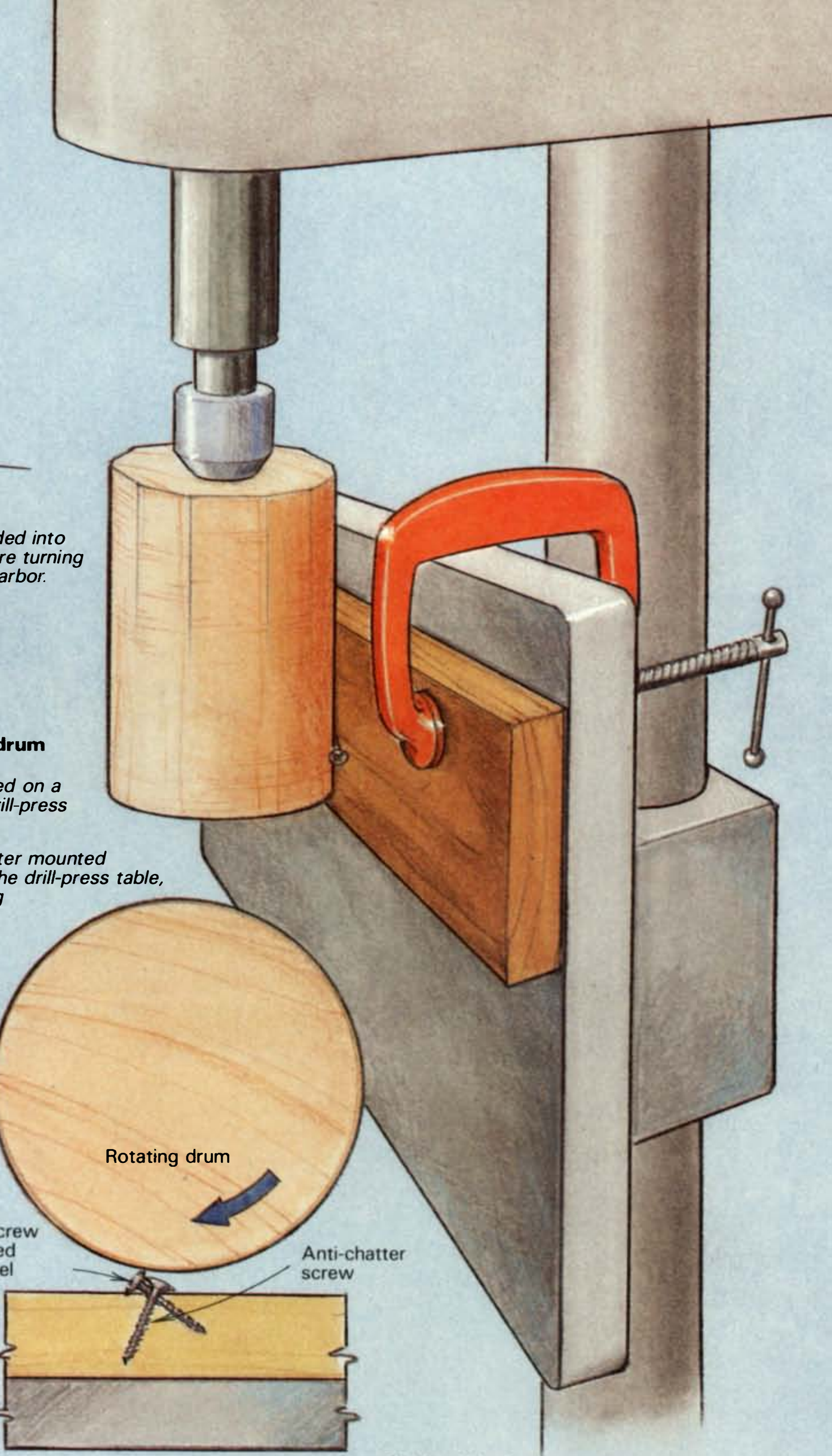


Fig. 3: Sandpaper locking pins

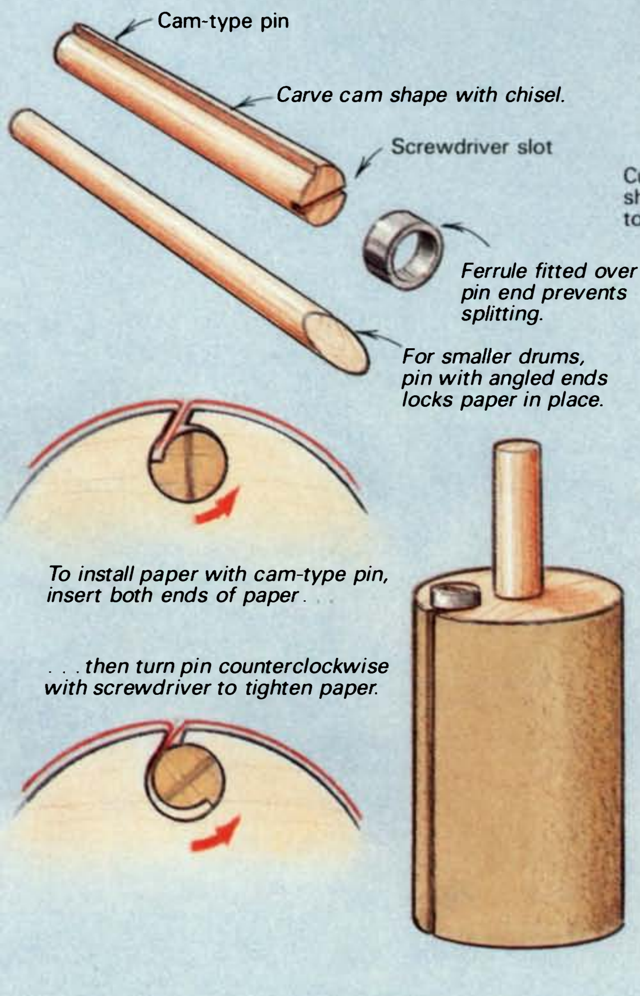
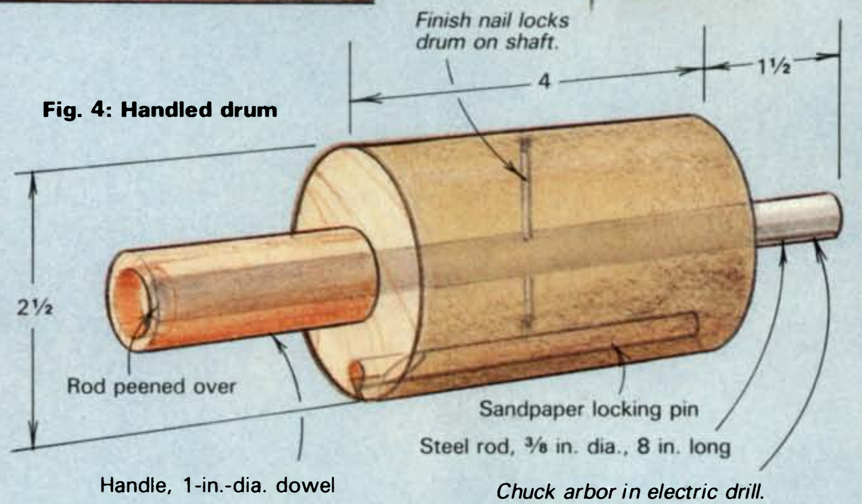


Fig. 4: Handled drum



Small-shop dust collection needn't be elaborate, as Claude Graham, owner of Masterworks in Wood of Jacksonville, Fla., demonstrates. Graham wheels a large Grizzly portable dust collector around the shop, connecting it where needed with a length of flexible hose. The same collector can be used in conjunction with ductwork as a central system.

Clearing the Air

Selecting and sizing a small-shop dust collector

by Roy Berendsohn

The advent of portable dust collectors during the past five years has made dust collection both affordable and practical for the small shop. Like many seemingly new tools, these portable collectors have found their way into the U.S. market from Europe, where small-shop dust collection has been more the rule than the exception for many years. Most of these collectors consist of a motor-driven blower that sucks dust and chips into a cloth bag or a drum.

The main purpose of dust collection is safety—chips and dust on the floor are slippery underfoot and pose a danger during operations when you need firm footing, such as ripping on a tablesaw. With the system permanently connected to your worst dust-making equipment, to capture dust and wood chips at their source, your shop will be cleaner and safer. And, at the end of a tiring day, you won't have to shovel planer shavings into plastic bags.

Then there's the health issue. Wood dust has been implicated as a cause of sinonasal cancer, so it stands to reason that, at best, a dust-collection system might reduce the risk of cancer; at the least, it will remove some of the eye-irritating, sneeze-provoking particles from the air. Also, insurance companies like to see dust collectors in woodworking shops—whether home shop or commercial—and installing one may reduce your fire rates.

The smallest portable collector on the market, Makita's Model 410, is light enough to be carried from machine to machine. The larger portables are usually mounted on dollies, so if you're not up to building a full-blown central collection system with ductwork and hoses, you could simply wheel the machine around the shop and connect it as needed. In this case, estimating the size of the collector is easy: it simply needs to have slightly more capacity than that required for the heaviest collection task, which is usually a planer or a shaper. However, in interviewing owners of various collection systems, I learned that all but a few of the dolly-mounted dust collectors available are, in fact, powerful enough to operate small central dust-collection systems. If I were setting up a shop, I'd buy one with a central system in mind. Though centralized dust collection is more expensive to install, it's much more convenient and efficient than a portable system.

Designing a central system—To set up a central dust-collection system, you'll need to design the ductwork that connects your machines to the collector, then calculate the size of collector you'll need. Start with plan and elevation drawings of the shop, each showing the proposed location of the collector, as well as the ducts and the various woodworking machines. The drawing on p. 72 shows a typical duct setup, and the accompanying text explains the steps necessary to calculate collector capacity. As the drawing shows, a typical dust system consists of a main duct from which branch ducts sprout, connecting each machine. As a general rule, duct runs should be as short as possible, with a minimum number of bends. Flexible hose lengths should also be minimized to reduce friction losses. Each branch duct will need a metal or plastic blast gate (see "Sources of supply," p. 75) that disconnects the machine from the system when another one is in use.

In researching this article, I discovered some disagreement over the best type of duct to use. I've seen a number of systems constructed of either Schedule 40 plastic plumbing pipe or a thin-walled variety of plastic used for sewers and drains. From what I've seen, plastic is easier to assemble than metal, and it works quite well. However, because plastic pipe is an insulator, air moving through the pipe builds up a static electricity charge that can discharge with disastrous results. One reader reported that a static discharge shattered a section of plastic pipe in his shopmade system, and it seems possible that suspended dust could explode or catch fire. It's possible to ground a plastic pipe with copper wire routed inside the pipe or around its outside diameter, but the safer choice is metal duct, which also happens to be more resistant to cracks from sharp-edged scraps hurtling along at 3,500 feet per minute inside the pipe.

The usual choice in metal duct is 22-gauge or 24-gauge round spiral duct, but other types and wall thicknesses will do the job adequately. For the example shown on p. 72, we used 24-gauge spiral duct and connectors. The cost of outfitting a system like the one shown wouldn't be cheap—the example calls for about $1,000 worth of spiral metal duct, elbows, hose and blast gates (minus freight costs). In any case, shop aggressively. I was quoted wide differences in prices for metal duct and, surprisingly enough, one supplier I contacted quoted higher prices for Schedule 40 plastic pipe than for 24-gauge spiral duct. Before buying duct, check with the local building inspector or fire marshal. Local codes may require a certain type of metal duct for dust-collection systems.

If you're collecting from only one machine at a time, the branch ducts (or, if you prefer, flexible hoses) to each machine can be 4 in. or 5 in. in diameter, connecting to a main branch that is also constructed of 4-in. or 5-in. duct. If you plan to operate all the machines at once, or if your shop is equipped with industrial equipment, you may need to increase the diameter of the main duct where each branch enters, but this isn't a job to be taken lightly. In complex systems, where there are multiple connections being made to the main duct run, you may want to have an air-movement-system engineer check your calculations. It's a tricky job to balance duct diameters and connections so the system works properly regardless of how many machines are running. If one or more machines are shut off, then the duct diameter may be too large for the amount of air moving through it. Though you may expect the air velocity to increase in these situations, just the reverse is true. Air velocity will be slowed enough to allow dust to settle out and plug the duct.

Once you've determined the layout of your duct system, calculate the size collector you'll need to operate it. Dust collectors are rated for their ability to move a certain number of cubic feet of air per minute (cfm) at a certain static pressure. Simply stated, static pressure is a measure of the friction the air encounters as it moves through the duct. If there's too much resistance, the collector won't be able to move its rated cfm. As a result, the velocity inside the main duct may fall too far below the 3,500 feet per minute velocity recommended as the minimum for wood dust and chips, and the waste will settle out, clogging the system. Generally speaking, the higher the static pressure rating a collector has, the more powerful it is, given equal cfm ratings.

Engineers who design industrial dust systems calculate volume and static pressure requirements with all machines running, but the typical small shop won't require that kind of capacity. You can easily figure your maximum volume requirements by referring to chart A on the following page and determining the need of the largest machine. A tablesaw or planer, for example, will require a collector with a minimum capacity of 300 or 400 cfm.

Similarly, use charts B, C and D to calculate static pressure losses on the worst branch of the system, which is usually the one most distant from the collector and containing the most bends and connections. Note that chart D is calculated to give the static pressure loss per foot of pipe at the 3,500 fpm or 4,000 fpm minimum velocity, based on the required cfm of volume. Recommended duct diameters are also included. As the chart shows, each section of straight duct accounts for its share of static pressure loss. Furthermore, as illustrated in charts B and C, elbows and branch connectors create turbulence, so the air travels a much longer distance than the actual length of the component. Using your plans, add up the linear feet of straight runs and equivalent duct lengths for elbows and branches (from charts B and C), then multiply this figure by the pressure loss per foot (from chart D) for the cfm capacity you've determined your system will need (from chart A). This figure represents the total system static pressure loss, and you'll need a collector

Fig. 1: Two types of dust collectors

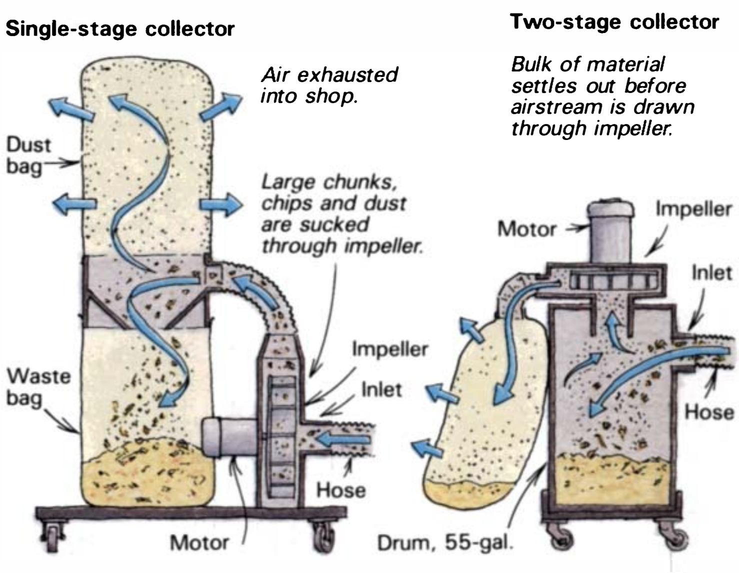
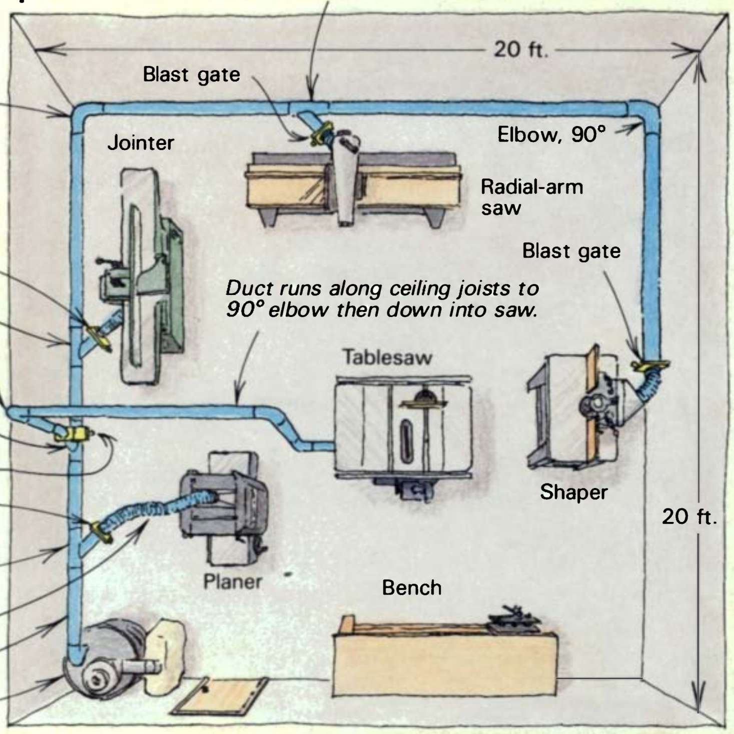


Fig. 2: Shop floor plan



Figuring dust-collection needs

To calculate the size of collector you need, follow these steps:

1. First, determine how to interconnect the duct to the machines. In the hypothetical shop shown above, the duct runs about 42 in. off the floor from the shaper to the radial-arm saw, where a plywood or sheet-metal hood draws in dust. The duct continues on to the jointer, where the connection is made with flexible hose and a 45° lateral connector. About 20 ft. down the line, another lateral connector runs the duct up to ceiling height, where it makes a turn perpendicular to the main run and continues on to the tablesaw. There, the duct drops down again and into the side of the saw through a cutout in the saw body. Inside the saw, a plywood or sheet-metal hood is positioned below the blade. A lateral connector is also used at the planer, and flexible hose runs from it to a sheet-metal hood atop the machine. Note that lateral connectors are specified throughout. These Y-shaped connectors impose a fraction of the friction loss imposed by T-shaped connectors.

2. Next, determine the duct diameter needed, based on the cfm requirements of the machine. (In this example, calculations are based on the use of 4-in.-dia. duct.) Chart D shows the relationship between the velocity you want the airstream to move at and the static pressure loss the airstream will experience at that speed while moving through a recommended duct diameter. If you want the airstream to move faster through the duct, you'll experience greater static pressure losses. These losses are compensated for by buying a more powerful dust collector that has the ability to pull in air against greater static pressure losses. A machine that requires 300 or 350 cfm exhaust volume needs 4-in.-dia. duct to permit the airstream to move at the required speed. At 3,500 fpm, you can expect a static pressure loss of .05 in. per ft. of duct. *(Note that static pressure losses are described at two different air speeds—3,500 fpm and 4,000 fpm. Make calculations based on 3,500 fpm for the main duct and 4,000 fpm for branches leading to the main duct.)*

3. Calculate straight and equivalent lengths of duct along the ductwork branch that will have the greatest static

A. Exhaust volume requirements for industrial (I) machines and home-shop (H) machines* in cubic feet per minute (cfm)

Machine	I	H
Jointer, 4-12 in.	350	300
Disc sander, to 12 in.	350	300
Vertical belt sander, to 12 in.	440	300
Bandsaw, 2-in. blade	700	400
Tablesaw, up to 16 in.	350	300
Radial-arm saw	500	350
Planer, to 20 in.	785	400
Shaper, ½-in. spindle (see note)	400-1,400	300
Shaper, 1-in. spindle (see note)	350-1,400	500
Lathe (see note)	350-1,400	500
Floor sweep	800	350

* Figures courtesy of Delta International Machinery Corp., Cincinnati Fan and Ventilator Co., Manual of Industrial Ventilation. Exhaust requirements for shapers and lathes can vary greatly depending on operation. The larger the cutter on the shaper, or the more complex a cutter's shape, the greater the exhaust requirement. Lathes also require more exhaust volume during heavy cutting as opposed to light sanding.

B. Equivalent resistance in feet of straight pipe for 90° elbow, centerline radius*

Duct dia.	1.5 D.	2.0 D.
3 in.	5 ft.	3 ft.
4 in.	6 ft.	4 ft.
5 in.	9 ft.	6 ft.
6 in.	12 ft.	7 ft.
7 in.	13 ft.	9 ft.
8 in.	15 ft.	10 ft.
10 in.	20 ft.	14 ft.
12 in.	25 ft.	17 ft.

1.5 D. and 2.0 D. describe the radius of the elbow's bend. An elbow with a 1.5 D. bend has a radius 1.5 times the diameter of the pipe. Note: For 60° elbows, loss equals .67 × loss for 90° elbow; loss for 45° elbows equals .50 × loss for 90° elbow; loss for 30° elbows equals .33 × loss for 90° elbows.

* *Industrial Ventilation, A Manual of Recommended Practice,* 19th edition, Edward Brothers, Inc., 2500 South State St., Ann Arbor, Mich. 48104. Also, Ductilator slide rule, Manufacturers' Service Co., (see "Sources of Supply," p. 75).

C. Equivalent lengths for lateral branch connectors

Duct dia.	30° branch	45° branch
3 in.	2 ft.	3 ft.
4 in.	3 ft.	5 ft.
5 in.	4 ft.	6 ft.
6 in.	5 ft.	7 ft.
7 in.	6 ft.	9 ft.
8 in.	7 ft.	11 ft.
10 in.	9 ft.	14 ft.
12 in.	11 ft.	17 ft.

pressure loss. In this example, only one machine is typically used at a time. Thus, the duct length likely to have the highest losses would be either the one leading to the tablesaw or the one to the shaper.

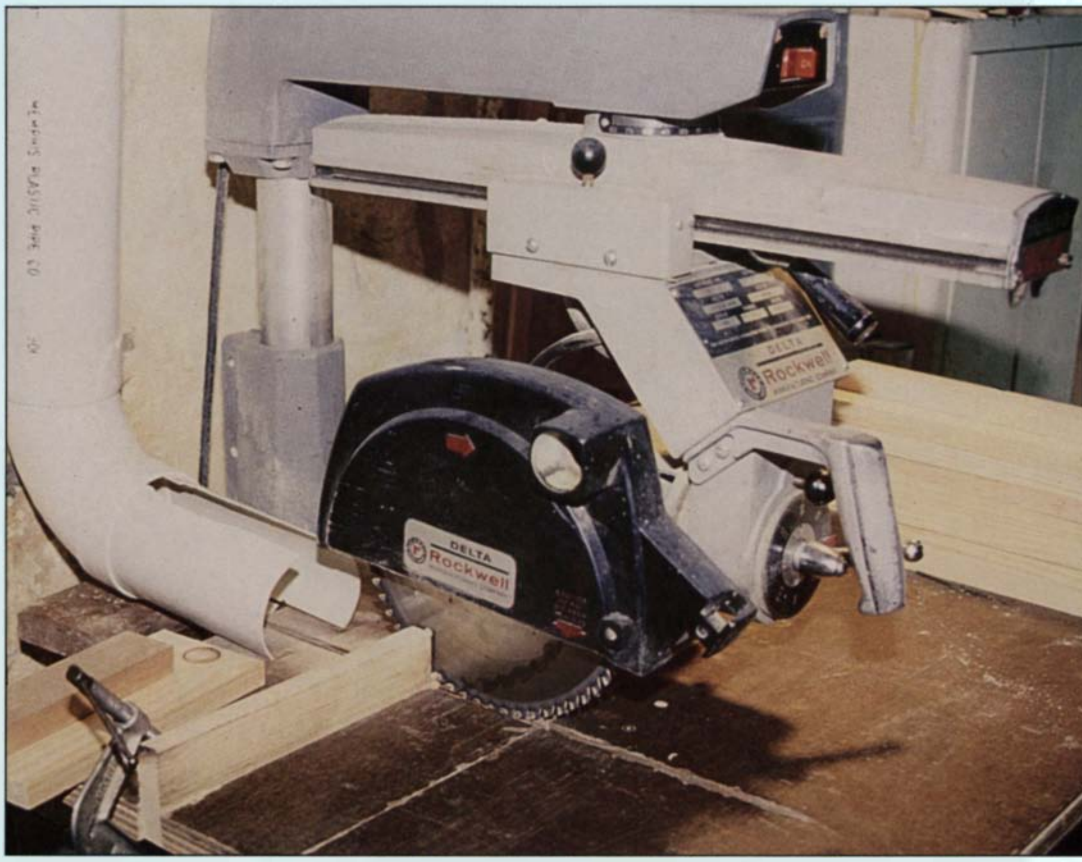
There are 50 straight ft. of duct running from the shaper to the collector, plus the equivalent length of 12 ft. in the two elbows. Multiply the static pressure loss per ft. (.05—see chart D) experienced when moving 300 cfm of air volume at 3,500 fpm by 62. The static pressure loss for this run of duct was about 3.1 in. There is the equivalent of 46 ft. of straight duct (three straight sections, three 90° elbows, a 45° elbow and a 45° lateral connector) leading to the tablesaw. Multiply 46 by the static pressure loss for a 300 cfm airstream you want to move at 4,000 fpm through 4-in. dia. duct (.07). This equals a static pressure loss of 3.2 in. Thus, the static pressure loss for the tablesaw is the greatest of any in the dust-collection system and should be used in all subsequent calculations.

4. Add to the total static pressure loss another 1 in. of loss due to dirty filter bags, plus 1 in. for other system losses. The total system loss is about 5.2 in.

5. The collector should have sufficient cfm capacity to draw from either the tablesaw and or shaper. The minimum collector that this shop would need would have a 300 cfm rating at 5.2 in. of static pressure. A better collector would be oversized by 20 percent, with a 360 cfm rating at about 6.2 inches of static pressure. Several collectors on the chart, p. 74, would fit the bill. —*R.B.*

D. Static pressure loss per foot of pipe at 3,500 FPM and 4,000 FPM

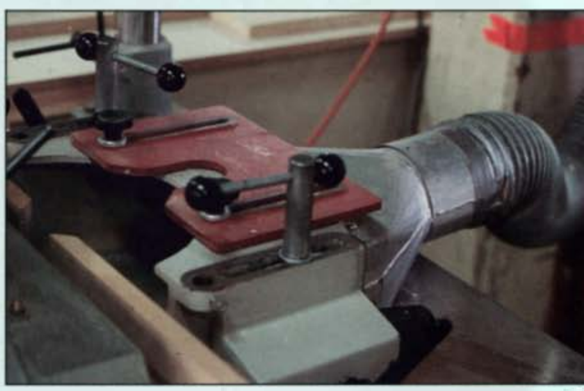
CFM	Duct dia.	3,500 FPM	4,000 FPM
300	4 in.	.05	.07
350	4 in.	.05	.07
400	4 in.	.05	.06
500	5 in.	.04	.06
600	5 in.	.04	.05
700	6 in.	.04	.024
800	6 in.	.03	.04
900	6 in.	NA	.04
900	7 in.	.03	NA
1,000	7 in.	.03	.04
1,100	7 in.	NA	.035
1,100	8 in.	.025	NA
1,200	7 in.	NA	.035
1,200	8 in.	.025	NA
1,300	8 in.	.022	.03
1,400	8 in.	.022	.03
1,500	8 in.	NA	.03
1,500	9 in.	.02	NA



A plastic pipe pulls dust away from a radial-arm saw. More elaborate hoods can be made from solid wood, plywood, plastic sheet or sheet metal.

Above left, Verner Peer of Summit, N.J., turned a handful of plugs on his lathe to act as blast gates. Commercial blast gates, right, shut off duct leading to an industrial Torit dust collector at Coastal Woodworking of Bridgeport, Conn.

Below, left: Peer's homemade setup is made from white pine and combines a fence and built-in guard made from clear plastic laminate. The hood/fence is fastened to a homemade shaper with quick-action clamps. Below, right: An interchangeable flexible hose leads to a high-volume dust hood for a shaper at Coastal Woodworking. The hose can be pulled off the shaper and plugged on to a hood at another smaller shaper.



Manufacturers' specifications

Make-Model	CFM	Static pressure (in. of water)	Motor (HP)	Volts	Storage capacity (gal.)	Impeller type	Inlet dia. (inches)	Casters
AGET 11T-51	1,000	3.2	1.5 or 3	220	55	cast alum.	6	opt.
Cincinnati 200S	1,100	8.5	2	220	55	cast alum.	6	opt.
Delta 50-181	1,100	8.5	2	220	55	cast alum.	6	opt.
Dustking 750-4	1,100	8	2	110,220,440	55	cast alum.	6	yes
Elektra Beckum SPA-1000	765	4.7	3,4	110,220	40	ABS plastic	4	yes
Grizzly G-1029	1,182	9	2	110,220	30	welded steel	4	yes
Holz 910	1,030	8.5	1	220	35	cast alum.	4.9	yes
Inca 910	840	8.5	6,10	110	25	welded steel	4	yes
Jet DC-1182	1,182	9	2	110,220	40	welded steel	5 or 4	yes
Kraemer S2	1,011	5	2	110,220,550	52	cast alum.	7	yes
Makita 410	300	20	1.3	110	52	welded steel	3	NA
Moldow MF	1,000	5	3	110,220,440	52	welded steel	6	opt.
Murphy-Rodgers MRT-5B	804	7	2	110,220,440	55	welded steel	5	opt.
Rees 211C	900	5	2	110,220	55	cast alum.	6	opt.
Sen Kong UFO-101	1,182	9	2	110,220	30	welded steel	4	yes
Scheppach HA 261	1,780	5	3,4	220	30	welded steel	4	yes
Shopsmith DC3300	368	5	1,2	110	30	plastic	2.5	wheels
Torit 19FM	1,200	4.6	2	220	55	welded steel	6	opt.
Ulmia DCAG	700	5.5	1.25	110	35	cast alum.	4	yes

Standard equipment: 1. Vacuum cleaner or floor-cleaning attachments; 2. Barrel or cabinet storage; 3. Starter switch; 4. Inlet hose; 5. Multi-branch inlet.

Optional equipment: 1. Vacuum cleaner or floor-cleaning attachments; 2. Starter switch; 3. Industrial options (explosion vents, bag-house covers, dust bag shaker, etc.); 4. Aluminum impeller; 5. Multi-branch inlet.

with at least that much static pressure capacity to do the job.

A word to the wise here: Allow generous excess capacity in determining the size of collector you need. A collector that's at least 20 percent larger than the demands placed upon it by the collection system, both in cfm capacity and static pressure loss, should be sufficient. The collector won't be overworked and will probably last longer. It'll also be adequate to handle an additional hook up, should you add a machine in the future.

Picking a system—I discovered some 30 portable dust collectors made by 19 manufacturers, and I'm sure there are a few that escaped my search. Practically all of the dust-collector owners I interviewed bought their machines on price, and I came to understand why: As far as light-duty collectors are concerned, there's not much to distinguish one machine from another, apart from physical size, minor features and capacities. In fact, two Taiwan-made brands, Jet and Grizzly, look identical.

Besides allowing for expansion, there's another reason for buying a slightly larger collector than you need immediately: cfm and static pressure figures can be misleading, even inflated. The cfm rating for any dust collector can be arrived at in two ways. One way is to measure what's called "free air movement"—the air moved only by the collector's fan. This figure is determined by the fan manufacturer (not necessarily the same company that makes the collector), based on standards established by the Air Movement and Control Association, an industry trade group. The second method is more realistic. It involves measuring the volume the collector will actually deliver with the resistance of its dust bag and hose accounted for.

Determining which manufacturers use what calculation method can be difficult. AGET, a maker of industrial systems, employs a test lab complete with ductwork and baffles to test their collectors, while Dustking performs some of its tests with collectors hooked up to a thickness planer. I had to pry the static pressure ratings out of one importer, who insisted he didn't want to provide them because his competition was simply pulling numbers out of thin air. My research suggests that makers of industrial collectors—AGET, Murphy-Rodgers and Torit, to name a few—provide more realistic or, at least, more consistent ratings than do makers of inexpensive home-shop portables. The issue isn't super critical for the small shop; just remember to oversize the collector slightly.

Portable collectors are manufactured in two basic design types: single stage and two stage. Single-stage collectors pull dust and large chips through an impeller, right along with the air. A cyclone action deposits heavy debris in a lower waste bag while lighter dust rides the center of the cyclone up into a dust bag, usually mounted on top of the waste bag. The airstream moves through the dust bag and back into the shop, keeping heated air inside the building. Most industrial-commercial dust-collection units—the type you see installed on the roof of a factory, for example—are just gigantic, heavy-duty, single-stage collectors.

In a two-stage collector, the impeller is positioned so that heavy debris and scraps are first deposited in a barrel or waste bag, so only light dust moves through the impeller. This translates into less wear and tear on the impeller, as well as on the motor and the arbor attached to it. As in a single-stage collector, the airstream passes through a bag, filtering out the remaining dust before the air re-enters the shop.

Single-stage collectors like the Grizzly, Jet and Shopsmith have one advantage over two-stage designs: The waste is collected in an easily detachable bag, so they're easier to empty out. A two-stage collector is likely to be mounted atop a drum, requiring you to disconnect and remove the drum to empty out the waste. Also, some two-stage collectors come without a barrel or bag: you supply

Standard equipment	Accessories	Type	Suggested retail price
2	2,3,4	single stage	$2,200
None	5	two stage	$ 750
3,4	5	two stage	$ 731
2,3,4,5	1	two stage	$ 459
2,4	1,2,3	single stage	$ 495
2,3,5	None	single stage	$ 355
1,2,3,5	None	single stage	$ 905
3,4	5	single stage	$ 695
3,5	2,5	single stage	$ 561
2,3	1,2,4,5	single stage	$1,090
2,3,4	None	single stage	$ 410
2	None	single stage	$ 850 (3-phase)
None	1,2,3,4,5	single stage	$ 860 (West Coast)
None	None	single stage	$1,125
2,3,5	None	single stage	$ 325
1,2,3,4	None	single stage	$ 499
1,2,3,4,5	None	single stage	$ 449
2	3,4	single stage	$1,598
2,3	1,5	single stage	$1,250

your own. Two-stage collectors are, on the other hand, generally quieter running and will probably hold up better if your system draws in large chunks of waste.

Another consideration is how the collector's impeller is constructed. There are two common designs: cast aluminum or welded sheet steel. A cast impeller is less likely to spark and ignite wood waste if metal debris is sucked into the impeller, or if the impeller itself runs out of balance, scraping against its housing. Local fire codes or your insurance company may require an aluminum impeller in your collector; check before you install.

A collector's waste capacity is tied directly to its physical size. Smaller portables, like the Inca 910 and the Shopsmith DC3300, will hold 25 and 30 gallons of waste, respectively. Because of their small size, portability and limited capacity, these machines are ideal for a home shop having only a few stationary tools. They can be connected as needed, without bothering with a central system. A busy commercial shop, on the other hand, will require more capacity, particularly if a thickness planer is often running. Unless you want to empty the collector bag or drum more than once a day—or rework the collector so it has greater capacity—buy at least enough capacity to contain what you'd sweep up off the floor in a typical day.

A dust collector won't be able to hold its advertised capacity, either. Several woodworkers told me what happens if you allow a collector's waste container to fill up right to the top; the air back-up pops the dust bag off the collector, raising great clouds of dust. String or cord tied tightly around the bag solves this problem, but you should empty the bag before it's too full. An overfilled collector is inefficient and defeats the purpose of having dust collection in the first place.

The chart above lists portable dust collectors and the accessories available for them. With the right attachments, you can press some portable collectors into service as large shop vacuums. Check the chart to see which manufacturers offer vacuum attachments. Elektra Beckum, Holz, Scheppach, Shopsmith and Ulmia, for instance, offer floor-cleaning attachments.

Hoods and nozzles that funnel chips and dust from the machine into the duct need not be elaborate. One shop I visited simply tied a portable dust collector's hose to a shaper that hadn't been hooked into the main system. Granted, it was far from the most efficient setup I've seen, but it was still better than letting the machine throw chips all over the shop floor, and it served its purpose until they could fashion a more elaborate setup. Hoods can be made from solid wood, plywood, plastic sheet (see "Sources of supply," above) or sheet metal. □

Roy Berendsohn is an assistant editor of Fine Woodworking.

Sources of supply

Dust-collector manufacturers:

AGET Manufacturing Co., P.O. Box 248, Adrian, MI 49221-0248.
Cincinnati Fan & Ventilator Co., Inc., 5345 Creek Rd., Cincinnati, OH 45242-3999.
Delta Machinery Corp., 246 Alpha Dr., Pittsburgh, PA 15238.
Dustking, BEC Industries, Box 368, Sunman, IN 47041.
Elektra Beckum USA Corp., 401-403 Kennedy Blvd., P.O. Box 24, Somerdale, NJ 08083.
Grizzly Imports, Inc., P.O. Box 2069, Bellingham, WA 98227.
Holz Machinery Corp., 45 Halladay St., Jersey City, NJ 07304.
Inca, Garrett Wade Co., 161 Ave. of the Americas, New York, NY 10013.
Jet Equipment & Tools, P.O. Box 1477, Tacoma, WA 98401.
Kraemer Tool and Mfg. Co. Ltd., 190 Milvan Dr., Weston, Ont., Canada M9L 1Z9.
Makita USA, Inc., 12950 E. Aldondra Blvd., Cerritos, CA 95701.
Moldow, EAC Engineering, 322 Edwardia Dr., Greensboro, NC 27409.
Murphy-Rodgers, Inc., 2301 Belgrave Ave., Huntington Park, CA 90255.
Rees-Memphis, Inc., Memphis Machinery & Supply Co., Inc., P.O. Box 13225, Memphis, TN 38113.
Sen Kong (Pit Bull), A.J. Tool Company, Inc., 15250 Texaco Ave., Paramount, CA 90723.
Scheppach, ABBA International, Inc., Box 135, N. Miami Beach, FL 33163.
Shopsmith Inc., 3931 Image Dr., Dayton, OH 45414-2591.
Torit (a division of the Donaldson Co. Inc.), P.O. Box 1299, Minneapolis, MN 55440.
Ulmia, Mahogany Masterpieces, Inc., RFD 1, Wing Rd., Suncook, NH 03275.

Manufacturers and distributors of dust-collection hardware:

AGET Manufacturing Co.—see address above (duct, hoppers, bins, bag houses).
AIN Plastics, Inc., P.O. Box 151, Mt. Vernon, NY 10550 (plastics for forming hoods and connectors).
Cincinnati Fan & Ventilator Co.—see address above (dolly bases, dust bags, hose extension arms, hose, nozzles, related hardware).
Duravent, Dayco Corp., Dayflex Co., 333 W. First St., Dayton, OH 45402 (flexible hose).
Dustex Corp., P.O. Box 7368, 3139 Westinghouse Blvd., Charlotte, NC 28217 (valves, filters, cyclones, hoppers).
Manufacturers' Service Co., Inc., Air Handling Systems, 358 Bishop Ave., Bridgeport, CT 06610 (duct, duct-calculating aids, hose, connectors, nozzles, blast gates, duct-related hardware, filter bags).
Murphy-Rodgers, Inc.—see address above (duct, hoods, connectors, fittings, blast gates, dust bags, hose).
Northfab Systems, Inc., Box 429, Thomasville, NC 27361 (duct connector clamps).
Wyndon Inc., P.O. Box 1359, Hillsboro, NH 03244 (blast gates wired to function as on/off switches, Sen Kong distributor, hose).

Veneers colored with fabric dyes create a field of bluebonnets, Indian blankets and other Texas wildflowers in Austin's Radisson hotel.

Marquetry Mural

Patch-pad flowers bloom on a grand scale

by Spider Johnson and Lora Hunt

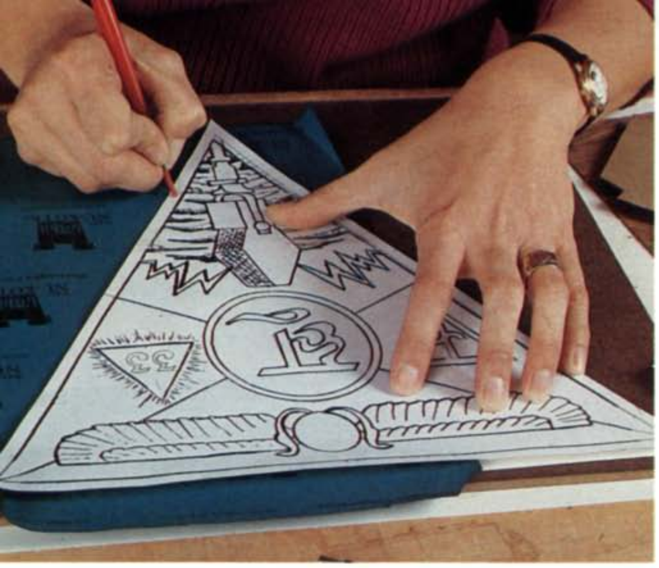
My wife, Lora, and I are professional artists making marquetry jewelry boxes, folding screens and clocks. Most of our work has been relatively small, ranging from 1-in. earrings to 5-ft.-tall screens, but we had to gear up radically last summer when we were commissioned to make the 9-ft. by 25-ft. mural shown above for the new Radisson Hotel in Austin, Tex.

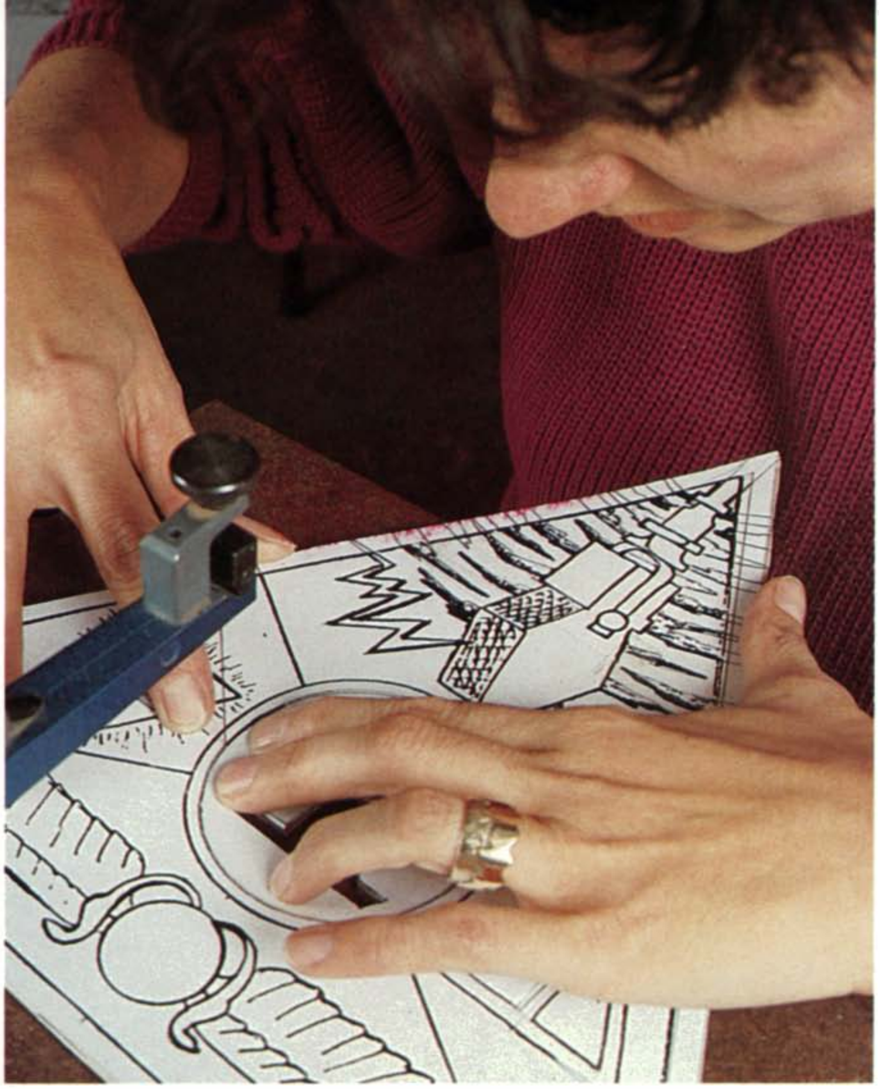
The hotel designers had specified marquetry for the mural, but professional marquetarians are as rare as chicken sexers, so the hotel's art scout was delighted to find our work in Eagle's Nest, a fine-art gallery in Austin. We were just as delighted, and interpreted the commission as an encouraging sign that marquetry is regaining the status it once held during the Italian Renaissance of the 16th and 17th centuries, when it was regarded as a worthy equal to the finest painting and sculpture. After several conferences with the art broker and the hotel's owners, we agreed that a marquetry panorama of native Texas wildflowers would be ideal behind the main desk in the hotel lobby.

In our work, Lora and I collaborate on designs and methods: she does most of the graphics and cuts the marquetry; I make working drawings from her renderings and handle all the joinery, detail-modification and finishing. It's a serendipitous blend of skills, temperaments, predilections, creativity and romance. Couples who work together harmoniously are, we've heard, rare.

Assembling the marquetry panels was a multi-step process. Working from color photos we took ourselves and others from field guides to Texas wildflowers, we made a full-size drawing of each flower scene. Every component of the drawing was then labeled to indicate the color of veneer needed to represent it. We

Photo above: Dewey Mears; photos right: Staff





To demonstrate patch-pad marquetry, Hunt first transfers a crest design to posterboard with carbon paper, top left. Veneer segments for the individual marquetry components are then taped into "windows" cut in the posterboard, above left. Each posterboard sheet can hold several patches. The posterboard layers needed to complete a picture are rubber-cemented together, then a photocopy of the design is cemented to the top of the pad. The individual segments are cut apart with a scroll saw, above right.

cut these individual color components using the non-traditional patch-pad techniques described below, then assembled and taped the color segments together as shown in figure 1. The individual flower scenes were then fitted into the background veneers, affixed to the millwork panel and finished.

This job posed some unique problems because the marquetries were so large and had to be applied to finished plywood panels. We usually rely on Titebond glue, clamping cauls and tremendous pressure to affix our marquetry to boxes and screens, but that method would have been unwieldy and neither cost- nor time-effective with these 9-ft. by 3-ft. panels. I decided against hot hide glue because I had no experience with hammer veneering, nor any teachers handy. A real veneer press would have been the ticket, but time and money eliminated that choice.

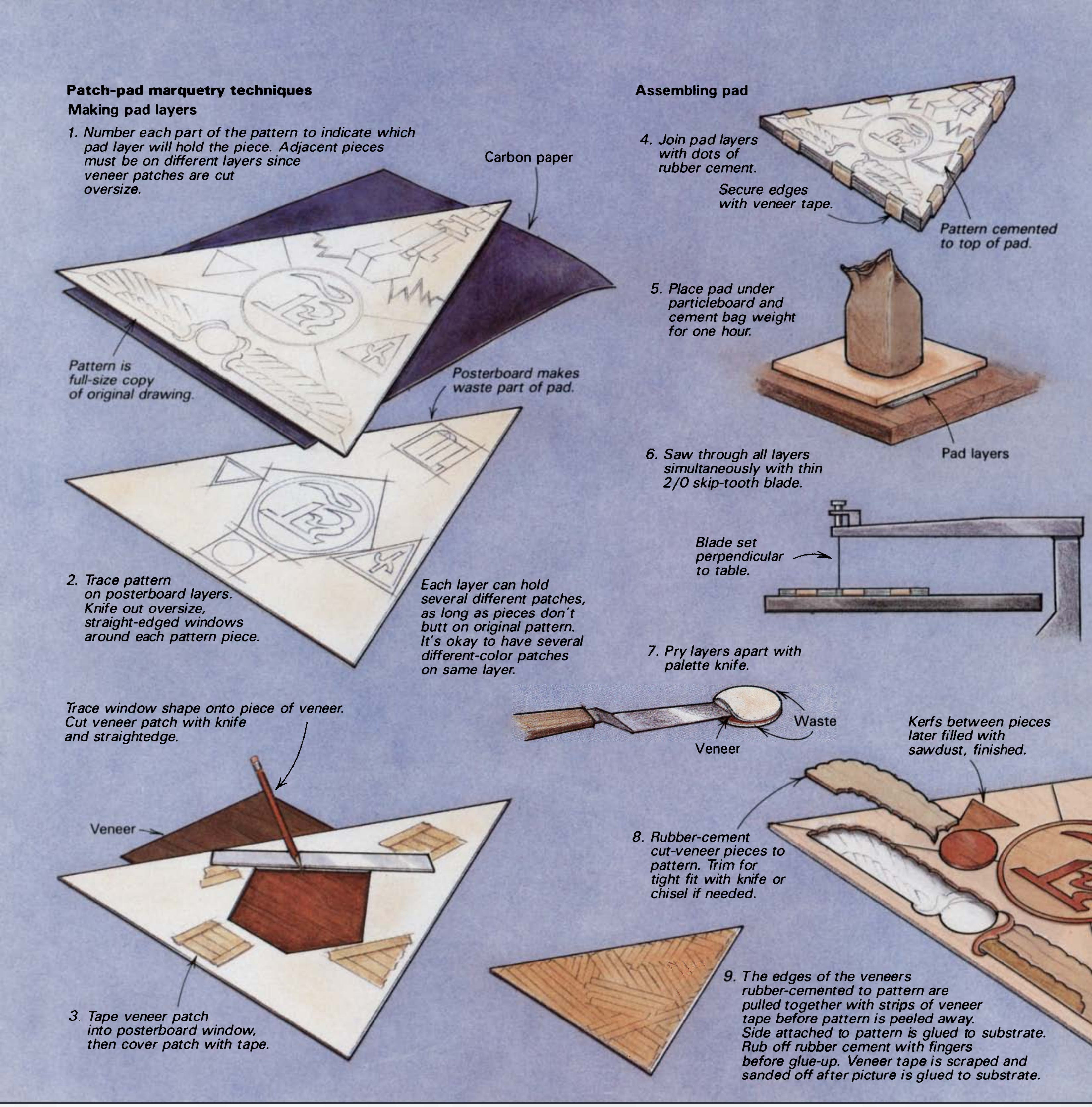
Eventually, I contacted 3M's technical assistance department (3M Center, St. Paul, Minn. 55144), presented them with the parameters of the job (materials, finish, installation position, ambient temperatures, humidity) and asked them for advice. They recommended a neoprene-based contact adhesive, 3M #80, which has a rated shear strength of 540 psi—more than twice that of other contact cements. The adhesive worked great on our mock-up sample, resisting water, sunlight and even the prying action of a putty knife. And the 24½-oz. spray cans spared us from messy rollers and brushes or expensive spray equipment.

Another problem was finding veneers that matched the colors of the wildflowers. Dyed veneers come in a very limited selection of colors, and the shades tend to be inconsistent from batch to batch. Therefore, we decided to dye maple, holly and sycamore with Rit brand cloth dyes. These dyes (available in supermarkets and department stores) had given us good results in the past. Unlike aniline dyes dissolved in lacquer thinner, cloth dyes penetrate the entire thickness of the veneer. Since so much wood is removed when the marquetry is sanded level, it's important that the color be consistent throughout the veneer's thickness.

To dye the veneers, we dissolved a packet of dye in six quarts of warm tap water—half the amount of liquid called for in fabric dyeing. Then, we put the veneer leaves into the largest stainless-steel pressure cooker we could find. (Note: do *not* use an aluminum pot—the dye will react with the metal and the color will darken.) Our 6-qt. cooker was barely big enough for this job, and some pieces had to be bent slightly to fit. We poured enough dye solution over the veneers to cover them, but never filled the cooker more than three-quarters full. Next, we heated each dye batch for at least 45 minutes after the pressure-regulator cap started rattling at the lowest pressure setting (about 15 psi). After dyeing, the wet veneers were sandwiched in brown paper, then newspaper, and left under particleboard weights for five hours to dry.

While our scenes were large, we couldn't skip details. If anything, enlarging the flowers made detailing even more important visually. The Indian blanket and the prickly pear poppy, for example, were very complex, large marquetries. But their intricacy was balanced by the simplicity of the winecups and bluebonnets, in which we achieved realism with only a few large pieces.

On the project, Lora varied the traditional patch-pad method



somewhat by substituting posterboard for veneer as the "waste" portion of the pad (see top left photo, previous page). Posterboard is cheaper and more readily available than veneer, and it can be easily cut with an X-Acto knife to accept the various patches of show veneer. In order to prevent the fragile veneers from splintering during cutting, Lora taped their surfaces entirely when patching them into the posterboard "windows" (see figure 1, above). Because of the number of segments required, she also included patches for several design sections in each posterboard layer.

For this design, we needed three marquetries of most of the flowers, so Lora cemented three patch pads together and cut through veneer/posterboard layers up to ¾-in. thick. Before sawing, she joined the layers into glued-up pads with scattered dots of rubber cement, then topped each pad with a full-size photocopy of the design. Veneer tape wrapped around the edges of the pads held them together while they dried for about an hour under a piece of particleboard weighted with a 90-lb. bag of concrete mix. When the cement was dry, Lora cut the pads apart with a Hegner Multimax-2 scroll saw with speed control (distributed by Advanced Machinery Imports Ltd., Box 312, New Castle, Del. 19720).

Since the flowers were too large for the throat depth of the saw, we designed the pads so they could be cut into quarters. Once the pads were quartered, Lora sawed out the individual pieces and immediately rubber-cemented them to a full-size

Several of the large flower segments exceeded the saw's throat capacity, so each section was quartered and cut apart. Then, the tiny components were rubber-cemented to a photocopy of the original design and joined with veneer tape.

After all of the marquetry components are taped together, the drawing can be carefully peeled away.

The completed marquetry is glued to the panel, then sanded and leveled with a belt sander and a worn 120-grit belt.

photocopy of the original line drawing. She worked from the center outward to minimize the width of the sawkerfs and to make the spacing work out.

The cutting technique for patch-pad marquetry—in which all the pieces in all the layers are cut at once—leaves a wider gap between the pieces than you'd get with the double-bevel cutting method or an X-Acto knife cut, but I think the difference is negligible. If the individual pieces are cut carefully, they fit together like a jigsaw puzzle, with the pieces separated by only the width of a thin scroll-saw blade. An X-Acto knife leaves a thinner kerf than a scroll saw, but hand-cutting is slow and tedious. With double-bevel cutting, the sawkerf is virtually eliminated, since butting pieces are cut together at an angle. The drawback of the double-bevel method, however, is that only two pieces of veneer can be cut at one time, and that would really hurt our production schedule. Besides, we often fill the kerfs with a contrasting color of sawdust to outline the forms, so we consider them a happy side effect.

It's important during assembly to use pieces cut from the same pad; segments cut from different pads may vary a bit due to blade drift during cutting. The tiny 2/0 skip-toothed blade flexes somewhat as the pad is moved during the cut and the layers press against the blade. To minimize this effect, Lora periodically relaxes her grip on the pad slightly to allow the blade's motion to move the pad sufficiently to straighten out the blade.

After the cutting was completed, Lora veneer-taped the entire surface of the marquetry, then carefully peeled away the underlying photocopy paper (see top and middle photos, left).

Next, the taped-up marquetries were hand-cut into their cherry, benin, teak and birch background veneers. I laid the background pieces in place on the panels and positioned the taped-up marquetries on top of them. Then, I used an X-Acto knife to cut the marquetry scenes into their backgrounds. At the same time, I also cut a Kraft paper mask to shield the panel from the adhesive used in the next step. When the marquetry pieces were fitted in place, they were secured to their backgrounds with tape.

I then sprayed both the plywood panels and the assembled marquetries with the #80 spray adhesive, passing over the surfaces twice in a cross-direction pattern to cover every square millimeter. To prevent the delicate marquetry from sticking prematurely, I inserted ½-in. dowels as spacers between the marquetries and the panels. Then, I lined up several points along one edge of the mask, pressed the two adhesive surfaces together, removed the dowels and smoothed the veneer in place with my hand and a mallet.

After the adhesive cured for several hours, I used a well-worn 120-grit belt to belt-sand and level the marquetry. This is a treacherous, risky business. It takes a delicate touch, great control and an intimate relationship with your belt sander—one that comes only after years of love and trust. I've sanded right through intricate marquetry in the past and can tell you from experience that they're nowhere near as simple to replace as a piece of solid veneer. Since Lora puts a lot of time and talent into creating the marquetries, moments like these test our marriage. Restraint is the watchword in areas where two veneers of greatly varying thicknesses butt together; it's best to scrape these areas, or hand-sand them. The completed panels can then be sprayed with six to eight coats of clear lacquer.

While designing and producing this large work, we vacillated tremendously between elation and frustration. It's rare to be so grandly commissioned, hence our excitement was barely containable. The project occupied us in one way or another ten hours a day for three and a half months. Trepidation seems to be an essential part of the creative process that leads to fresh and provocative artifacts, but the wear and tear on a typical American comfort-addict's psyche makes me occasionally wonder if a factory job stamping out tin-can lids might be preferable. However, after doing art as a full-time occupation for almost five years, we've developed a knack for making a living ***and*** fulfilling the artisan's fundamental need for satisfaction through creating something of beauty. . .something that people want to buy. □

Spider Johnson and Lora Hunt live and work in a small town in the central Texas hill country. Their work can be found in art galleries in Austin and across the U.S. Readers may contact them at Box 1247, Mason, Tex. 76856

Photos this page: Spider Johnson and Lora Hunt

Fixing Fish Eye

by Michael Dresdner

Fish eyes are probably the most common problem in lacquer finishing and refinishing, and one of the most difficult to remedy. In a freshly sprayed coat of lacquer, fish eyes pop up as small, randomly spaced craters in an otherwise smooth film. They're caused by silicone, a common chemical in furniture polishes, which alters the wet lacquer's surface tension, preventing it from flowing out. Silicone sinks into the wood through tiny cracks in the finish and then—when the piece is stripped—it dissolves in the stripping solution and spreads over the entire surface.

You can deal with fish eyes in one of two ways: by carefully preparing the surface before lacquering, or by using commerically available fish-eye preventers. On a wood surface that needs refinishing, I use a four-step wash to eliminate the offending silicones, as well as waxes and residues, then seal the surface with shellac before lacquering. My method might be overkill, but keep in mind that if fish eye occurs, no amount of spraying will cover it up. You'll have to strip the piece and deal with the source of the problem.

After the bulk of the stripper is scraped away, the piece is treated with (in succession): lacquer thinner, alcohol, naptha and warm water with a small amount of household-strength ammoniated detergent (not soap) added. Wearing gloves, wipe on a liberal amount of each solution and scrub down the wood, using a fresh pad of steel wool each time. Wipe the wood with a clean rag between treatments. The lacquer thinner neutralizes the stripper and removes most of its residue. The alcohol helps to remove aniline stains, oils and waxes, and what I call "shellac glaze"—that last bit of sealer that the lacquer thinner doesn't get rid of. The naptha dissolves any remaining contaminants, and can also be an early warning sign: If silicone persists, subtle but recognizable fish eyes will occur as soon as the mixture is applied. Finally, the water and ammonia solution will remove residual silicone. To avoid lifting veneers, perform this final step quickly, using liberal amounts of the solution, and wipe the piece dry immediately. Any lingering puddles cause water stains that are almost impossible to remove.

If all else fails and fish eye still occurs, the only answer is to fight fire with fire and apply fish-eye eliminator, which is simply pure silicone. Adding more of the offending material to the lacquer mix unites the random pockets of silicone to form one big silicone bubble, hence making the smaller bubbles invisible. Once used, the silicone must be added to every succeeding finishing coat.

Fish-eye dimples like these often indicate silicone contamination.

While adding fish-eye eliminator sounds like an easy solution, it can create more problems than it solves. The silicone alters the lacquer mixture, and can change its gloss and reduce its hardness. Furthermore, silicone will insinuate itself everywhere. Some years ago, I visited a small refinishing shop that had been regularly spraying lacquer that contained fish-eye eliminator. The silicone-laden overspray was settling on bare furniture waiting to be sprayed, requiring that it, too, be sprayed with silicone additive. A vicious circle had been set up—silicone was in the guns, the lacquer reserves and the strip tanks, and was even on the workbenches and rags. If you do choose to add silicone, be certain to contain the overspray. Also, discard or store siliconed lacquers separately, and clean your guns thoroughly before using them with plain lacquer.

I recently tested two new anti-silicone materials from Hood Products, Box 163, Freehold, N.J. 07728. Purge-All is billed as a stain, silicone and soil remover that brings out the natural beauty of the wood. Hood's Fish Eye and Silicone Stop (FESS) is said to stop fish eyes caused by silicone polishes, waxes and oils.

I took some maple-veneered flakeboard, sanded it and inundated it with silicone. The board was then sprayed with a thin coat of lacquer to be sure it fish-eyed evenly (see photo), then washed off with lacquer thinner, which removed the lacquer but not the silicone. I cut the board into eight pieces, treated each sample as indicated below, then sprayed all of them with a coat of lacquer and checked for silicone contamination. Here's what I did and the results, assessed while the lacquer was still wet.

#1: Four-step wash; very mild fish eye
#2: Four-step wash, sealed with shellac; no fish eye apparent
#3: Four-step wash, sealed with FESS; no fish eye apparent
#4: Purge-All wash; severe fish eye
#5: Purge-All wash, sealed with shellac; very mild fish eye
#6: Purge-all wash, sealed with FESS; very mild fish eye
#7: Sealed with shellac (no wash step); mild fish eye
#8: Sealed with FESS (no wash step); mild fish eye

Frankly, I surprised myself. I've been using the four-step wash for years and thought the shellac step was just extra insurance. But it's clear that the sealer—FESS and shellac seem equally effective here—is just as important as the wash, and neither alone is enough. It's best to use freshly mixed shellac for the sealer coat, although vinyl sealer sprayed thin and fast is an adequate substitute. I wasn't surprised that the four-step wash was decidedly superior to the Purge-All. In past tests, other silicone washes haven't worked especially well, because they tend to dissolve the silicone and spread it around, removing only the solution that stays in the wash rag.

Although the amount of silicone I introduced was more than you'll find on an average refinishing job, I've run into similar levels of contamination. I once refinished an "oiled" walnut table. It was virtually bare wood the owner had cleaned for years with a silicone polish. The wash-and-seal process saved it, and it went out of my shop looking a lot less greasy than when it came in. □

Michael Dresdner is an instrumentmaker in Zionhill, Pa.



Because of the large diameter of Pine's mahogany interpretation of a Philadelphia-style tripod, the author dished the top with a router instead of on the lathe. Hand tools then leveled the surface and carved the piecrust design. The ball on the shaft can be left plain or be carved. In either case, it should be turned to the diameter shown in the measured drawing on p. 82—the carving is so shallow that no allowance is necessary for it. The ball-and-claw foot and knee carving are hallmarks of high-style work, but less ambitious tables with pad feet and plain legs can succeed in capturing the uncluttered look of the best Queen Anne.

Tip-and-Turn Tables

Philadelphia detailing produced the masterpieces

by David Ray Pine

Of the many tripod tea tables made in America in the 18th century, those built in the Philadelphia area are considered by many experts to be the most desirable. The basic design and proportions are very successful when left unadorned ("in the Quaker taste"), but these tables lend themselves equally well to the highly embellished forms that are more often associated with Philadelphia Chippendale furniture.

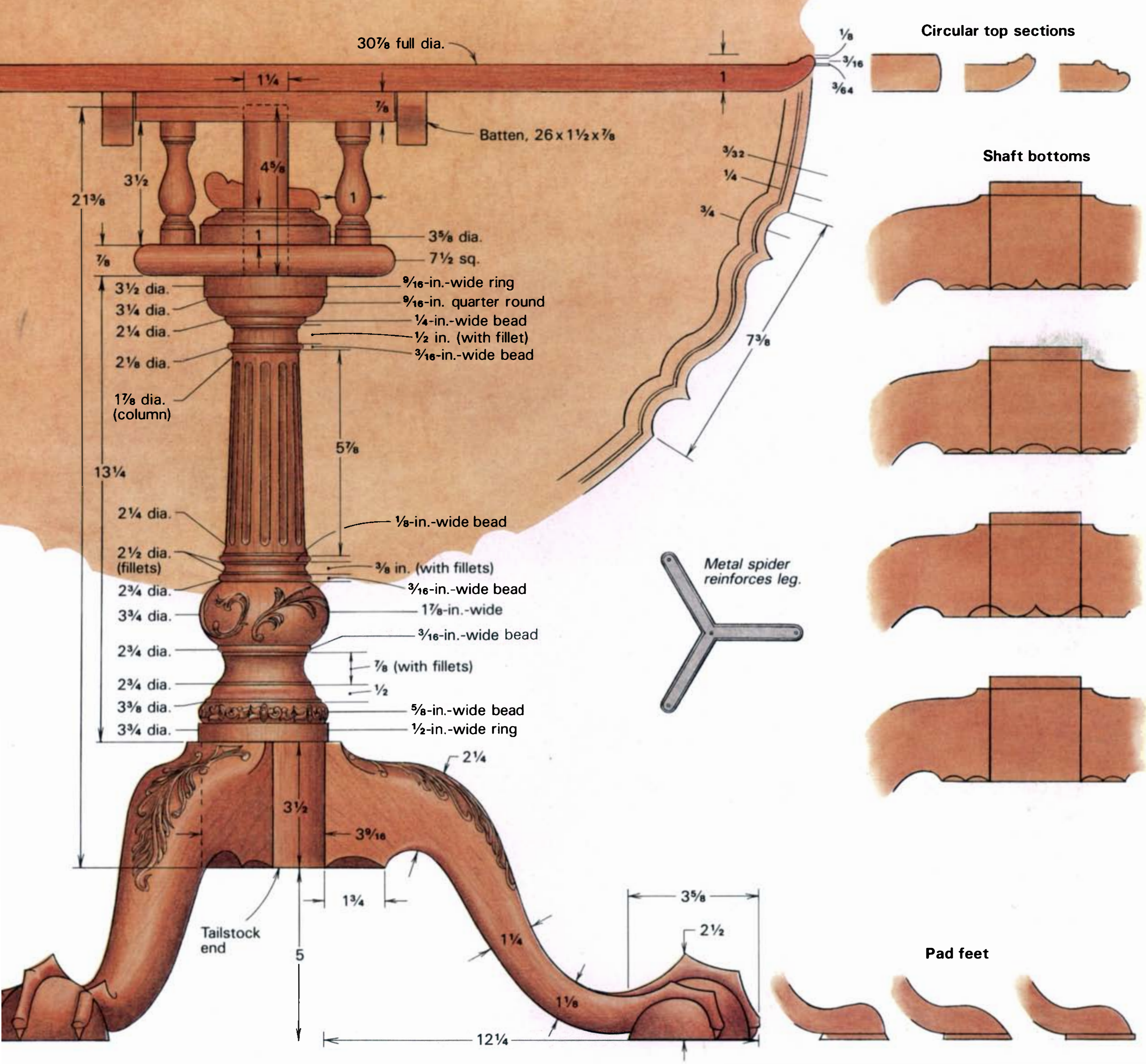
The tripod table that I built and will describe here is often called a piecrust table, in reference to its scalloped molded top. Tables of this type—regardless their top's shape—are often called "tip-and-turn" tables, since the top of such tables can be swung to a vertical position and/or rotated on its "birdcage" support, much like a lazy Susan (see details in figure 2). The birdcage seems to have been popular only in the Pennsylvania region. New England and Southern tripod tables often tip, but seldom do they turn.

Figure 1 shows the dimensions of my table. If this project tempts you but seems too ambitious, there are many ways in which the design can be simplified. In *Fine Points of Furniture* ($12.95 from Crown Publishers, 34 Engelhard Ave., Avenel, N.J. 07001), Albert Sack shows some two dozen variations on the tripod table. Many have pad feet and plain turned tops with slightly raised rims, and there's at least one with a simple flat top with a half-round edge. Still others have fixed tops that neither tilt nor turn.

I won't concern myself much with turning or carving in this article, but will describe the general order of how to make a tripod table, including important considerations that might not be too evident if you haven't made one before.

Construction begins with turning the shaft. Take special care

Fig. 1: Philadelphia piecrust table



in turning the area of the shaft where the legs will join. This section must be perfectly cylindrical—any taper will affect the stance of the legs. Turn both ends of the shaft and the ledge where the birdcage will rest flat and square to the axis of the shaft. Wait until the legs are fitted to the shaft before doing any carving or fluting. This will decrease the likelihood of damaging fine details while driving legs into and out of their sockets.

Choosing stock for the legs is next. Note that while each leg requires 3-in.-thick stock for the ball-and-claw foot, the leg is only 2 in. thick where it enters the shaft. With pad feet, you can get away with 2-in.-thick stock. After sawing the legs to shape, plane the end for the dovetail square to both the foot and the sides. I have a set of flat bits for my tablesaw's molding cutter-head that are ground to 14°, and I use them for cutting sliding dovetail pins. The pins can be cut with a crosscut blade on the tablesaw instead.

The shoulders of the dovetails can either be carved to fit around the shaft or left flat with the shaft faceted to match. Old tables were done both ways—then as now, it seems to have been a matter of preference for each maker. I've used both methods, and prefer to flatten the shaft for each leg, as shown in figure 3. It's easier for me to achieve a good fit at the shoulder, and I believe it makes the dovetails somewhat stronger, as there is more wood surrounding the pins because the angle is not so acute. The other approach—making legs to fit a round base—is described in the article on making music stands in *FWW* #63.

Drawings: Lee Hov

I like to align one leg with the grain rings exposed on the ball of the shaft and space the others equidistant from that one. This "master leg" will be at the front of the table (if a round table *has* a front!). Fit each leg to its socket by trial and error, paring waste away until the leg slides snugly up to the shoulder. It's a good idea to mark each dovetail pin and its socket to avoid mixups.

Now, finish shaping the legs and carve the feet. Carve the master leg last, so you can "put your best foot forward." Do any carving on the shaft now, then glue the pedestal up.

After the glue hardens, the bottoms of the legs should be pared even with the end of the shaft. Often, the bottom edge of the portion of shaft between the legs and the bottom edge of each leg itself are decorated with scallops. This scallop pattern is cut at an angle, so that it runs out a little way under the base of the table. The photo and drawings show the idea.

The best tables are reinforced at the bottom of the shaft with a three-legged iron "spider," which is screwed to the bottom of the shaft in the center, and to each leg somewhere beyond the dovetail joint. On some tables, the spider is bent to conform with the curve of the leg and can run several inches down each leg. The dovetail joints are the table's weakest point, and a sudden jolt, as from an armload of books, can cause the shaft to split out between two of the legs. The spider spreads the stress evenly around the base of the table. If you don't know a blacksmith who can forge a spider for you, you can cut one out of heavy ³⁄₃₂-in. sheet metal. Either way, the edges are best beveled back so they're less likely to show. Alternatively, the spider can be inlaid.

The two battens that help hold the tabletop flat will eventually be screwed to the underside of the top. The top tips up by rotating on dowels worked on the top edge of the birdcage (see figure 2). These dowels are captured in holes bored tangentially to the top edge of the battens. On old tables, battens often taper from the center to the ends; sometimes, they have an ogee or a lamb's tongue sawn on the ends. Make the battens before the birdcage. If you plan to make a small table that neither tips nor turns, make a single wide batten to fit a wedged through tenon at the top of the shaft. This tenon can be round or square—either is correct. On old tables, battens always run cross-grain (to prevent warping), and there is no provision for wood movement. On a new table, it makes sense to slot the screw holes in the battens.

The birdcage consists of a top and a bottom plate, held together by four turned balusters. The plates are generally square in shape (very rarely is one circular) and about twice the size of the shaft's largest diameter. Most often, the top plate is square-edged, but, on better tables, the bottom plate has a half-round worked on all four of its edges. Work the dowels on the top plate by bandsawing waste away, then rounding them over by hand until they slip-fit in their batten holes. Bore both plates for the balusters' tenons simultaneously if you're planning on through tenons, which can be wedged. Blind tenons are, perhaps, neater in appearance, but they require a lot of measuring for location and depth. The central hole for the shaft should pierce the bottom plate, but stop about ¼ in. deep in the underside of the top plate.

The length of the balusters (between tenon shoulders) should be about the same as the diameter of the table's shaft. It's a curious fact that the birdcage balusters keep their characteristic vase shape (except English birdcage balusters, which are columnar in shape), regardless of whether the shape of the shaft is vasiform or has the flattened ball and column. Thus, the balusters aren't necessarily miniature copies of the shaft. The balusters' through tenons should be cut off about ¹⁄₃₂ in. too long—this leaves enough surplus to trim after glue-up. Split the tenon ends with a chisel and drive the wedges immediately after glue-up, aligning them cross-grain so they don't split the plates.

The bottom plate of the birdcage is sandwiched between a ledge on the shaft and a loose, lathe-turned ring that's held in place by a wedge through the shaft. There's often a notch cut into the flat on opposite sides of the top of the ring. The wedge engages these twin notches and keeps the ring from rotating when the top is turned, which would wear away the finish and eventually the bearing surface. With the ring and birdcage in place, mark the location of the wedge on the shaft. This should be at right angles to the master leg. Cut the tapered slot for the wedge and make the wedge several inches longer than necessary. For the

Fig. 2: Birdcage and battens

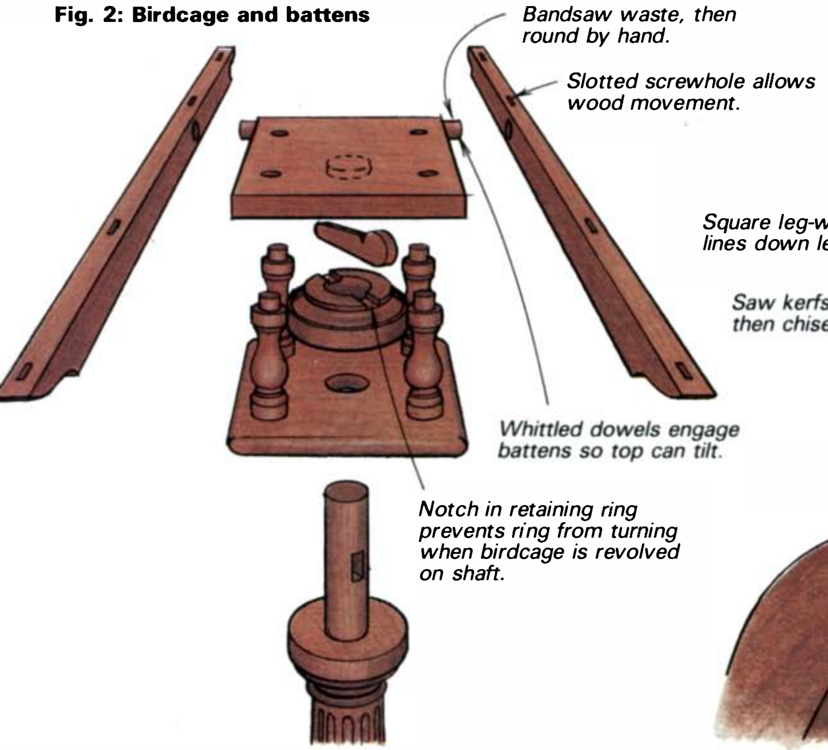
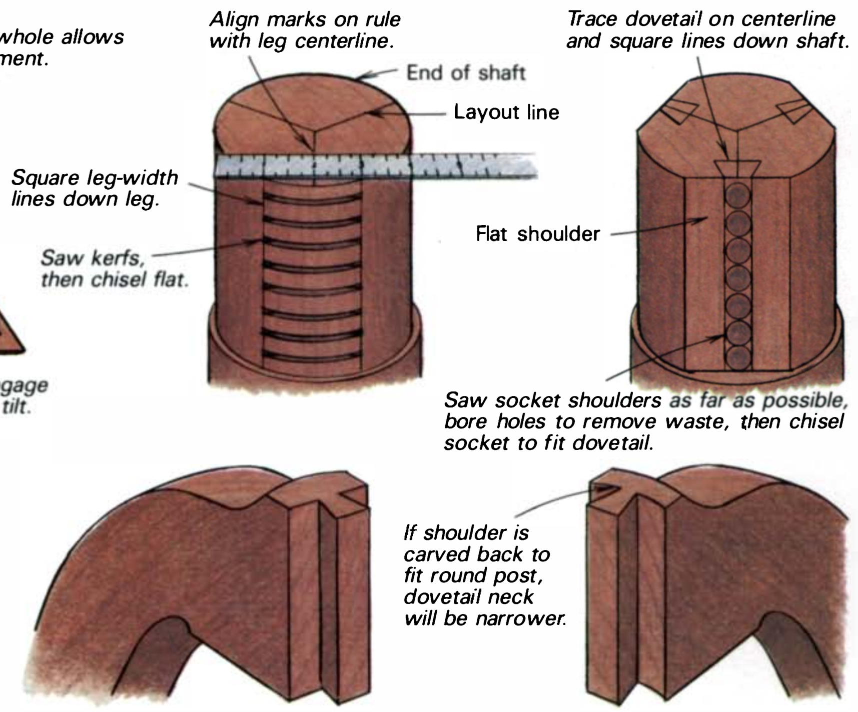


Fig. 3: Cutting dovetails and sockets



tabletop to revolve properly, the wedge should bottom out in its slot while just removing all slop from the ring and birdcage. The bottom of the slot must line up exactly with the top surface of the ring. If the slot is too high, the tabletop will rattle around; if the ring is too thick, the wedge will bind things up and the top won't turn at all. When you have things just right, trim the wedge to length and shape its ends.

Tops are generally done as faceplate turnings, as described by Gene Landon in the article beginning below. Dished tops have a tendency to cup after the center is wasted away, either because of unbalanced tension or due to moisture within the wood. It's a good idea to temporarily attach the battens as soon as the top is dished, to keep the top from moving. Stock for any dished top should be at least 15/16 in. thick, but stock more than 1⅛ in. thick will look too heavy, even on a large table. The total height of the raised rim is usually 5/16 in. to ⅜ in., which looks taller than you'd think after it's shaped up.

The molding on old tables doesn't usually have much of a perk or fillet at the surface of the top—just enough to define the edge of the cove. In contrast to Landon's method (see below), I dish the top first, truing out any cupping as it occurs. Next, I true and turn the top surface of the rim, with the back of the rim last. It's a good idea to do all the lathework in one session, as the top will probably move overnight, causing the edge to wobble. This can make sanding difficult, and makes further turning a real problem.

The scallop on a piecrust top consists of a serpentine curve flanked by a small semicircle on both sides. These scallops repeat from 8 to 12 times (always an even number) around the top, and are separated by small segments of the circular edge. As a rule of thumb, the scallops are about twice the length of the segments, though this does vary on old work. When laying out a top, draw the whole width of the molding out, as what looks good on the outside edge may appear too cramped on the inside perimeter. The width of the molding is usually between ⅜ in. and 1 in., and radii of arcs and curves increase and decrease accordingly. Usually, tops are laid out with a serpentine curve topmost when the top is tipped, rather than a plain segment.

I'm uncomfortable turning a top bigger than about 24 in. on my homemade lathe. An alternative method, which I used to make this table, is to use a router and flat bit to waste the center away. First, bandsaw the piecrust perimeter. Then begin routing in the middle of the top, and make a spiral cut toward the outside edge. As you approach the rim, use a block (thicknessed equal to the depth of cut) to help support the router base. Rout as near the inside line of the piecrust mold as possible, then remove the marks left by the router bit using a plane and a scraper. Pare to the inside line of the molding using appropriate gouges, then lay out the line of the bead. I use a compass set to the bead's diameter and slide it around the top with the point hanging over the scalloped edge.

Set the bit depth to cut the stepdown from the topmost bead, then rout it using the same support block as before. Conceivably, you could rout a portion of the cove using templates, but I doubt that it would be worth it. It's easy enough from this point to finish the job using carving tools.

The birdcage can now be installed between the battens. Attach the catch (part H-43 or H-48 from Horton Brasses, P.O. Box 120, Cromwell, Conn. 06416) to the top and inlet its keeper into the birdcage top if you haven't done so already. A little final sanding should be all it takes to get the table ready for finish. □

Ray Pine makes furniture in Mt. Crawford, Va.

Turning and Carving Piecrust

Traditional methods still pay off

by Eugene E. Landon

A piecrust top looks intimidating, but even a beginner can carve one with sharp tools and some attention to the order of events. You don't need many carving tools—a ⅝-in. #5 gouge (or one suitable for the shape of cove to be carved), a #2 gouge about the same width and a medium-size flat chisel will suffice. I've probably turned and carved three or four dozen piecrusts, and can tell you that the job is very satisfying. Be sure, however, that your wood and your glue joints are sound. I once had a knot catch the tool while turning a 30-in. blank, and the exploding top left permanent marks on both my shop and my memory.

Tops come in a variety of sizes. The one shown here is medium size, about 20 in. in diameter. Feel free to scale the design up or down. You expect a mahogany tabletop of any size to be one piece—mahogany was once available in very wide planks indeed—but walnut tabletops larger than 12 in. in diameter are generally glued up from two or three boards.

Old tabletops were made from air-dried wood with about a 15% moisture content. In modern houses, they shrink quite a bit as central heating brings the wood's moisture content down to about 8%. One hallmark of a genuine lathe-turned antique top is that it's no longer round. So, for this reproduction, I'm using air-dried walnut from the stack out behind my shop, rather than wood from my kiln. With luck, it'll shrink about as much as the original table, which is ⅜ in. out of round. This shrinkage will take a year or so to occur.

The process begins by gluing up the blank, bandsawing it round and attaching a glue block to which the lathe faceplate can be screwed. I don't use paper in the glue-block joint because I don't want any chance of repeating that memorable explosion. It's easy enough to saw off the bulk of the block when the turning is done—run the tabletop horizontally over the tablesaw to make a series of side-by-side kerfs in the block, chisel off the waste, then plane the bottom of the table flat.

Gene Landon works wood in Montoursville, Pa. The original of the table shown here is at Independence Hall, in Philadelphia.

1. With my lathe turning at its slowest speed, about 700 RPM, I flatten the back and round the outside edge with a gouge, then clean the surface with a skew used as a scraper. This produces dust from the endgrain areas, but pretty good shavings from the long grain.

2. I traced a portion of the tabletop, which the curators at Independence Hall in Philadelphia were kind enough to let me do, and took careful measurements. Here, with a parting tool, I'm marking the inner extent of the piecrust—the center of the top will be dished out flat up to this line. If you look closely, you can make out the slight step at the outside rim, made with the point of a skew. This is my gauge line for the final thickness of the rim.

3. Here's an early stage of dishing, using a gouge. As wood is removed, the top will warp slightly because the uneven tensions in the wood are finding new balances. This causes the rim to go out of a flat plane, which is desirable—the final carving will not look too mechanical, but will have a little up-and-down wander.

4. I turn the cove with a carbide-tipped scraper (soldered up for me by my favorite local machine shop) that has a profile like a flat little fingernail. This narrow profile allows me to fine-tune the shape of the cove until it exactly matches the profile of the gouge I'll use for the carving, as shown in the next step.

5. Check the profile of the cove by stopping the lathe and pressing the gouge—in this case a $\frac{3}{8}$-in., #5 sweep—into the cove at the same angle as when you will be carving. The fit shown here is just right and matches the original table. Piecrusts superficially look alike, but each carver makes the cove to match his particular tools.

6. With the top cut to final depth, tool marks can be removed by scraping. I made this tool from a power-hacksaw blade—there's a clear view of it in photo 15. It has a slightly convex edge, and I use it with the burr left by the grinding wheel.

7. With a template made from the tracing of the top, you can step around the circumference. Note that each small scallop comes the same distance from the step at the top of the cove. This distance will be the width of the outer bead when the carving is complete. One reason I don't make a lot of drawings is that I document each reproduction with photos of the original; I also make rubbings of carvings and other relief details when possible.

8. Bandsawing the profile is about as nerve-racking as this project gets. The scallops are at the limit of what this ¼-in. blade can turn. Be sure before you start that you can cut the tight radius, or else everything up to this point is wasted labor.

9. After filing the profile smooth, mark the width of the outer bead with calipers or a compass, then make vertical "stop cuts" using gouges of the appropriate sweeps to match the curves. These cuts define the inner border of the bead and prevent it from splitting off when the adjacent surface is lowered. I prefer narrow gouges for this job, because wider ones require so much pressure that they may split the bead off anyway. Where the grain is short, I use an X-Acto knife for the stop cut. However, with a bead as narrow as this one, be prepared to glue some chips back on (I use model-airplane cement).

10. Using a #2 gouge, which will make cleaner cuts than a flat chisel, rough a level surface from the bead to the top of the turned cove. Deepen your stop cuts if the chips aren't coming off clean next to the bead, but don't go so deep that the cuts will show in the finished carving. If the gouge digs in, cut from the other direction.

11. With the gouge from photo 5, gradually work the profile of the cove out toward the rim, leaving enough wood beneath the cove to allow for the stepdown to the tabletop. I've chosen this photo out of sequence so that you can see what the finished step will look like (see lower right corner of photo). The tool action for the roughing cut is worth practicing—it's a combination of turning a screwdriver and prying up a paint-can lid. This slices and scoops uniform, controlled chips. Work with the grain as much as possible. Where the coves meet, a skew chisel or a knife can make a neat miter stop cut, but it's a tough job to carve the cove up to the miter—the wood gets in the way. When it gets impossible to get the gouge into position, switch to a #2 gouge and use the corner of it, working at whatever angles it takes, to slice and scoop out the final shape of the cove. Some cuts will have to be made vertically. Expect the miters to take some time. Be patient worrying away the wood and the result will be just fine.

12. The next four photos show a critical part of the carving, extending the flat top up to the cove. Marking out is done with a compass, then stop cuts are made with chisels and gouges. Be careful not to make your stop cuts too deep, or they will mar the look of the top. The trick is to work the flat down gradually.

13. The first cuts, made with a #2 gouge, can be fairly bold, similar to the way in which the roughing cuts were made when carving the cove. But be somewhat cautious. There's a real danger of going too deep and making a depression between the flat top and the cove. This will absolutely ruin the look of the table.

14. I've switched to a flat chisel here for paring away the gouge marks. Note the size of the chips and try to match them with your own tools. You must work in thousandths-of-an-inch—if you can't produce chips of this size, your chisel is dull. Check frequently with a small straightedge to be sure you don't go too deep.

15. Final leveling and polishing comes from scraping. The tool is pushed and the touch is very light. Up to this point in the process (including the turning), I've reground the edge three times to refresh the burr. The fuzz in front of the tool is not so much dust as it is super-thin shavings.

16. Here's the idea on the back. Rough out with a coarse rasp, then finish up with ever-finer rasps and files until the wood shimmers. You'll probably find that the back has warped as a result of the dish on the other side. This is no problem, because the surface ought to be planed flat anyway, when the glue block is removed.

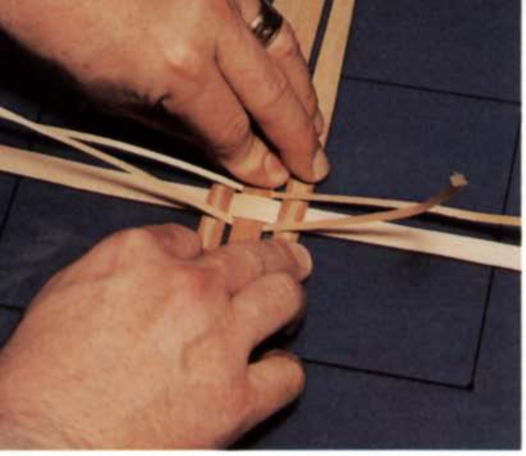
17. I still have a way to go yet, and the sun is going down, but I'll have plenty of time tomorrow to finish the carving. Even with just this small section done, I think it's astounding how sculptural and strong a piecrust looks, especially when you consider that the carving stands only $\frac{1}{4}$ in. proud of the top. Those old carvers really knew how to catch light and shadow, didn't they? They set the standards for us all. □

The author's personal carrier basket draws its inspiration from Shaker designs. Light but sturdy, it's woven from black ash splints with a hickory handle cross-lashed to the basket's rim.

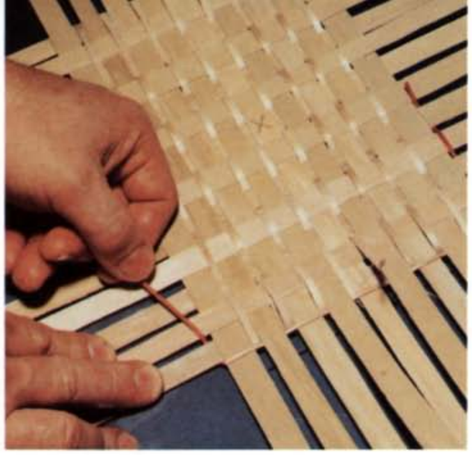
Black Ash Basket

Weaving a Shaker-style carrier on a removable form

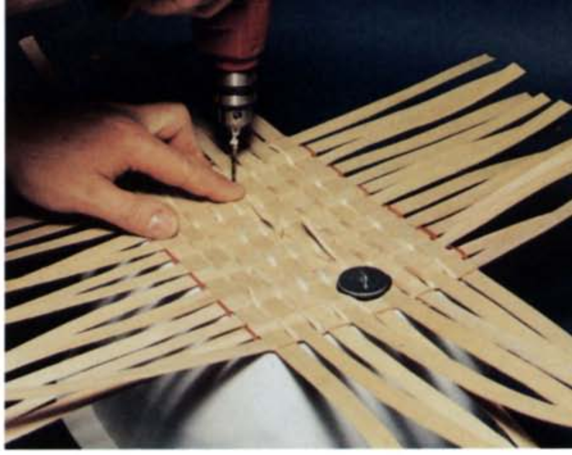
by John McGuire



To begin the weaving process, a 6-in. by 9-in. rectangle representing the basket's bottom is marked on the work surface, and the splints are laid out from its center. The narrow filler splints fill the gaps between the larger splints and help hold the bottom together.



A narrow 'keeper' splint is woven around the perimeter of the basket's bottom to help secure it. One face of the keeper is painted red to enhance its visibility. After the keeper is overlapped at its starting point and tucked under an upright, any excess is clipped off.



The author uses a hollow plastic mold to help him shape the basket, but a plastic washtub or wooden mold would work just as well. Note that screws used to hold the basket in place during weaving are driven through the gaps left by the unsecured filler splint.

For much of the 19th century, the Shakers made baskets like the one shown here, both for sale to the general public and for their own use. Basketmaking became a significant industry in Shaker communities, leading to the development of about 80 different styles of baskets. The basket I'll show you how to weave in this article is known as a "personal carrier." It is lightweight and elegant, yet surprisingly sturdy.

Woven from black ash splints, the basket has a 6-in. by 9-in. bottom and 5-in.-tall sides. It's a good beginner's basket in that its construction is straightforward. Many of the techniques that you'll use to weave this style apply to other baskets as well. Rather than show you how to prepare the ash splints from a tree (for information on harvesting, pounding and preparing black ash splints, see *FWW on Bending Wood*), I've opted to concentrate on weaving technique, but have listed supply sources at the end of the article.

You still need to dress commercially available splints to the right thickness and width. To split black ash to the correct thickness, score across its width with a knife, carefully peel the splint back at the score mark and split its thickness in half. Additional scraping with a knife blade can thin these parts.

To begin a basket, thoroughly dampen your splints and cut them to length using a sturdy pair of scissors. You'll need: thirteen pieces $\frac{1}{32}$ in. thick by ½ in. wide by 20 in. long; nine pieces $\frac{1}{32}$ in. thick by ½ in. wide by 23 in. long; and eight pieces $\frac{1}{32}$ in. thick by ⅛ in. wide by 16 in. long. Begin construction by drawing a 6-in. by 9-in. rectangle on the workbench, then find the center of the rectangle's width and length. Next, lay an 18-in.-long splint across the width of the rectangle at its center and lay a 21-in.-long splint perpendicular to it, positioned at the center of the rectangle's length. These two splints should be laid so that an equal length of splint falls outside the perimeter of the rectangle on either side (see top left photo); otherwise, the basket will have sides of unequal height. These splints and others to follow will later be bent upright around a form to create the final shape of the basket.

Next, lay two ⅛-in.-wide splints along the rectangle's long axis and under the splint laid across the rectangle's short axis. Follow these with two ½-in.-wide splints, as shown in the top left photo—note how the six pieces of splint are interwoven over and under each other. The ½-in.-wide splints are interwoven across the long and short axis of the basket, while the ⅛-in.-wide splints are woven only across the long axis. Periodically push the splints together using enough force to close up gaps, but not so much as to buckle the splints. It helps to slide a ruler or a wooden stick held on edge between the pieces to give you more bearing area with which to push the splints together. Tightening up the weaving prevents large gaps from opening between the splints as the basket dries.

Continue weaving narrow and wide splints together, working evenly out from the center, until the layout rectangle is filled. Allow the basket bottom to dry, then snug up any gaps that develop. Wet the narrow filler splints, then bend them back on themselves and tuck them under the third upright from the end that has been laid across the short axis of the rectangle. Trim off any excess after the splints are tucked in. Leave a center filler splint near the middle untucked to help fasten the basket to the form later. Note how the narrow splints fill in the gaps and lock the bottom together.

Woven in this fashion, the basket bottom is said to be "laid tight," or is described as having a "closed bottom." Not all baskets are woven this way. Some are woven with gaps left between the bottom splints to let dirt fall through. In these cases, the weaver uses only a narrow "keeper" strip woven around the perimeter of the bottom to lock the splints in place.

Next, take a splint about ⅛ in. wide, and—starting near the center of the long axis—weave along the perimeter of the bottom (see center photo, above). One face of this keeper strip is painted red to make it more visible. Weave the keeper around the perimeter, "mitering" it at the corners by folding it 90°. Overlap it through several uprights past the starting point, cut it off and tuck its end under one of the uprights. With the keeper tucked in, the bottom of the basket is finished and is ready to be placed on the mold.

I developed the hollow plastic mold shown in the top right photo as a teaching aid in weaving up the sides of baskets, but you can make your own mold from a solid or glued-up block of wood. You can also make a mold from a small, commonly available plastic washtub. Rather than use a mold, you can bend up the side of a basket freehand—the Shakers used both the freehand technique and molds. I prefer using molds because they ensure a more uniform shape and help maintain consistency in a run of several baskets. Either way, lift the narrow filler splint that was left untucked and bore two ⅛-in.-dia. (or smaller) holes underneath it at each end. Then, attach the basket to the mold with a small round-head wood screw and a fender washer or, if you're using a hollow plastic tub, a small nut, bolt and fender washer. Insert a rubber washer under the steel one to keep it from crushing the splints when you tighten the screw to the form.

Moisten the splints again, bend them against the mold, then cut them off at the top of the mold. Shape the two neighboring splints at each corner with a pair of scissors (see bottom photo, p. 90) to make the corners of the basket curve more gently. Also, split a cen-

Photo left: Staff; other photos: Henry Peach

ter splint on one of the basket's ends with scissors. Point the end of a long piece of ¼-in.-wide splint, dampen it and weave it through the split upright. Appropriately enough, this splint is known as a weaver. Spiral the weaver around the basket, pushing it down so it snugs up to itself as you go. It's normal for the corners of the basket to lift up slightly as the basket is spiraled, since the weaver puts tension on the long and short axes of the basket. These "feet" are part of the basket's look.

The weaver is not one continuous piece of splint, but, instead, is several cleverly overlapped pieces with their meeting points carefully concealed. The joint where two weavers meet is strongest if the new weaver overlaps four uprights in conjunction with the old weaver. Continue the weaver to the correct rim height (about 5 in.), point its end and stop it at the first upright beyond the one that was split. Let the basket dry, then pack the weaver down to eliminate any gaps that developed while it was drying.

The rims and handle—The basket shown here has three rims: a false rim that's held in place by tucking the uprights around it; an inner, carved rim and an outer "dress splint" rim. The latter two rims are lashed to the false rim, and all three rims act in unison to provide a strong and attractive rim, whether viewed from inside or outside the basket. To determine the amount of splint you'll need for the rim, measure the circumference of the basket at its rim, using a piece of string or a tape measure. The false rim is about ³⁄₁₆ in. wide and a little longer than the basket's circumference.

Start weaving the false rim anywhere on the basket's circumference. Wherever you start, however, make sure that the false rim falls on the side of the upright opposite the top weaver below it; if the top weaver goes over an upright, then the false rim should start under it and vice versa. Weaving the false rim in this alternate manner prevents it from sliding down on the weaver below it, hampering the lashing process. Overlap the false rim at the starting point and continue for another three or four uprights.

Next, dampen the tips of the uprights. Starting anywhere on the rim, point the end of an upright on the outside of the false rim. Fold that upright over the false rim and under the first weaver. Also push it under the next several weavers so that it is completely secured and bends neatly around the false rim. Clip the next upright flush with the top of the false rim, and tuck the next upright under, as described above. Continue in this fashion until all of the uprights are either clipped off or tucked in. Weaving the handle is next.

The two corner splints are shaped with scissors so they form less of an abrupt bend at the corner of the basket. This step improves corner strength and adds to the basket's appearance.

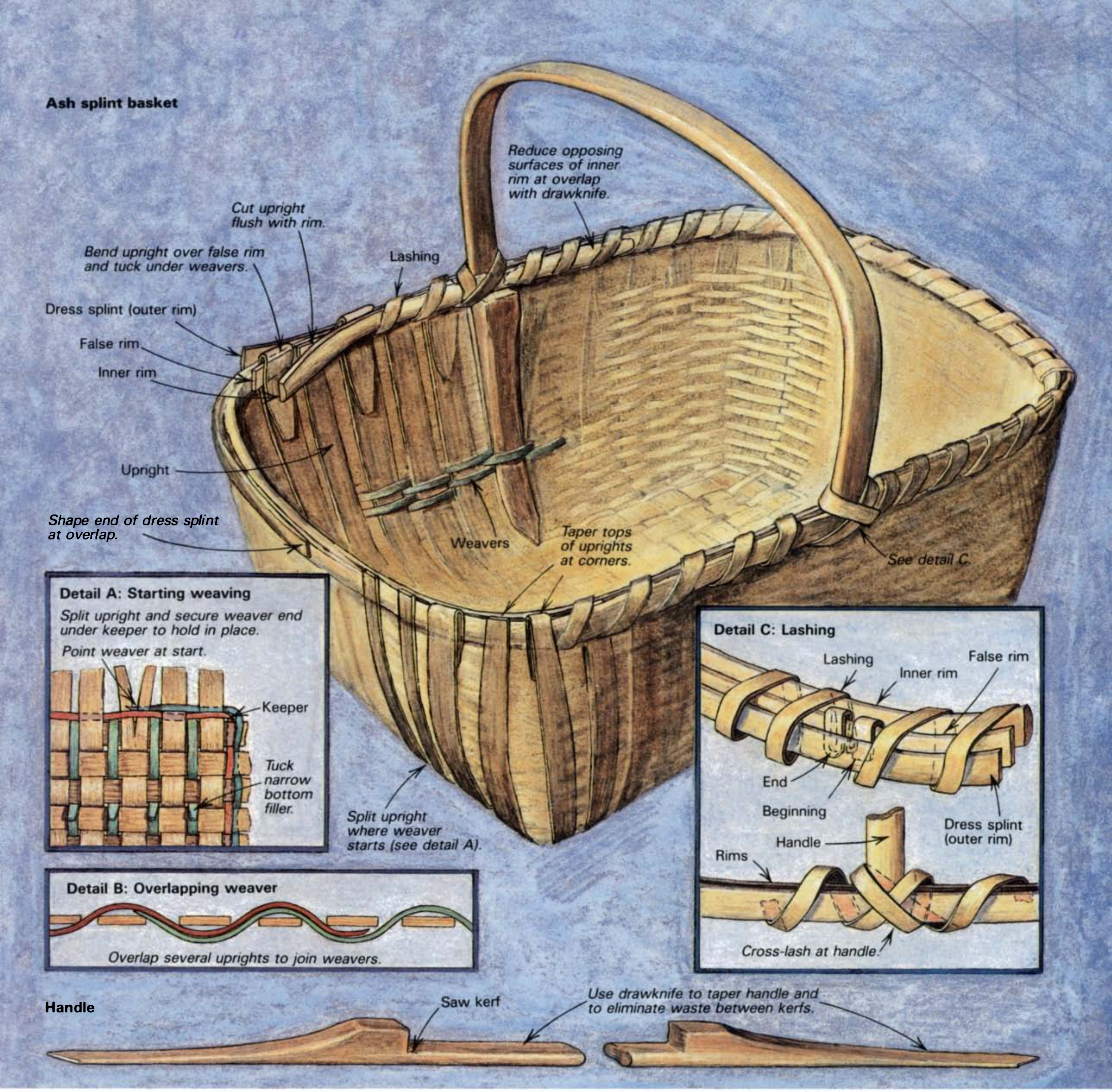
Like the inner rim and the dress splint, the handle doesn't necessarily have to be carved from black ash. My first choice for handle wood is shagbark hickory—it's more durable than black ash. If you can't get shagbark hickory, try pig nut hickory, white oak or black ash. Determine the handle's length by laying a tape measure or string along the outside of the basket, across the short axis, from the top of one rim to the top of the other. To this length, add about 8 in.—a little less than the height of two sides. Shape the handle as shown in the drawing using a drawknife, pocketknife or spokeshave. Note how the handle tapers to a thin point at its ends—to help in tucking it under the weavers. Thoroughly soak the handle stock and cut halfway through it about 5 in. in from each end. Shave the area between the cuts to half the original thickness. Point each end and taper the handle down gradually to them. The handle can now be shaped by gripping it in one hand and bending it into the palm of the other hand. Or, you can bend it around a form in the shape you want. Once the handle is shaped, tuck it into the sides of the basket, starting about ten weavers down from the false rim. If you've tapered the handle properly, it should slip snugly under the weavers.

The next step is to weave the inner rim. This rim is ¼ in. wide (or wide enough to cover the false rim) and about ⅛ in. thick, maximum—thin enough to conform to the inside of the basket without distorting the basket's shape. The face toward the inside of the basket is a gentle half circle in cross section while the other face is flat. The length of the inner rim equals the inner circumference of the basket, plus about 1½ in. of overlap. Bend the rim around the inside of the basket and mark the inside and outside of the inner rim where it overlaps itself. Shave up to the marks using a drawknife or sharp pocketknife, removing about half of the splint's thickness. The object here is to create a smooth juncture where the inner rim overlaps itself, so be sure to shave the rim on any faces that meet each other. Clamp the rim in place with C-clamps or spring clamps. Once assembled, the top edge of the rim should be flush with the false rim and snug to the handle.

The dress splint (or outer rim) is ¼ in. wide, but it isn't as thick as the inner rim; make it about ¹⁄₃₂ in. thick. It's shaped flat on both sides and is overlapped like the inside rim. Once it's finished, round off its end for appearance and clamp it in place.

Lashing—The personal carrier described here uses lashing about ¹⁄₃₂ in. thick and ³⁄₁₆ in. wide. Its length should be about three times the basket's circumference. The basket is single-lashed—that is, the lashing is passed once around the rim and then tucked in. A double-lashed basket requires two passes around the rim, so the lashing crosses itself, forming an X at each overlap (this requires a length of lashing six times the circumference).

Begin the lashing to the right of the outside overlap if you're right-handed, to the left of it if you're left-handed (similarly, lash counterclockwise if you're right-handed, clockwise if you're left-handed). Starting on the outside, tuck the lashing so it passes under both the dress splint rim and the false rim. Bring the lashing up between the false and inner rim. Loop it over the top of the false rim, and bring it back down on the inside of the dress splint rim, as illustrated in detail C. Pull the loop snug and proceed to lash down the rim of the basket, passing the lashing around both inner and outer rims and between uprights. Avoid passing the lashing between any of the weavers. Tuck it between



the top weaver and under the false rim. When you come to the handle, cross the lashing over its outside (see detail A, above). Stop lashing at the starting point. Coming from the inside of the basket, tuck the lash under the inner rim and bring it up between the inner rim and the false rim. Loop it over the top of the false rim and dress splint rim and pull it taut.

Clip off the excess lashing on the outside and the inside, and you've finished your first basket. I often stand back and admire a basket's wonderful symmetry and simplicity of design. I'm sure the Shakers must have done the same. □

John McGuire is basketmaker in residence at Hancock Shaker Village in Pittsfield, Mass., and the author of Old New England Splint Baskets *(Schiffer Publishing Co., West Chester, Pa.).*

Sources of supply

For a complete list of material/tool suppliers, consult A Materials Guide for the Basketmaker, *Kirmeyer Publications, Box 24815, San Jose, CA 95154 ($8.95, postpaid). The following suppliers stock hand-pounded black ash splints; many also carry basket-making tools, kits and molds:*

Baskets and Bears, 398 S. Main St., Geneva, NY 14456.
Basketworks, 510 W. Earl Ave., Lafayette, IN 47904.
Basketworks, 4900 Wetherdsville Rd., Dickeyville, MD 21207.
Connecticut Cane and Reed Co., Box 762, Manchester, CT 06040.
Hens Tooth, 133A Palmetto Park Rd., Boca Raton, FL 33432.
Lock House II, 48 W. Ferry St., New Hope, PA 18938.
Martha Wetherbee Basket Shop, Star Rte., Box 116, Sanbornton, NH 03269.
Royalwood, 517 Woodville Rd., Mansfield, OH 44907.

Drawing: Michael Janos

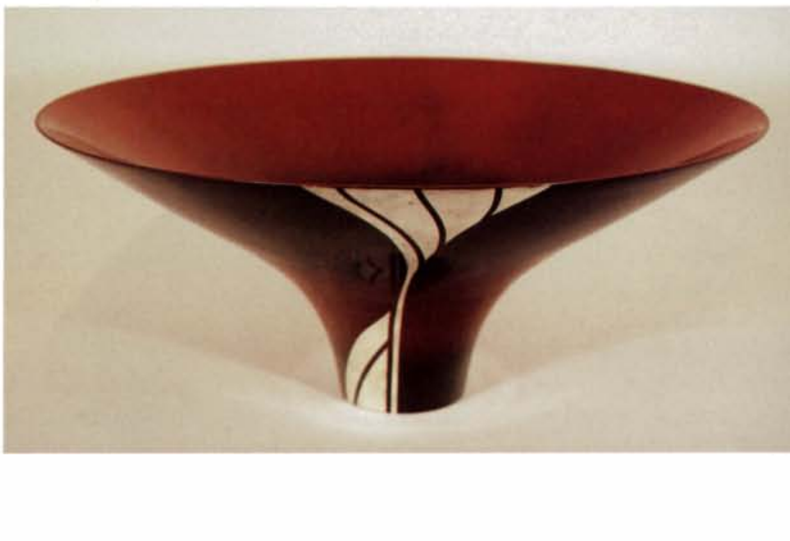
Current Work in Turning

Do high gallery prices make it art?

by Richard Raffan

Right: This 24-in.-dia. bowl is the latest in a series of lacquered bowls by Giles Gilson. The bowl's interior is sprayed with a rubberized material similar to automobile undercoating. Price: $13,500. Below: Two versions of the same bowl idea by John Whitehead. Each bowl is about 7 in. in diameter and priced at $150. Rob Sterba brick-builds his bowl blanks out of aspen, then turns them on a shopmade lathe. The bowl at bottom—priced at $2,200—is 25 in. in diameter and is finished with nitrocellulose and acrylic lacquer, detailed with silver leaf.

Staff



Of all the objects that can be turned on a lathe, the bowl has attracted the most interest among amateur and professional woodturners. Indeed, entire professional careers have been built on bowls, and there is now enough interest—both aesthetic and economic—in these objects for galleries to mount entire shows devoted to the subject, or at least very nearly. Major shows at two craft galleries last summer, "Masters of Turned Wood" at The Elements Gallery in Greenwich, Conn., and "Works Off the Lathe: Old and New Faces" at the Craft Alliance in St. Louis, illustrated the point. While touring the U.S., I attended both exhibitions.

Both of these shows revealed what I consider to be a disturbing trend in contemporary woodturning: Today, there exists a plethora of turners who are apparently in pursuit of recognition as top artists, as collectible as David Hockney or Andy Warhol. In these shows (as in others I've seen), the favored vehicles for expression are the bowl and the vase, along with their bastard cousins, the Bowl-form and the Vase-form.

The high prices attached to many of the individual pieces in both shows indicated clearly that we must be looking at Art or, at least, at something quite rare, and not a collection of what I thought was largely mediocre work from well-meaning turners not yet in full control of their medium. Art prices should be attached to art objects. But at these two shows, that vital, undefinable spark essential to a true object of art was missing in all but a few pieces. And there is too much of this work around now for it to have scarcity value.

The varying quality of The Elements' show suggested that the gallery was getting into turning, but without a great degree of knowledge or discernment. The press release proclaimed one turner to be a "consummate technician," said that a second "reveals the character of the wood," and noted that a third considers his bowls "works of art." I felt that, between them, these three makers failed to come up with one piece remotely near exhibition quality. I found distorted rims indicating excessive and inexpert use of abrasives in little bowls which I would regard as overpriced at one-fifth the gallery tag. Such work belongs in gift or kitchen stores, not in a gallery claiming to deal in art.

A typical example is a pair of bowls by John Whitehead, shown in the middle photo at right. The piece on the right is visually unbalanced, contrasting sharply with Whitehead's other version of the same idea on the left, which is well-balanced with a good line (though the wood, to my eye, doesn't make this an exhibition bowl either). In the same show, the mundane forms of David Lory's "Heirloom Bowls," with their wavering curves and indecisive rims and bases, are not enhanced by the

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Top: This walnut burl bowl ($6,500) is a recent example of David Ellsworth's deep, hollowed turnings. Two smaller Ellsworth pieces, above, were shown at The Elements: an 8½-in.-dia. ebony bowl ($1,800) and a 15-in.-tall, spalted Norwegian burl bowl ($1,500).

epoxy finish that renders them dishwasher-proof but not, I could see, scratch-proof.

In the world of turned wood, spectacular wood grain or color is frequently mistaken for art, as is the ultra thin or wany-edge bowl. Praise for the material might often be justified, but should clever manipulation of wood grain really be the basis of a reputation as an artist, unless the object resulting from the use of that wood is of particular merit in its own right? Should a mediocre form displaying technical virtuosity gain entrance into a collection purporting to be of fine art? A mechanical museum perhaps, because such objects are not art, but demonstrations of expertise, despite what exhibition notes might imply.

In the end, no amount of gallery rhetoric will obscure the fact that while most of the objects were well enough made and finished, I didn't see widespread evidence of any real feeling for form in either of these shows. This, combined with a general lack of finesse or exquisite detailing, reveals that too few turners are in control of their material and tools as they struggle to be different in a competitive market.

This, however, is not to say that I found nothing of merit. Far from it. Giles Gilson, for example, has that elusive combination of skill, eye and attention to detail needed to produce a truly remarkable object. With its precise and subtle surface patterns, his large-scale "Sunset Piece" (large photo, above) shown at The Elements is wonderful to look at and to touch. It is almost churlish to wonder why Gilson left holes in the metal rim ring, but these do detract from an otherwise near-perfect object. The soft irridescent glossiness of the outside contrasts with the black, rubberized undercoating material sprayed on the mysterious interior. Similarly, Robert Sterba's 24½-in.-dia., outflowing lacquered bowl (bottom photo, left) displays a mastery of line rarely matched. I'm not convinced that the silver appliqué is necessary in a form so strong, even though it's a nice example of restrained decoration. Each of these bowls is a technical achievement of both turning and finishing, but that fact is overshadowed by the stunning results.

These two lacquered and polished pieces contrast sharply with a similarly sized walnut piece of classic hollow turning (top photo, above) by the acknowledged grand master of the genre, David Ellsworth. I found the form to be good and well detailed. But what kills any rational thought concerning the piece is the hole near the base. Instantly, this reveals a very thin-walled, impractical object whose insides have been removed through the small hole in the top. The piece exudes technical achievement, and this really overwhelms any aesthetic consideration as it cries out "see how clever I am." I preferred Ellsworth's smaller and much less flamboyant macassar ebony vase which, together with a tall bottle form, are in a different league (bottom photo, above). These forms have no holes to confuse the eye, and there's no indication of their weight until they're handled. Shape

Photos courtesy of Craft Alliance, except where noted.

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At 14 in. in diameter, the $745 tulipwood bowl, above, is diminutive by Ed Moulthrop's usual standards. Moulthrop is better known for bowls as large as three feet in diameter. Like Ellsworth, Bob Krause also turns deep, hollowed shapes, albeit on a more accessible scale. His ebony lidded box, left, sold for $525 at the Craft Alliance show in St. Louis last summer. A trio of spalted silver maple boxes by Michael Mode, below, sold at the same show for $875. Turning impresario Albert LeCoff, who curated the St. Louis show, sought to broaden the exhibition's appeal by including non-bowl turnings like the ash and cherry croquet set by Skip Johnson, below right. A favorite among St. Louis show-goers, the whimsical set sold for $1,200.

is the concern and shape is what we see. They are comparatively heavy, woody. No longer is extreme feather-lightness considered an unquestionable mark of skill.

Ellsworth's small pieces have another quality worth noting: the delightful rim details might encourage others to pay attention to this important feature of any turning. Ed Moulthrop, well known for his large-scale bowls, rarely seems to consider rims at all, but he did for one piece (top photo, left) in The Elements' show. But what a difference in that one case: The bowl starts to feel wonderful, instead of merely looking spectacular. This piece differs, too, in not being a standard, somewhat uninspiring Moulthrop form. The bowl springs off the table and could have been a truly exceptional object had the surface been devoid of scratches and other finishing marks. But I suspect this worries woodworkers more than the galleries and collectors, who seem to rate Moulthrops by the inch.

The best turnery in these shows was on a less monumental scale and more accessible. At Craft Alliance, I gave laurels to Bob Krause for his ebony box (middle photo, left), to Michael Mode's three "Sibling Boxes" in spalted silver maple and ebony (lower left), and to Skip Johnson's highly eccentric croquet set, shown below. Delight in the whimsy of the croquet set masks the display of skill in turning matching balls, mallets and stakes, which is as things should be: appreciation of the object first, then the skills that executed it. His was a delightful departure from vessels. Every lawn should have one. Krause's and Mode's boxes are not only useful, but well proportioned and immaculately detailed, both inside and out, with a flawless finish and well-fitted lids. Although I thought both were rather expensive for what they are, we can all relate easily to such objects and see them inside almost any home.

At The Elements, my favorite piece was undoubtedly Alan Stirt's quiet and understated 8-in. cocobolo bowl (top photo, right). This is a bowl to dream of emulating, if only once in a lifetime. The carving is discreet, harmonizing with the smoother surfaces rather than overpowering them. The inside line is a smooth sweep, and the whole has a balance impossible to convey without picking the thing up. Other pieces involved more dramatic carving but less turning: Michael Hosaluk's fishes and Mark Sffirri's cut-and-colored dish rim each used carving to enhance the turned form successfully. Less successful was Bruce

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Alan Stirt fluted the outside of his 9-in. cocobolo bowl, above, with a power carver. The bowl was shown at The Elements, priced at $350. Bruce Mitchell's carved, spalted bay laurel bowl at right sold for $2,850. Segmentation is the usual method for achieving patterns in turned work, but in the macassar ebony bowl below, Mike Shuler bandsawed circular segments from a single disc of laminated wood, gluing the segments together to form a conical turning blank. The bowl was priced at $950 at the Craft Alliance show.

Mitchell's "Super Nova" (large photo, above). The carving creates subtle, tactile surfaces, but the form itself is uncharacteristically weak.

I thought those represented in both shows had their best work at The Elements, but the St. Louis show—curated by turning impresario Albert LeCoff—had a wider range of the unusual, including some ornamental turnery by Frank Knox. A leader in the field of ornamental turning, Knox proffered several archetypes, all well-made, highly decorated, traditional forms. Most curious of all was a pair of twisting spiral candlesticks designed by Leonardo da Vinci, who apparently left no clue as to how it was done. My theory is that he threw away any notes to save the world from reproductions. In any case, Knox's pieces were a notable achievement.

In St. Louis, there were a few nice ideas apart from the croquet set. Leo Doyle's "Spindle Bowl"—looking like an upturned multi-legged stool—was certainly different, if not an aesthetic triumph. Identical spindles are set into a base at an angle to create a bowl ideal for large fruit or tennis balls, but nothing smaller. The fine segmented macassar ebony bowl made by Mike Shuler (lower photo, above) is an excellent example of frugality many turners should investigate. There were fun pieces, too, like Joanne Shima's bright, high-tech kids' chair and Hap Sakwa's pedestal bowl full of bright, geometric shapes. Unquestionably a curiosity was Dennis Stewart's highly collectible "Temple of Tri," with an exotic little Easter scene of androgynous figures enclosed in glass cylinders.

The word "exhibition" suggests quality, especially in a gallery. But time and time again, I've been let down with expectations unfulfilled. More discretion needs to be exercised during the selection processes, both by the organizers and by the exhibitors. I realize people must hustle to earn a living in the arts and crafts, but there are too many pretentious objects passing through these shows, created by turners anxiously hoping to boast of a sale of so many thousands of dollars. Would that the standard could rise, real things might appear to which we might all relate and the price might lower to realistic levels so that more people can afford to have nice, handmade artifacts in their homes.

This should be a reality. After all, turning is a technique for rapid and, therefore, low-cost production. Any efficient and fluent turner should complete a well-made 12-in. bowl or a fine lidded box in well less than an hour. If prices reflect the hours spent turning and finishing, then few of these turners can claim to be either masters or craftsmen as I understand the term. Or are they really earning hundreds of dollars an hour and on to an easy ride? I've always thought I did better than most by keeping the price down to keep sales up and cash flowing. The aesthetics of the end product will depend on whether the turner has an eye for form. Few of us do, so masterpieces will be rare. But the quest for the ultimate curve should produce a good deal of high-quality, competent turnery for a ready market. □

Richard Raffan is a professional turner, mostly mass producing one-off bowls. He lives in Canberra, Australia. Raffan just completed his second book, Turned Bowl Design, *available from The Taunton Press this winter for $17.95.*

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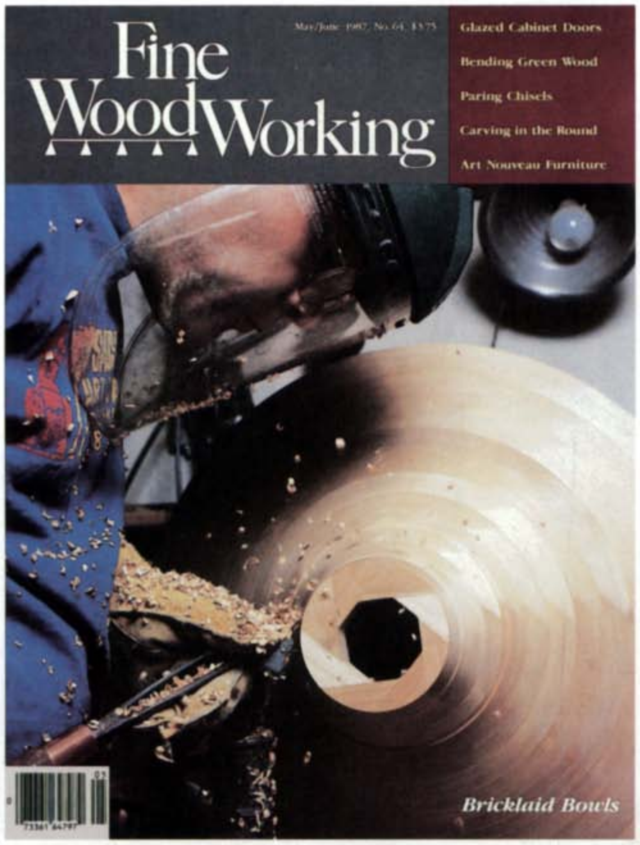

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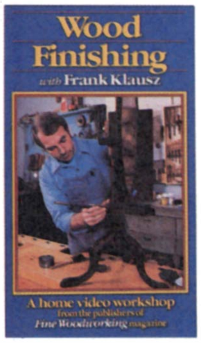

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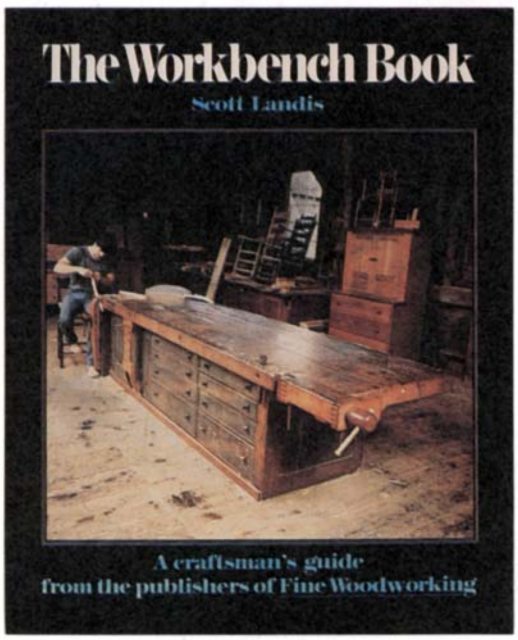

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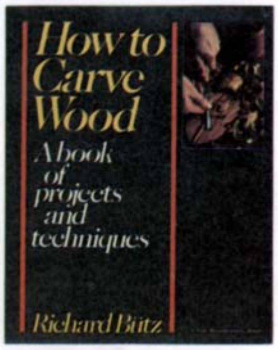

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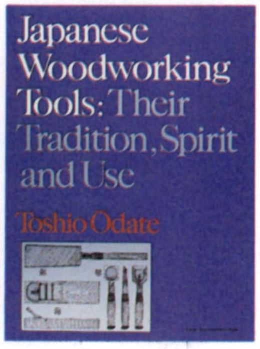

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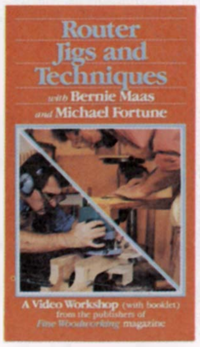

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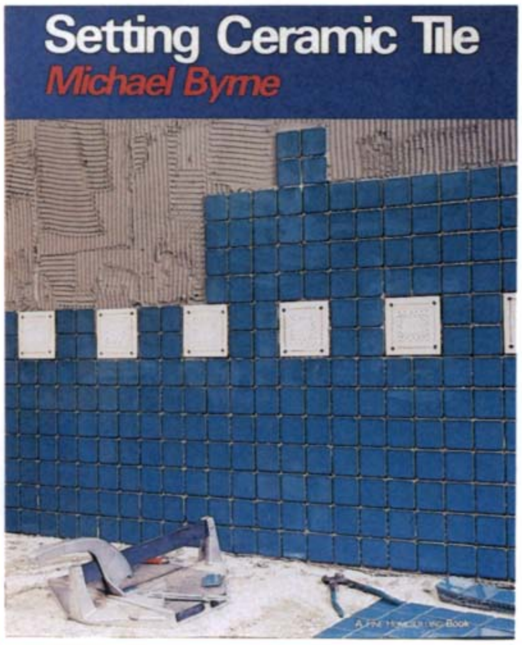

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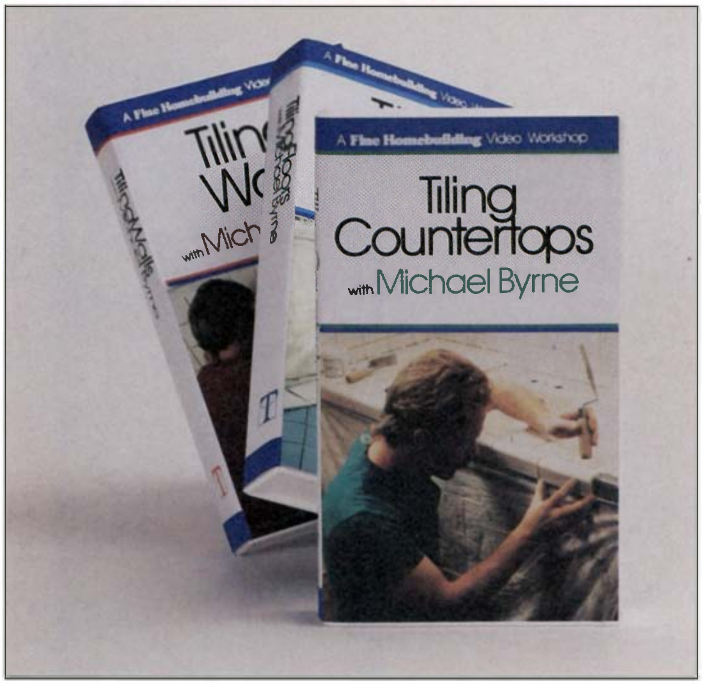

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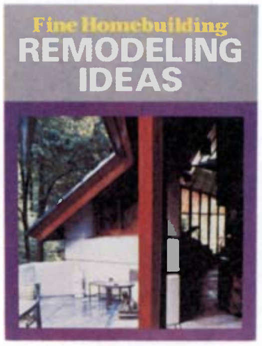
Remodeling



Fine Homebuilding Remodeling Ideas

Get a head start on your own remodeling jobs by finding out what expert builders have learned on theirs. These 43 full-color articles from *Fine Homebuilding* offer detailed technical information, design ideas and, in some cases, working plans and elevations—all drawn from particularly interesting restorations, additions and renovations.

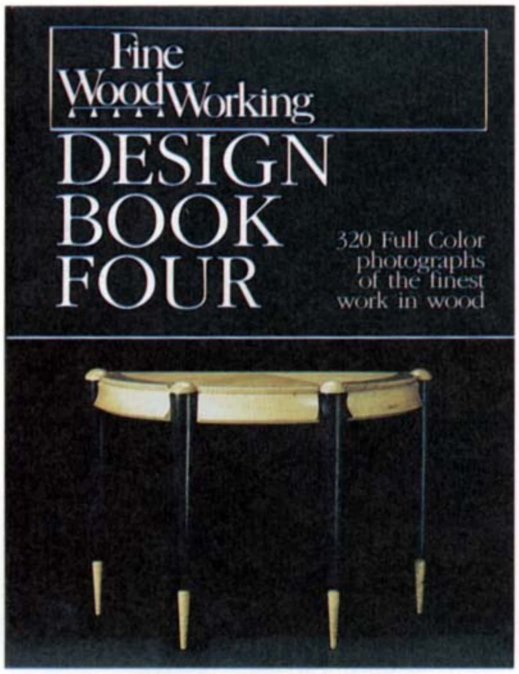
Softcover, color, $21.95
#56

Building Your Own Kitchen Cabinets
by Jere Cary

All you need to know to custom build your own cabinets, presented by a skilled cabinetmaker and teacher. Detailed drawings and instructions provide invaluable information about layout, case joinery, drawer construction, hardware, countertops and jigs. There's even advice on estimating costs. A bestseller.

Softcover, $12.95
#23

NEW BOOK



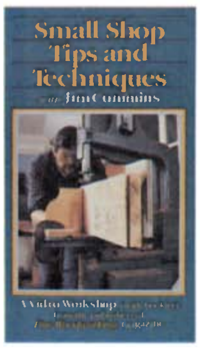
An all-new, full-color look at the best in contemporary woodworking. Selected from some 10,000 photos submitted by *Fine Woodworking* readers, the 320 objects pictured here show just how far the craft has come since we published our first *Biennial Design Book* in 1977. Woodworking like this takes your breath away, whether it's a beautifully crafted period piece or some playfully painted art furniture. There's a new sense of mastery among woodworkers, and a new fascination with color and materials other than wood. *Design Book Four* captures all the excitement with stunning photographs and compelling essays by seven designer-craftsmen.

Softcover, color, $16.95
#65

SAVE ON Earlier Design Books
Three volumes of superb woodworking at specially reduced prices. *But only while supplies last.*

#02 Biennial Design Book, **Softcover.** ~~$11.95~~ ***$10.75***
#08 Design Book Two, **Hardcover.** ~~$13.95~~ ***$12.55***
#25 Design Book Three, **Softcover.** ~~$13.95~~ ***$12.55***
#91 Set of three books ~~$39.85~~ ***$31.50***

Small Shop



VIDEO

Small Shop Tips and Techniques
with Jim Cummins

Jim Cummins lets you in on the tips and tricks he's picked up in his years as associate editor of *Fine Woodworking*'s Methods of Work column. He teaches you how to use common tools and machines to achieve uncommon results. Among the things you'll learn: how to get a home-shop bandsaw to work better, how to expand the role of your drill press, how to make hand tools and machines work together, how to be precise and safe at the tablesaw and how to sharpen dull twist drills. An accompanying booklet includes notes, drawings and supply sources for easy reference.

60 minutes, $29.95
(Rental: $14.95)
#625 (VHS), #626 (Beta)

Fine Woodworking on The Small Workshop

A bookful of ideas culled from ten years of *Fine Woodworking* magazine. At the heart of it all are a variety of suggestions about building and improving workbenches. In addition, five master craftsmen tell you how they'd set up their own small shop, while others offer suggestions about storing tools, methods of clamping and holding your work, dealing with seasonal wood shrinkage, controlling dust, keeping your shop safe and more.

Softcover, $7.95
#33

Fine Woodworking on Proven Shop Tips

"Real solutions to real woodworking problems—devised by real woodworkers." That's what editor Jim Richey has to say about these hundreds of contributions to *Fine Woodworking*'s Methods of Work column. You'll find methods for drying green wood and polishing a finish, and for every operation in between. Plus, jigs to enhance shop tools and more ideas for clamps than you can shake a handmade dowel at.

Softcover, $7.95
#38

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Projects

Fine Woodworking on Things to Make

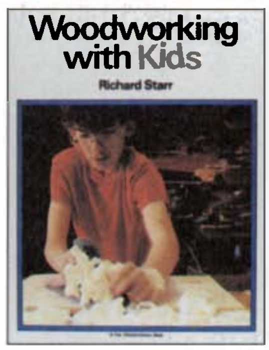
Good ideas and practical advice about making everything from simple toys to elegant furniture. These 35 articles from *Fine Woodworking* show you how to make tables, trays, chairs, sleds, music boxes, an Aztec drum, an American harp, an Appalachian dulcimer, a world globe—even wooden eyeglass frames.

Softcover, $7.95
#49

Fine Woodworking on Woodshop Specialties

Looking for a different kind of project? Try these 27 *Fine Woodworking* articles. You'll learn how to make a microscope out of wood, create wooden clockworks and fashion marionettes. The list of specialties goes on: miniature ships, puzzles, doors, barrels, antebellum shutters, picture frames, covered bridges and more—all with detailed photos and illustrations.

Softcover, $7.95
#60



Woodworking with Kids
by Richard Starr

Help your children make what they want out of wood and they'll learn to love the craft. Woodworking teacher Richard Starr shows you how with plans for toy airplanes, tables, boxes, tools and more. He begins with simple projects for younger kids, then moves on to more challenging ones, explaining the tools and techniques that are used.

Hardcover, $19.95
#21

Magazines

Fine Woodworking

If you love working with wood, *Fine Woodworking* is your magazine. Each issue is filled with the ideas and discoveries of practicing woodworkers—master craftsmen, serious amateurs and talented professionals. A year's subscription brings you practical, hands-on information about an incredible range of subjects: joinery, turning, carving, veneering, finishing, design, machines, hand tools and any of a hundred other woodworking specialties. You'll find demonstrations of tools and techniques, projects that teach new skills, shop tests, sources of supply, tips, tricks and jigs, plus some breathtaking examples of the woodworker's art for inspiration.

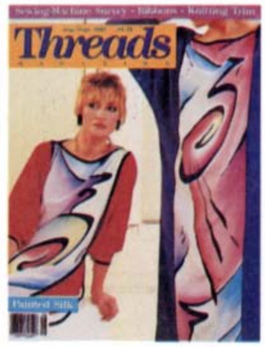
Bimonthly, $18/year
#10

Note: Our *Fine Woodworking on...* series organizes ten years' worth of articles from the magazine into 20 inexpensive volumes by subject. You'll find the individual books listed under the appropriate subject headings.

Fine Homebuilding

Whether it's remodeling an attic, building a new greenhouse, putting down a brick floor or renovating a staircase, *Fine Homebuilding* shows you how to do the job right. You'll find articles by some of today's best builders. The information is solid—nothing left out, nothing glossed over, every step shown in full color, with photos that let you see just what's going on. And each spring there's a special issue devoted entirely to home design.

Seven issues, $22/year
#20



Threads

The practical magazine that helps you make beautiful things to wear and use. *Threads* covers every facet of the textile arts and needle crafts. The design, construction and detailing of fine clothing is at the heart of every issue, but the world of *Threads* extends beyond what we wear. Detailed articles let you learn directly from expert designers, sewers, knitters and tailors, as well as dyers, surface designers, embroiderers, quilters and others.

Bimonthly, $18/year
#30

Great Gift Ideas

Our magazines, books and videos make marvelous gifts. And we'll announce any gift you send with a handsome card. Just tell us how you want it signed. You can use the attached order form or call toll-free 1-800-243-7252.

Indexes

Available Dec. 15, 1987
Fine Homebuilding
Cumulative Index
(Issues 1-42)

A comprehensive listing of articles, columns, reports and reviews from the first 42 issues of *Fine Homebuilding.* Cross references to the Construction *Techniques* books.

Softcover, $4.95
#72

NEW
Fine Woodworking
Supplementary Index
(Issues 51-65)

This new 12-page index gives a listing of articles, letters, columns and photos from issues 51 through 65. It also includes references to all the *Fine Woodworking on...* and *Techniques* books (through *Techniques 9*).

Softcover, $1.95
#75

Fine Woodworking
Cumulative Index
(Issues 1-50)

Complete listing of articles, photos and columns from the first 50 issues. Covers the first six *Techniques* books and eight *Fine Woodworking on...* books.

Softcover, $3.95
#71

Fine Woodworking **Set**
Both indexes, $4.95
#76

Techniques

Fine Woodworking
Techniques Series

Techniques 8, *issues 44-49*
Hardcover, color, $19.95
#55

Techniques 7, *issues 38-43*
Hardcover, $17.95
#42

Techniques 6, *issues 32-37*
Hardcover, $17.95
#29

Techniques 5, *issues 26-31*
Hardcover, $17.95
#24

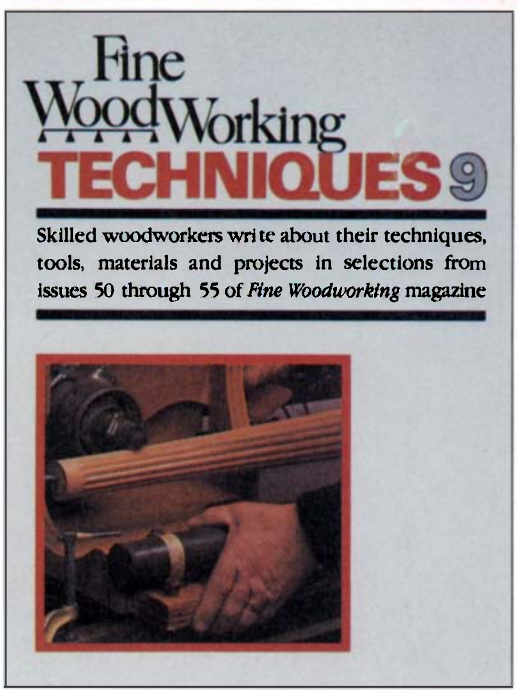
Techniques 4, *issues 20-25*
Hardcover, $17.95
#17

Techniques 3, *issues 14-19*
Hardcover, $17.95
#15

Techniques 2, *issues 8-13*
Hardcover, $17.95
#13

Techniques 1, *issues 1-7*
Hardcover, $17.95
#03

NEW BOOK

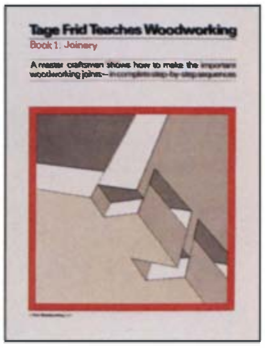


Full-color articles by skilled woodworkers on techniques, tools and materials. *Techniques 9* captures an exciting year's worth of articles from the 1985 issues of *Fine Woodworking* (numbers 50 through 55). You'll learn about Frank Klausz's classic workbench, how to turn a lidded box, what wood grain really means, how to design with veneer and how to make a Queen Anne handkerchief table. Plus, there are articles on making marionettes, testing chisels, wood stains and more.

Hardcover, color, $19.95
#64

Note: We've reduced the price on *Techniques 8* by $5 to match our low price on *Techniques 9*. Both full-color volumes are now just $19.95

Tage Frid



Tage Frid Teaches Woodworking Book 1: Joinery

Good woodworking starts here. Calling on more than 50 years of experience, master craftsman Tage Frid shows you how to use hand and power tools to make virtually all the joints useful to cabinetmakers, from the simple tongue-and-groove to more complicated dovetails and multiple spline miters. In each case, Frid describes the joint in detail, explains which applications it's best suited for, and demonstrates how to make it, step-by-step, in easy-to-follow photographs and drawings. There's even advice about how to cope with those inevitable mistakes, plus a thorough discussion of wood, saws and stock preparation.

Hardcover, $18.95
#09

Tage Frid Teaches Woodworking Book 2: Shaping, Veneering, Finishing

A step-by-step guidebook to essential woodworking techniques. Frid covers bending (everything from building a steambox to working complicated bends), turning (spindle and faceplate turning, stacking and bricklaying), and veneering (with clamps, press or hammer; also working with plywood). In addition, Frid demonstrates the intricacies of inlaying, carving and finishing. It's all here, and it's all taught in the incomparable Frid way, with hundreds of detailed photographs, drawings and step-by-step instructions.

Hardcover, $18.95
#19

Tage Frid Teaches Woodworking Book 3: Furnituremaking

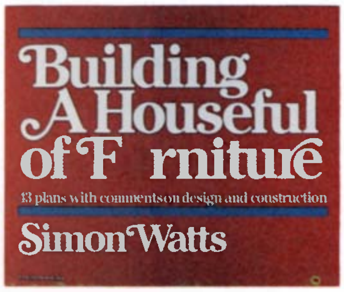
Frid concludes his woodworking series with photos, instructions and complete working drawings for 18 of his most distinctive pieces. There's his well-known workbench, three-legged stool and more. In each case Frid explains how he designed the piece, outlines the steps involved in making it and describes the steps that are most difficult or interesting.

Hardcover, $18.95
#43

Frid Three-Book Set

Hardcover, $44.95
#90

Furnituremaking



Building a Houseful of Furniture

by Simon Watts

Build furniture for any room in your home. Cabinetmaker Simon Watts gives you complete plans for 43 of his favorite pieces: sturdy bed frames, handsome chests, a variety of tables, desks, bureaus, comfortable sofas, chairs and more. Some projects are perfect for beginners, others will challenge even the most experienced woodworker. Throughout the book, Watts covers the difficult spots in construction and explains his own techniques for overcoming them. He also offers some fascinating information about the history, uses and design of household furniture and talks about how he develops his designs.

Softcover, $19.95
#22

Fine Woodworking on Chairs and Beds

Expert chairmakers share their techniques for designing and making furniture that fits the human body. There are no quick-and-easy shortcuts, but there's plenty to learn from craftsmen who have mastered this difficult art. Chairs, stools, sofas, cribs and beds—all are covered in 33 articles from the pages of *Fine Woodworking.* There are even plans for making everybody's favorite, the rocking chair.

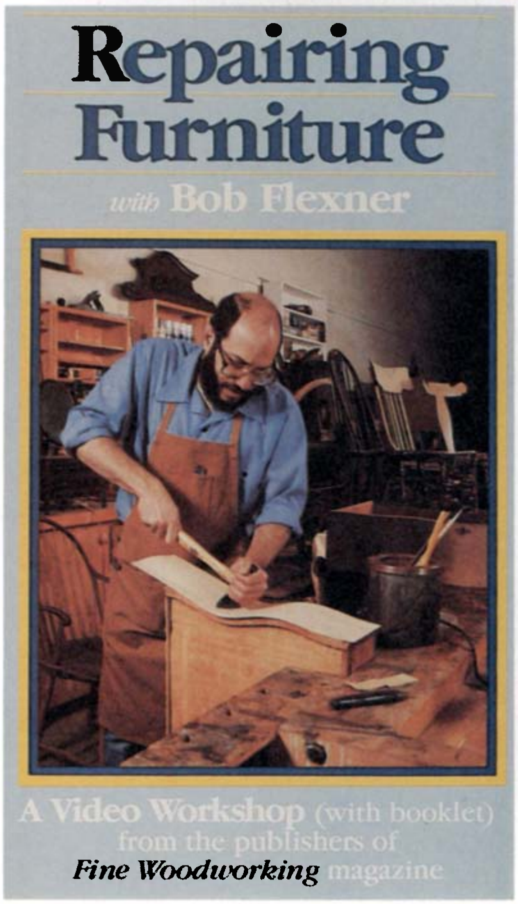
Softcover, $7.95
#45

Fine Woodworking on Tables and Desks

How big should a dining table be? How do drop-leaves work, and are there better ways to make the top expand? How about plans for interesting coffee tables, a lion's-paw pedestal table, trestle tables? How does a table become a desk, with pigeonholes or a roll-top? In 32 articles from *Fine Woodworking* magazine, skilled craftsmen reveal their methods for making and designing every kind of table and desk.

Softcover, $7.95
#46

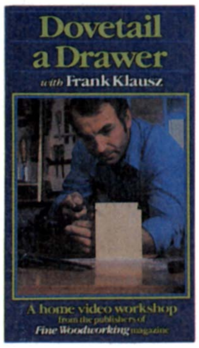
NEW VIDEO



Here's a vast repertoire of straightforward techniques you can use to repair furniture. Expert furniture restorer Bob Flexner demonstrates each method and tells you how to decide which one is right for the job at hand. Among the things you'll learn: why wood joints fatigue, how to clamp problem pieces like round tabletops, disassemble pieces safely, choose the proper glue, mend broken parts, match missing moldings and reglue or replace damaged veneer. By watching Flexner, you'll learn to repair a piece so it won't suffer the same fate again, and still keep the original character of the piece intact. Best of all, you won't need an elaborate workshop or extensive experience to perform your repair work. With Flexner's easy-to-follow instructions, and the information in the accompanying booklet, those wobbly chairs and banged-up bureaus are as good as fixed.

70 minutes, $29.95
(Rental: $14.95)
#619 (VHS), #620 (Beta)

Joinery



VIDEO

Dovetail a Drawer
with Frank Klausz

Cabinetmaker Frank Klausz shows you how to make crisp, clean, properly fitting drawers by hand. After sizing the stock and running the grooves for the drawer bottom, you'll see Klausz cut quick, precise dovetails without the use of jigs or templates, and glue up and fit the finished drawer. You'll also learn about tools and techniques that will come in handy in other woodworking projects: how to use a backsaw, chisel and smoothing plane confidently and how to rip, crosscut and dado on power machinery efficiently and safely.

60 minutes, $29.95
(Rental: $14.95)
#601 (VHS), #602 (Beta)

VIDEO

Radial-Arm-Saw Joinery
with Curtis Erpelding

By watching Curtis Erpelding at the radial-arm saw, you'll be able to cut impeccably precise joints time after time. You'll learn how to set up and fine tune your own machine as you work, lay out and cut a series of identical slip joints, make a frame composed of such joints and see this frame as a design building block. Erpelding's artful jigging techniques will help you come up with a host of workable furniture designs. And by watching him perform his craft, you'll see how to think through your own joinery, both structurally and aesthetically.

110 minutes, $39.95
(Rental: $14.95)
#609 (VHS), #610 (Beta)

Fine Woodworking on Boxes, Carcases, and Drawers

Skilled woodworkers show you how to build boxes and drawers that stand up to everyday use. These 41 articles from *Fine Woodworking* show you how to choose, make and use every kind of carcase joint with particular emphasis on the classic dovetail. You'll also find detailed projects for hand-tool and machine methods.

Softcover, $7.95
#32

Fine Woodworking on Joinery

Experienced craftsmen explain their techniques for fitting flat sticks together to make strong, lightweight frames. Most of these 36 articles from *Fine Woodworking* cover numerous forms of the mortise-and-tenon joint, although you'll also find expert information about dovetails and other decorative and specialty joints for paneled walls and doors, cabinets, tables and chairs. You'll even pick up some valuable information on using wood glue.

Softcover, $7.95
#31

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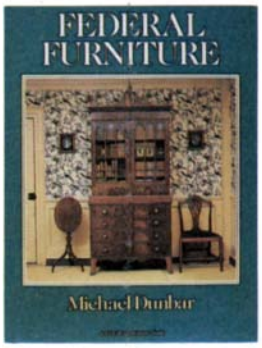
If any of our books or videos disappoints you, just return it for a complete and immediate refund. We don't want you to keep anything you're not happy with.

Period Furniture



Federal Furniture
by Michael Dunbar

A complete workshop in the design and construction of selected Federal-period pieces, written by a craftsman who knows the subject as few others do. Michael Dunbar shows you how to make 20 pieces from his home. In particular: a card table, Pembroke table, candlestand, Hepplewhite and Windsor chairs, chest of drawers, high-post bed and more. To help you make each piece he provides measured drawings and practical construction tips. Dunbar also offers detailed photos, isometric drawings and instructions for reproducing an aspect of each piece that is uniquely Federal.

Softcover, $18.95
#41

Make a Windsor Chair with Michael Dunbar

Making a comfortable and sturdy Windsor chair can be relatively simple—especially if you're working along with Michael Dunbar. With easy-to-follow instructions and illustrations, Dunbar shows you how to build two popular Windsors: the sack-back and the continuous-arm. You'll learn how to cut a pine plank and shape it into a seat, turn the legs and stretchers, whittle the spindles and bend the back. Plus, you'll come away with a new appreciation for an old-time craft as well as some attractive chairs.

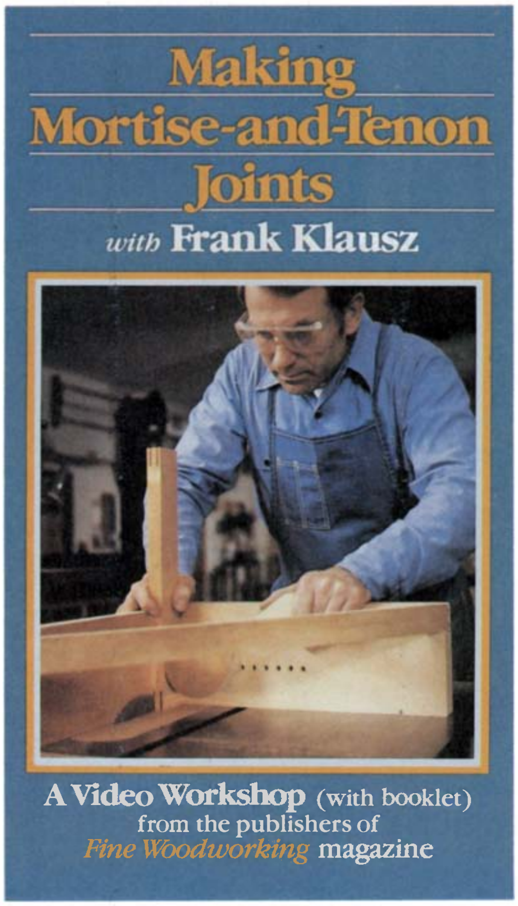
Softcover, $13.95
#27

Fine Woodworking on Making Period Furniture

Recapture the golden age of American furniture in your own workshop. These 37 articles from *Fine Woodworking* offer plans and technical explanations for making a variety of period furniture pieces: a Queen Anne table, a tall-case clock, a small highboy, post-and-panel chests, ball-and-claw feet, cabriole legs and more.

Softcover, $7.95
#36

FINE WOODWORKING VIDEO



Master the mortise-and-tenon, furnituremaking's fundamental joint.

Frank Klausz brings his 20-plus years of experience before the camera to show you three different techniques for making three variations on the mortise-and-tenon. You'll learn how to make a haunched mortise-and-tenon joint for a table, using ordinary hand tools; a through/wedged mortise-and-tenon joint as part of a door, using a router and bandsaw; and an angled mortise-and-tenon joint for a chair, using a hollow-chisel mortiser and tablesaw. Klausz also explains how to determine which joint is best for which application and how to organize your procedures for maximum efficiency and best results. Included with the tape is an illustrated booklet that outlines all the procedures Klausz covers. This handy step-by-step guide will help you take what you've learned back to your own workshop.

60 minutes, $29.95
(Rental: $14.95)
#621 (VHS), #622 (Beta)

Specialties

Fine Woodworking on Marquetry and Veneer

Skilled craftsmen share their marquetry and veneering techniques in 38 articles from *Fine Woodworking*'s first ten years. You'll learn how veneer is made, how you can saw your own, how you can lay it using simple equipment and how to design with veneer panels. There are also detailed articles that demonstrate marquetry methods, with particular attention to shop-built saws for cutting intricate details.

Softcover, $7.95
#59

Fine Woodworking on Bending Wood

Learn the three most common and useful methods of bending wood. In 35 articles from *Fine Woodworking*, skilled woodworkers explain their steam-bending, green-wood, and laminate bending methods. You'll discover the techniques involved in each, pick up useful trade secrets and learn how to make the tools you need for successful bending. An index is included for quick reference.

Softcover, $7.95
#35

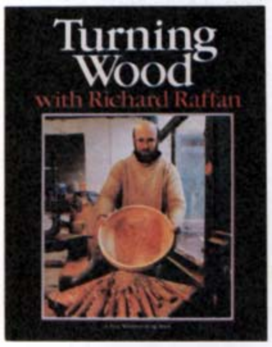
Make a Chair from a Tree: An Introduction to Working with Green Wood

by John D. Alexander, Jr.

A wonderfully readable demonstration of how to "bust a chair out of a tree." Alexander tells you how to fell the tree, split suitable pieces from it, shape those pieces and assemble them into an elegantly simple chair.

Softcover, $9.95
#04

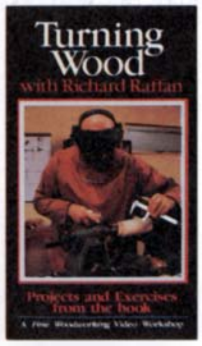
Turning



Turning Wood with Richard Raffan

Master woodturner Richard Raffan provides an extensive introduction to his craft. At the heart of the book are his chapters on centerwork and facework turning, but you'll also learn about your work area, lathe, tools, stock, abrasives and finishes. Using a series of carefully selected exercises, Raffan teaches you ways to angle a tool to get the cut and surface you want. Detailed drawings and photos show you how the position and support of your body affect the outcome of the finished piece and a number of projects help you develop the skills you've learned. What's more, a 16-page color gallery of Raffan's work shows you how far you can take your new skills.

Softcover, $17.95
#39



VIDEO

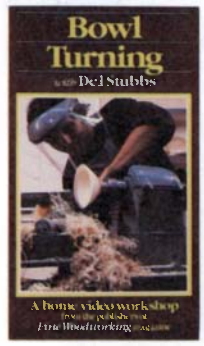
Turning Wood with Richard Raffan

Produced and directed to capture the book's dynamic details, this companion videotape lets you experience woodturning from a variety of useful perspectives: up close, over Raffan's shoulder and from a distance. Raffan demonstrates his tool-sharpening techniques and a series of gouge and skew exercises. He then takes you through six complete projects: a tool handle, light-pull knob, scoop, box, bowl and breadboard. Page references on the screen refer you to the book.

117 minutes, $39.95
(Rental: $14.95)
#611 (VHS), #612 (Beta)

The Raffan Set

Book and video, $49.95,
#99



VIDEO

Bowl Turning *with Del Stubbs*

Noted turner Del Stubbs shows you the basic techniques of bowl turning and then some. You'll learn the different ways to lay out and mount a bowl blank, use different gouges and flat tools to shape the outside and excavate the inside of a bowl and more. You'll even learn how to handle special challenges like turning thin-wall, bark-edge and end-grain bowls and how to slow down your lathe so you can see exactly what's happening when a tool cuts well—or not so well. What's more, the video format lets you get up close to see the careful contact of edge on wood and step back to study the effect of various tool positions, grips and stances. All in all, Stubbs's easy-to-follow approach and polished techniques are sure to help you become a better bowl turner.

120 minutes, $39.95
(Rental: $14.95)
#607 (VHS), #608 (Beta)

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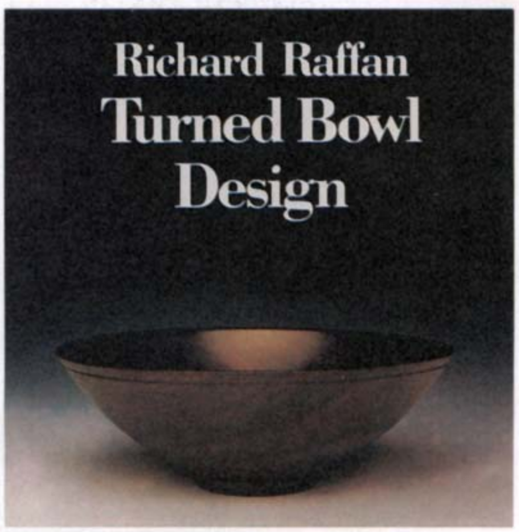
NEW BOOK—AVAILABLE NOVEMBER 1, 1987



The first in-depth examination of bowl design from a master turner. Richard Raffan takes you beyond the skills he taught in his first book and video, and shows you how to design bowls that remain beautiful after the color and grain have faded. Raffan covers all the steps from timber selection to polished piece. You'll learn how to refine the shape, cut sides, decorate surfaces and more. There are templates to get you started and a full-color photo gallery of design ideas.

Softcover, color, $17.95
#63

Fine Woodworking on Spindle Turning

Explore the variety of useful things that can be turned between centers. In 39 articles from *Fine Woodworking*, some of the past decade's most inventive turners show you how to use the turner's gouge and how to master the difficult skew chisel. You'll also get plans for making tools and gauges, clever shop tips and revealing looks at porch pillars, baseball bats and lacemaking bobbins. There's even advice about achieving the look of turned wood without a lathe.

Softcover, $7.95
#57

Fine Woodworking on Faceplate Turning

A rare look at how some of today's best turners create everything from drinking goblets to giant bowls. You'll learn about glued-up turning blanks, the modern bowl-turning gouge, a finish that's safe for food and more—all from 42 *Fine Woodworking* articles.

Softcover, $7.95
#58

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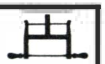

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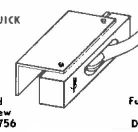

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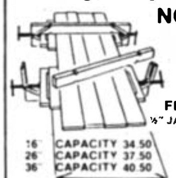

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Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We'll list events (including entry deadlines for future juried shows) that are current with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

ARIZONA: **Exhibition**—5th annual show of the Arizona Assoc. of Fine Woodworkers, Nov. 8, 12-4 P.M. Los Olivos Adult Center, 28th St., Phoenix. Contact Bill Senior, (602) 246-8245.

CALIFORNIA: **Workshop**—Woodworking techniques, Art Carpenter, Nov. 6-8. Sponsored by San Joaquin Fine Woodworkers Assoc. Contact Mark Webster, 670 N. G St., Porterville, 93257. (209) 781-4074.
Workshop/classes—Ornamental traditional woodcarving. Contact Dave Whillock, 2800 20th St., San Francisco, 94110. (415) 550-0116.
Workshops—Woodworking for women, beginners and advanced, traditional furnituremaking, focus on hand tools. Contact Debby Zito, 103 Wool St., San Francisco, 94110. (415) 648-6861.
Workshops—Traditional Japanese woodworking classes. Shoji screen, Tansu chest, joinery and handshaping. Contact Hida Tool & Hardware Co., 1333 San Pablo Ave., Berkeley, 94702. (415) 524-3700.
Fair—8th annual Christmas Wood Fair, Dec. 5-6. Gifts handcrafted from wood. Contact Janice Slife, Ganahl Lumber, Box 31, Anaheim, 92805. (714) 772-5444.
Juried show—4th annual exhibition of contemporary crafts, during San Francisco Winter Design Market Week, Jan. 24-31. Baulines Craftsman's Guild, Schoonmaker Point, Sausalito, 94965. (415) 331-8520.
Show/sale—4th Contemporary Crafts Market, featuring 200 craftsmen, Oct. 31-Nov. 1. Santa Monica Civic Auditorium. 11 A.M.-6 P.M. Admission: $2.50; children under 12 free. Contact Christine Anderson, (213) 829-2724.
Show/workshops—Woodworking machinery, supplies, tools; workshops and seminars, Dec. 4-6. Los Angeles County Fairgrounds, 1101 W. McKinley Ave., Pomona. Contact "The Woodworking Show," Marketing/Assoc. Services, Inc., (213) 477-8521.
Show/demonstrations—National "Working with Wood" Show, Nov. 21-22. Anaheim Convention Center, Pacific Room. Free seminars, tools, machinery, hardware, wood, kits, etc. Admission: $5. Booth space available. Contact J.D. Productions, 467 Saratoga Ave., Suite 110, San Jose, 95129. (408) 973-0447.
Exhibition—7th annual show of the Orange County Woodworkers Assoc., Nov. 14-Dec. 5. Anaheim Cultural Arts Center, 931 N. Harbor Blvd. Contact (714) 526-7100 or 998-6733.

COLORADO: **Juried show**—3rd annual exhibition by Colorado woodworkers, Nov. 28-Jan. 10. Pioneers' Museum, Colorado Springs. Contact the Woodworkers Guild, Box 9594, Colorado Springs, 80932. (303) 634-4683.

CONNECTICUT: **Workshop**—Production woodworking in the small shop, Bob Green, Nov. 7-8. Contact Brookfield Craft Center, Box 122, 286 Whisconier Rd., Brookfield, 06804. (203)775-4526.
Juried show—52nd annual juried exhibition of the Society of Connecticut Craftsmen, Nov. 7-Dec. 4. Newspace Gallery, Manchester Community College, 60 Bidwell St. Contact SCC, Box 615, Hartford, 06142. (203) 423-5532.
Juried show/sale—9th annual holiday exhibition & sale, all fine crafts. Contact Holiday Exposition, Box 589, Guilford, 06437. (203)453-6237.
Holiday sale—Annual Brookfield Craft Center sale, Nov. 27-Dec. 24. "Four corners" intersection of Rtes. 7 & 25, Brookfield; 127 Washington St., "Brookfield Alley," S. Norwalk. Contact BCC, Box 122, Brookfield, 06804. (203) 775-4526.
Exhibition—Wooden clock sculptures by Catherine Bloom, Nov. 14-Dec. 31. Free. Brookfield Craft Center, 127 Washington St., S. Norwalk. (203) 853-6155.

DELAWARE: **Auction**—Antique tools, Nov. 7. Wilmington Manor Lion's Club Memorial Hall, 227 S. Dupont Highway (Rte. 13), New Castle. Catalog: $12. Contact Bates & Brown, Inc., R.D.3, Box 159, Hockessin, DE 19707. (215) 777-0501.

DISTRICT OF COLUMBIA: **Show**—"Masters of Ceremony," Jewish ceremonial pieces by contemporary designers, thru Jan. 31. B'nai B'rith Klutznick Museum, Washington. Contact B'nai B'rith International, 1640 Rhode Island Ave., N.W., Washington, 20036. (202) 857-6536.

FLORIDA: **Juried show**—4th annual Rain Barrel Woodcrafters Exhibition, Jan. 16-17. Contact The Rain Barrel, 86700 Overseas Hwy., Islamorada, Florida Keys, 33036. (305) 852-3084.
Juried show/sale—25th annual Coconut Grove Arts Festival, Feb. 13-15, 1988. Outdoor festival; 350 exhibitors. Contact Coconut Grove Arts Festival, Box 330757, Coconut Grove, 33233.

ILLINOIS: **Exhibition**—17th annual Midwestern Wood Carvers Show, Nov. 7-8. Belle-Clair Expo Hall, 200 South Belt East, Belleville. Dealer/exhibitor space available. Contact Don Lougeay, 1830 East D St., Belleville, 62221. (618) 233-5970.
Exhibition—"Tuning the Wood," a display of the works of Illinois luthiers. University Museum, Carbondale, thru Nov. 8; Illinois State Museum, Springfield, Nov. 21-Jan. 10. Contact Terry Suhre, Illinois State Museum, Springfield, 62706. (217) 782-7386.
Classes—"Understanding the Properties & Qualities of Wood" with master restorer/cabinetmaker Dudley Greeley, Nov. 10-Dec. 15. Field Museum of Natural History, Roosevelt Rd. at Lake Shore Dr., Chicago. Tuition: $50 members, $60 non-members. Contact Education Dept., (312) 322-8854.
Annual meeting—Illinois Woodworking Teachers' Assoc., Nov. 6. Ill. State University, Circus Room, University Union, Normal. 8 A.M. Contact Greg Tuftie, 14909 Terrace Lane, Midlothian, 60445. (815) 371-9297.

MARYLAND: **Juried shows**—12th annual autumn crafts festival, Montgomery County Fairgrounds, Gaithersburg, Nov. 20-22; 10th annual winter crafts festival, Montgomery County Fairgrounds, Gaithersburg, Dec. 11-13. Send three stamps (66¢) for postage to: Sugarloaf Mtn. Works, 20251 Century Blvd., Germantown, 20874. (301) 540-0900.

MASSACHUSETTS: **Craft fair**—2nd annual "Crafts at the Castle," Dec. 11-13. Park Plaza Castle, Arlington St., Boston. Proceeds to benefit Family Service of Greater Boston. Admission: $5. Contact (617) 523-6400, ext. 504.
Craft fair—18th annual fair at Worcester Center for Crafts, May 20-22. Slide deadline: Feb. 14. Application fee: $15. Call or write for application packet: Craft Fair Registrar, Worcester Center for Crafts, 25 Sagamore Rd., Worcester, 01605. (617) 753-8183.

MINNESOTA: **Workshops/seminars**—Numerous events. The Woodworkers' Store, 3025 Lyndale Ave. S., Minneapolis. (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: **Exhibition**—5th annual Midwest Woodworkers Assoc. show/sale, Nov. 7. National Guard Armory, 701 E. Ash St., Columbia. Contact Gary Straub or Danny Roberts at Box 7093, Columbia, 65201.
Exhibition—3rd annual show of the Kansas City Woodworker's Guild, Nov. 12-Nov. 21. Union Hill Arts Gallery, 3013 Main St., Kansas City. Reception to be held on Nov. 14, 11 A.M.-3 P.M. Call (816) 561-3020.

NEBRASKA: **Exhibition**—Contemporary furniture by Michael Herres, thru Oct. 29. Joslyn Museum, 2200 Dodge St., Omaha. Contact (402) 342-3300.

NEW HAMPSHIRE: **Auction**—Listed antique & craftsman's tools, Oct. 24. Auction Barn, Danforths Four Corners, Hillsboro. Contact "Your Country Auctioneer," Hillsboro 03244. (603) 478-5723.

NEW JERSEY: **Show/seminars**—"Woodworking World," Nov. 13-15. Hyatt Cherry Hill, Cherry Hill, N.J. Machines, tools, supplies, local craftsmen, demos, seminars, door prizes. Contact CDI Productions, Box 796, Plymouth, N.H. 03264. (603) 536-3768.

NEW MEXICO: **Workshops**—Shaping Wood, Michael Mocho, Nov. 14; Router Techniques, Nicholas Claus, Dec. 12. Sponsored by the Albuquerque Woodworkers' Assoc. Contact A.W.A., (505) 296-5939.

NEW YORK: **Workshop**—Japanese hand tools, Robert Meadow, Nov. 7-8, 21-22. The Luthierie, 2449 W. Saugerties Rd., Saugerties, 12477. (914) 246-5207.
Workshop—Furniture finishing & refinishing, Susan Perry, Nov. 24-Jan. 19 (8 sessions). Tuition: $100. Y.W.C.A. Craft Students League, 610 Lexington Ave. at 53rd, N.Y.C. Contact (212) 735-9732.
Workshops—Veneering, woodcarving, furniture repair, marquetry, woodfinishing, other topics, Jan. thru April. Constantine's, 2050 Eastchester Rd., Bronx. 2-day workshops, Sat. or mid-week. Fee: $10. Contact Albert Constantine & Son., (212) 792-1600.
Invitational—"Function & Fantasy," works in wood, whimsical to sophisticated, thru Nov. 7. Carlyn Gallery, 1145 Madison Ave., N.Y.C., 10028. (212) 879-0003.
Exhibition—Selections from the permanent collection, thru Jan. 3, 1988. American Craft Museum, 40 W. 53rd St., N.Y.C. Sculptural and functional objects in wood, clay, metal, glass, fiber, mixed media dating from 1945. Tues. 10-8; Wed.-Sun., 10-5. Admission: $3.50 adults; $1.50 students & seniors. (212)956-3535.
Show/seminars—"Woodworking World," Nov. 6-8. New York State Fairgrounds, Syracuse. Machines, tools, supplies, local craftsmen, demos, seminars, door prizes. Admission: $5. Contact CDI Productions, Box 796, Plymouth, N.H. 03264. (603) 536-3768.

NORTH CAROLINA: **Exhibition**—"Young America: A Folk Art History," thru Jan. 3. The Mint Museum of Art, Charlotte. A major loan exhibit organized by the Museum of American Folk Art and supported by IBM. Contact Susan Flamm, 444 Park Ave. So., New York, N.Y. 10016. (212) 481-3080.
Show/sale—2nd annual Rutherford Country Woodworkers Club fine wood furniture show, Nov. 7-8. Courthouse Annex, Rutherfordton. Contact Marvin Overcash, Fernwood Dr., Rutherfordton, 28139. (704) 286-9375.
Show/seminars—"Woodworking World," Oct. 30-Nov. 1. Charlotte Convention Center. Machines, tools, supplies, local craftsmen, demos, seminars, door prizes. Admission: $5. Contact CDI Productions, Box 796, Plymouth, N.H. 03264. (603) 536-3768.
Juried show—14th annual High Country Christmas art & craft show, Nov. 27-29, Asheville Civic Center. Send legal SASE to High Country Crafters, Inc., 29 Haywood St., Asheville, 28801. (704) 254-0072.

OHIO: **Workshops**—Woodworking, Earl Richards, thru March. Contact Richards' Cabinetry & Mill Co., 410 W. Harrison St., Lewisburg, 45338. (513) 962-4788.
Workshops—Wildlife carvings, Nov. 3; turning between centers, Nov. 5; faceplate turning, Nov. 10; relief carving, Nov. 12; wooden toy projects, Nov. 17; finishing I, Nov. 19; finishing II, Nov. 24; finishing III, Dec. 1. The Woodworkers' Store, 2500 E. Main St., Columbus, 43209. (614) 231-0061.

OREGON: **Exhibition**—Annual show, Guild of Ore. Woodworkers, Oct. 23-25. World Forestry Center, 4033 S.W. Canyon Rd., Portland. Contact Ed Mattson, (503) 231-1643.
Exhibitions—Numerous shows, exhibitions. The Gallery, World Forestry Center, 4033 S.W. Canyon Rd., Portland, 97221. (503) 228-1367.
Show—Annual fall woodworking show, Siskiyou Woodcraft Guild, Nov. 27-29. Shakespeare Great Hall, Main St., Ashland. Contact Tom Phillips, SWG, 60 5th St., Ashland, 97520. (503) 482-4829.
Show/workshops—Woodworking machinery, supplies, tools; workshops and seminars, Nov. 13-15. Memorial Coliseum Complex, 1401 N. Wheeler St., Portland. Contact "The Woodworking Show," Marketing/Association Services, Inc., (800) 826-8257; in Calif. (213) 477-8521.

PENNSYLVANIA: **Juried show**—Contemporary crafts, thru Nov. 1. Luckenbach Mill Gallery, Bethlehem. Contact Janet Goloub, Historic Bethlehem Inc., 501 Main, Bethlehem, 18018. (215) 691-5300.
Juried show—International Turned Object Show (ITOS); eligible objects include sculpture, furniture, bowls, vessels, functional and non-utilitarian production items, miniatures, architectural forms, etc. Co-sponsored by the American Assn. of Woodturners, the Society of Philadelphia Woodworkers and the City of Philadelphia. Show will open in Oct. '88; international tour planned. Slide deadline: Nov. 11, 1987. Send legal SASE to American Assn. of Woodturners, ITOS Show, Box 982, San Marcos, TX 78667.
Show/sale—11th annual Philadelphia Craft Show, Nov. 5-8. 103rd Engineers' Armory, 33rd St. (just north of Market), Philadelphia. Admission: $5. Contact Philadelphia Museum of Art, Public Relations Dept., (215) 787-5431.
Workshop—Master woodfinisher George Frank's last public workshop, Oct. 24-25. Fee: $145. Contact Olde Mill Cabinet Shoppe, R.D.#3, Box 547A, Camp Betty Washington Rd., York, 17402. (717) 755-8884.
Show/workshops—"Woodworking World," Nov. 13-15. Hyatt Cherry Hill, Cherry Hill, N.J. Machines, tools, supplies, local craftsmen, demos, seminars, door prizes. Admission $5. Contact CDI Productions, Box 796, Plymouth, N.H. 03264. (603) 536-3768.

TENNESSEE: **Juried show**—Spotlight '87, thru Dec. 12. American Craft Council Southeast Region Assembly, Arrowmont Gallery. Contact Arrowmont School of Arts & Crafts, Box 567, Gatlinburg, 37738.

TEXAS: **Juried fair**—Annual Crafts & Arts Exposition, Houston International Festival, April 9-17. Application deadline: Dec. 15. Space also available at three open-air markets. Prospectus available from Barbara Metyko, Houston International Festival, 2 Houston Center, 909 Fannin, Suite 890, Houston, 77010. (713) 654-8808.

VERMONT: **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.
Workshop—Professional-level splint basketry, John McGuire, Nov. 16. Vermont State Craft Center at Frog Hollow, Middlebury, 05753. (802) 388-3177.

VIRGINIA: **Juried show**—12th annual craft show, Nov. 20-22. Richmond Convention Centre. Contact

Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.
Juried show—"Artistry in Wood," 13th annual woodcarving show, Nov. 28–29. Marymount University, N. Glebe Rd. & Old Dominion Dr., Arlington. Contact Northern Virginia Carvers, Box 524, Oakton, 22124. (703) 790-1034.
Juried show—3rd annual High Country Christmas art & craft show, Dec. 4–6, Norfolk Scope, Norfolk. Send legal SASE to High Country Crafters, Inc., 29 Haywood St., Asheville, 28801. (704) 254-0072.
Show/seminars—"Woodworking World," Jan. 8–10, the Norfolk Scope, Norfolk. Machines, tools, supplies, local craftsmen, demos, seminars, door prizes. Admission: $6. Contact CDI Productions, Box 796, Plymouth, N.H. 03264. (603) 536-3768.
Exhibit—Antique decoys and contemporary waterfowl carvings. Virginia Marine Science Museum, 717 General Booth Blvd., Virginia Beach. (804) 425-3474.

WASHINGTON: **Seminars**—Novice boatbuilding with Simon Watts, Oct. 31–Nov. 8; Nov. 14–21. Contact The Center for Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-2628.
Workshops—Lapstrake, Nov. 7; flat-bottomed skiffs, Nov. 21–22. Contact Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.
Workshops/demonstrations—Tools-In-Action series, free, every Saturday, 10 A.M. Boatbuilding, woodcarving, other woodworking topics. The Wooden Boat Shop, 1007 N.E. Boat St., Seattle, 98105. (206) 634-3600.
Show/workshops—Woodworking machinery, supplies, tools; workshops and seminars, Nov. 20–22. Seattle Center, Exhibition Hall, 305 Harrison St. Contact "The Woodworking Show," Marketing/Association Services, Inc., (800) 826-8257; in Calif. (213) 477-8521.
Shows—"Form, Function, Furniture," contemporary handmade furniture, thru Nov. 8; also, 1987 Box Competition & Container Show, Nov. 19–Dec. 31. Northwest Gallery of Fine Wood Working, 202 First Ave. So., Seattle, 98104. (206) 625-0542.

CANADA: **Exhibition**—"American Folk Art: Expressions of a New Spirit," thru Nov. 30. Maison Chevalier, Quebec City, Quebec. A traveling exhibition from the permanent collection of the Museum of American Folk Art. Contact Susan Flamm, 444 Park Ave. So., New York, N.Y. 10016. (212) 481-3080.
Seminar—Furniture design, Garry Bennett, Michael Fortune, Michael Hosaluk, Nov. 7–8. Contact Vancouver Island Woodworkers Guild, Box 6584, Station C, Victoria, B.C., V8P 5N7. (604) 595-2763.
Workshops—1987-88 workshop series. Mixed media, plus 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/seminars—"Explorations in Wood," Nov. 7–Dec. 7. Also, design seminars, Nov. 6–8. Contact Maltwood Art Museum and Gallery, University of Victoria, Box 1700, Victoria, B.C., V8W 2Y2. (604) 595-8508.
Show/seminars—"Woodworking World," Jan. 15–17. Skyline Hotel, Toronto, Ont. Machines, tools, supplies, local craftsmen, demos, seminars, door prizes. Contact CDI Productions, Box 796, Plymouth, N.H. 03264. (603) 536-3768.

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Woodworker Guide to Wood Finishing by Noel Johnson Leach. *Argus Books Ltd., 1 Golden Square, London W1R 3AB, Eng.; 1987. $20.00 postpaid, hardcover; 160 pp.*

In the relatively short space of 160 pages, *Woodworker Guide to Wood Finishing* not only provides much useful information on products used for finishing furniture, but it also treats us to one of the best discussions I've seen comparing the strengths and weaknesses of modern industrial finishes, including polyester, polyurethane, acid-catalyzed and pre-catalyzed lacquers.

However, there's surprisingly little information on how to actually *use* the products discussed. For instance, the application of shellac, varnish or wax to wood furniture isn't covered at all, and the use of strippers, bleaches, stains and paste wood fillers is treated so superficially that it might as well have been left out. There's not enough information for a beginner, and advanced finishers won't discover many new tricks.

Besides the lack of practical how-to information, this book hasn't been properly edited for the American audience. The products mentioned are all British, and much of the vocabulary will give fits to all but the initiated. Read mineral spirits for "white spirit," cratering for "cissing," can for "tin." And don't expect to find a pounce bag, mutton cloth, coal-tar soap or Vienna chalk at your local home center.

The process of learning involves piecing together many bits of information from different sources, then *practicing*. This book provides a lot of background product information for the more advanced finisher, but it's not a book for beginners.

—Bob Flexner

Step by Step Woodcarving by Alan and Gill Bridgewater. *Bell & Hyman Ltd., Denmark House, 37/39 Queen Elizabeth St., London SE1 2QB, Eng.; 1985. $16.95, hardcover; 127 pp.*

In their introduction to *Step by Step Woodcarving,* Alan and Gill Bridgewater state that the book is written for beginners. Yet the authors seem to quickly lose sight of their audience and, as a result, potentially hazardous problems can occur.

The first idea the Bridgewaters touch upon is tool sharpening. The opening paragraph of this section leads the reader to believe that only hand-sharpening will be discussed. The illustrations that accompany the text are concerned only with hand-sharpening. But, suddenly, the text begins to discuss grinding, with only one or two lines to describe technique. And there's nothing to warn the novice about the danger of overheating a tool and, thus, ruining the steel.

The authors give sound advice about buying tools, saying to start small and carefully build up the collection "when you're more experienced and able to see your needs more clearly." But they also recommend using "a vegetable knife, sheath knife, an old cut-throat razor or anything else that takes your fancy" for carving. I find it difficult to believe that a beginner will be able to tell the difference between a good piece of metal and a bad one. And I hope that nobody will try to use a cut-throat razor for carving or whittling without careful preparation of the tool. It could be dangerous.

Each of the 18 projects in the book is accompanied by a working time. Some of the times provided seem grossly inadequate for the projects described—particularly in light of the fact that beginning carvers will be attempting them. If a beginner is told that a project will take ten hours to complete and he or she is still working on it after 20 hours, discouragement is bound to set in. I wish the authors had simply advised their readers not to be frustrated if a piece takes a long time to produce. An added assurance here and there that carving time can be whittled down with experience wouldn't have hurt either.

On the positive side, the actual project instructions are very well written and provide excellent detail. The illustrations are superb. In fact, these are some of the best line drawings showing working hands in relation to carvings I've ever seen.

Overall, I recommend the project portions of *Step by Step Woodcarving* highly. But I would advise the reader to disregard the carving times quoted and to refer to other books for information on sharpening techniques and the uses of different carving tools.

—John L. Heatwole

Classic Designs for Woodcarving by Richard Adam Dabrowski. *Sterling Publishing Co., Inc., 2 Park Ave., New York, N.Y. 10016; 1987. $7.97, paperback; 96 pp.*

After quickly perusing Richard Dubrowski's *Classic Designs for Woodcarving*, my first impression was that it would be quite helpful to the beginning carver. A closer inspection, however, showed that there are some timeless designs here to challenge both the amateur and the professional.

This collection of 44 designs should be most helpful to the cabinetmaker or woodworker who wants to take that "next step" and embellish his or her work through carved ornamentation. For example, a design for a small box lid featuring a swirl and leaf pattern would be striking when used in a continuous fashion on trim for a sideboard or cabinet. A mask featured elsewhere in the book would be wonderful carved in oak or walnut and mounted as a headboard for a chest of drawers. I also found the section of the book on carving signs quite informative, with designs that would lend a distinctive touch.

In helping to renew my interest in what has become almost a lost art, I am grateful to Mr. Dabrowski.

—John E. Meyers

The International Design Yearbook 2 edited by Emilio Ambasz, Deyan Sudjic, Hilary More. *Abbeville Press Inc., 505 Park Avenue, New York, N.Y. 10022; 1986. $49.95, hardcover; 236 pp.*

There's something exciting about seeing diverse ideas presented in compendiums of well-designed products, be they wooden furniture or electronic gadgets. In that vein, *The International Design Yearbook 2* is as diverse a collection of well-designed and manufactured objects as you're likely to find, well presented in color and black-and-white photos. The book's selections encompass many categories, including furniture, lighting, tableware, textiles and a mélange of other products, from stereo components to sink faucets. If you're looking for insights into worldwide trends in design and materials, this book contains some of the most intriguing products and prototypes designed and/or manufactured in 1986.

Though the furniture chapter is the largest in the book, don't expect to see extensive coverage of all-wood pieces. This book adheres closely to the cutting edge of production furniture design, and the majority of the work shown is made of metal and painted or laminate-covered particleboard or plywood—materials highly favored for their predictable consistency in manufacturing.

The International Design Yearbook 2 not only provides a cosmopolitan source of ideas for both the casual browser and the aspiring designer, it acquaints the reader with the people and the notable design achievements of 1986. Quite an education, offered by a book that's mostly pictures.

—Sandor Nagyszalanczy

Bob Flexner restores furniture in Norman, Okla. John Heatwole is a professional woodcarver with a studio in Bridgewater, Va. John Meyers is a professional woodcarver who lives in Stirling, Ontario, Can. Sandor Nagyszalanczy is an assistant editor of Fine Woodworking.

Photos: Ryston Carss

Last summer's show of student work at England's Rycotewood College included Graham Morris' segmented elm and ash occasional tables, above, and Brian Fowler's upholstered chair, right.

Design & craftsmanship in London

Student exhibits by three London-area furniture colleges last summer presented a stimulating glimpse of some of the region's most talented young woodworkers, displaying meticulous craftsmanship and flamboyant design. The work was as diverse as the colleges—Rycotewood College's pastoral surroundings to the urban neighborhoods of the Royal College of Art and the London College of Furniture.

The finest workmanship, to my eye, was done by the Rycotewood College students. This college, located just outside London in Oxfordshire, has long been associated with English-inspired design.

Many pieces were copies of original Arts and Crafts work, a reflection of the college's philosophy that the mastery of woodworking is best accomplished by reproducing successful work. Rycotewood's goal is to produce graduates who can design and build high-quality furniture in a competitive commercial world. One sign of the school's success is a noticeboard covered each year with job offers for graduates. A record to be proud of, I suggested to Lucinda Leech, cabinetmaker and part-time teacher at the college. Yes and no, she said ruefully. "Employers who offer jobs sometimes find themselves being interviewed by the students."

The most encouraging aspect of the Rycotewood show was the artful blending of man-made materials with conventional hardwoods. Brightly colored fabrics and paint livened up the furniture, and extensive use of metal, plastic and spray finishes proved that, used sensitively, modern manufactured materials complement wood.

The London College of Furniture show reflected the school's emphasis on training managers, designers and machinists for the high-volume furniture industry. The work ranged from traditional Georgian reproduction dining tables to plastic-and-metal stacking seats. An example of the college's commitment to the commercial furniture trade was a metal child carrier made to fit a standard wheelchair, designed and made by Christina Jones.

The Royal College of Art is best known for teaching design. Many of the furniture design students are also skilled makers; but they consider themselves designers foremost. None of the designers who showed last summer favored wood over other materials. They used plastics, leather, standard metal tubing or sheet-metal pressings to achieve a diversity of appearance and construction. It was apparent that all the students strived for style, practicality and economy. They succeeded.

Many of the pieces were attempts to deal with the bugbears of modern urban living—possibly because the designers live in London, where living space is both limited and expensive. The most inventive of these attempts was an eminently practical and stylish fabric-and-metal tubing wardrobe by Boris Bartkiw. The wardrobe was the only one I've seen that wasn't a nightmare to move: it came apart much like a tent, and packed into a bundle of tubing and a canvas bag.

Wanting to build a folding table without a "forest of legs" was the genesis of what was, for me, the most interesting piece of the show. Anthony Rayward's table was visually arresting, open or closed. The lower quarter of a half-round of shimmering bird's-eye maple was encased in a narrow gray stand, like the cross section of an airplane wing. Two sides of the stand opened like gull-wing doors to form a three-part base with a diameter of about five feet. The open table was so simple and stable that the soundness of the design was undoubtable.

The injection of strong visual sense into traditional shapes can have dramatic results. A blue, orange and pale rust geometric design on a simple blanket chest, for example, showed what imagination can do with the cheapest of materials and the simplest of designs. Jiouxleigh Jacob's piece, made of particleboard assembled with Lamello biscuits, emphasized the need of the designer not to be limited by traditional methods or materials. It summed up for me the strength and inventiveness of the RCA show.

—Ben Bacon, London, Eng.

The first commission

"I'd like you to build a dictionary stand for my daughter," my would-be patron, Sally, said. Though I had expected her to call, I wasn't entirely prepared for what she had to say. Without having done any advertising or solicitation, I was receiving an offer for my first woodworking commission.

The very idea thrilled me: Someone was actually going to ***pay*** me to build something for them. I'd dreamed of the possibility, but never thought it would happen, since all my prior woodworking had been done strictly as a hobby. But I wasn't going to sell anything until I was sure my work was good enough. Sally obviously already thought my skills were adequate.

Making things for my own use had been

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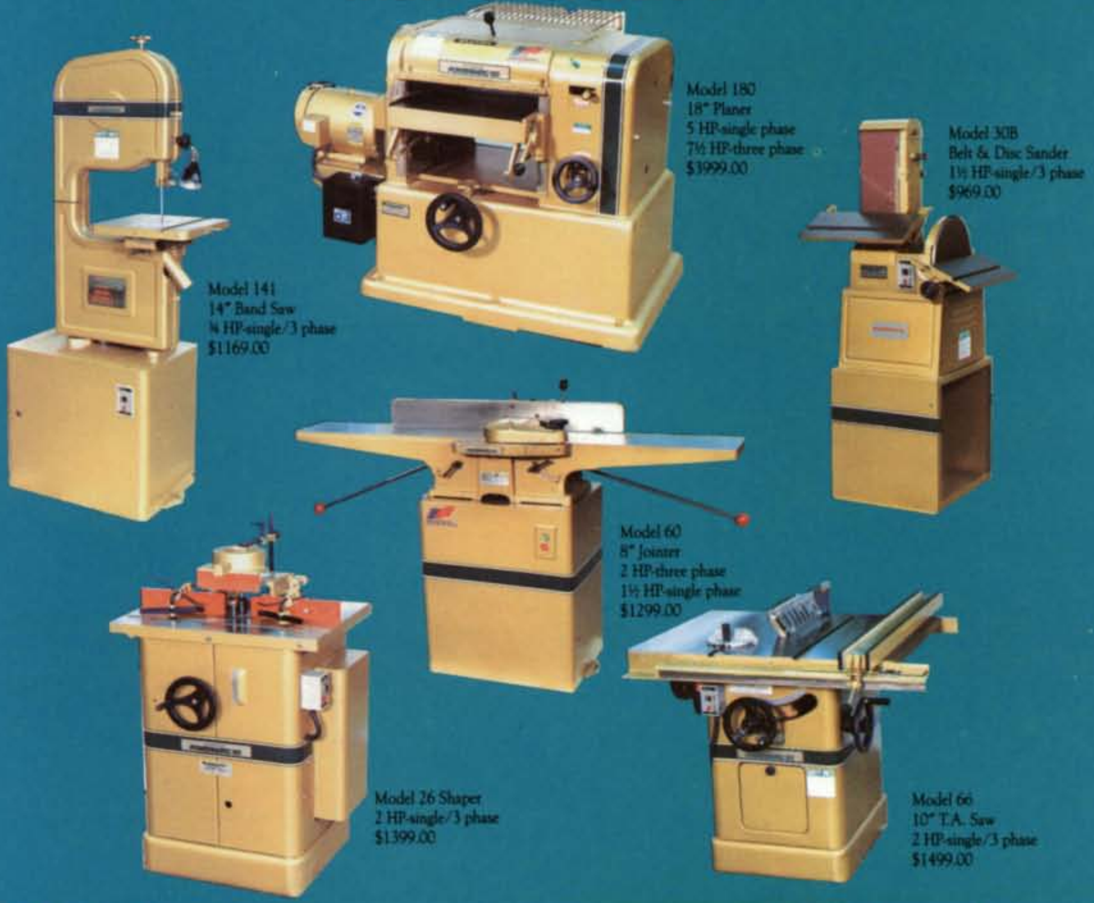

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easy, since I knew what I wanted and could set my own standards. Now I was going to have to fulfill someone else's expectations. A flood of doubts filled my head: Suppose she doesn't like my design? Suppose I'm just not good enough to sell what I build? Secretly, I hoped she would find a reason to tell me to forget the whole thing.

A few days later, Sally sent me a sketch showing the stand she envisioned. She also decided that it should be made of mahogany, since her daughter likes reddish wood.

It wasn't exactly a gigantic project, just a wedge-shaped box, with a ledge to hold a dictionary atop a lazy-Susan bearing so it could be rotated. Yet I began avoiding my shop, devising all sorts of reasons to delay the job. Every trip to the garage made me feel as if I were speaking to a large roomful of unsympathetic strangers. The tablesaw peered at me accusingly. The clamps clattered angrily in the corner each time the door bumped them. This went on for a few weeks, until finally I had no more excuses.

I headed to the local lumberyard and picked out some excellent quality mahogany, and I also bought some walnut for the trim. Back in the shop, things didn't go well at first: I couldn't get the saw to cut squarely, the planer needed sharpening and I was out of glue. I fussed and fiddled until everything in the shop was in tip-top condition. At last I began construction.

Making the stand took only a matter of hours, but, seeing as my whole future reputation was on the line, everything had to be perfect. I made the top boards as square as I could and cut and recut all the joints until they fit precisely. I sanded my fingers raw. Finally, I rubbed on thin, even coats of finish and waxed until the mahogany took on a gentle luster. The stand was finished.

I called Sally and told her the commission was done. I was excited yet skeptical: was the stand good enough? I had fretted over the project so long, I had no idea.

I put the dictionary stand in my living room and covered it with a linen cloth. When Sally arrived the next afternoon, I asked her to promise to tell me if she didn't like it. I pulled back the cloth and cringed. "It's absolutely beautiful!" she exclaimed. "I never expected it to be this nice."

As relieved as I felt, I was taken aback when Sally then asked how much she owed me. I had no idea what to charge. I could easily figure the cost of materials, but how much was my labor worth? What's the going rate for making something someone else thinks is beautiful?

I gulped and said, "Thir...forty-five dollars." She looked at me incredulously and said the price didn't seem right. Without further discussion, she picked up her checkbook and started writing. I said to myself, "Great, now I've spent all this time and trouble just to make this lady angry—I'll never do this again."

Sally handed me a check made out for $75. With what must have been a dumbfounded look on my face, I told her I couldn't accept her generous payment. "Yes you can," she said. "It should be more, but it's all I have right now. You've done a wonderful job and my daughter is absolutely going to love it."

As Sally headed for the door, stand cradled in her arms, she paused and asked if I'd be willing to make her another one. "Sure, I'd like that very much," I said without hesitation. After paying my dues the first time around, my second effort is bound to be a breeze.

—Robert Callahan, Chico, Calif.

Photo: Gary Clarke

The Balclutha's new figurehead was carved to be an exact replica of the original.

A new figurehead for the Balclutha

Although the Balclutha hasn't made a commercial voyage in more than 35 years, she still takes hundreds of sightseers on daily flights of fancy back to the days when tall-masted square-riggers carried travelers across the ocean. Now a tourist attraction at San Francisco's Fisherman's Wharf, the 100-year-old Balclutha was recently restored, including new fittings, paint and a replica of her buxom figurehead, executed by English carver Greg Powlesland.

Since the wood in the original figurehead was severely decayed, Powlesland had to recreate the figurehead from scratch. He chose yellow cedar for its superior weathering and carving qualities, gluing up a 42-in. by 10-ft. blank for the larger-than-life-size carving. Powlesland, who's carved extensively for historic ship restorations, says that all the large figureheads made in England were laminated, because it was hard to find trees big enough to carve them from a single blank.

Working directly on board the Balclutha, Powlesland measured and transferred dimensions between the old and the new figureheads, which were lying side-by-side on the deck like reclining matrons. After roughing out the torso with an axe, Powlesland used a mallet and chisels selected from a roll of 120 different tools. He used smaller, hand-pushed tools for the facial features and details, such as the crown-like tiara in the figure's Victorian-styled hair.

By the time the new figurehead was mounted to the bow of the refurbished Balclutha last February, Powlesland had carved for nearly 2½ months. The new figurehead is not only a highly accurate copy of the original; it's also true to the traditional figure-carving methods employed at the turn of the century. Besides using mostly original tools, Powlesland took care to carve in the same manner as the original carvers, leaving the details as they came off the chisel and using no sandpaper. Since figureheads were regularly pounded by the sea and exposed to harsh weather, fine details were avoided out of practicality.

Built in England, the three-masted Balclutha worked as a mixed cargo trader, carrying goods around the world. The National Maritime Museum at San Francisco now owns and maintains the Balclutha and keeps her berthed near Fisherman's Wharf. She's open to the public from 10:00 A.M. to 6:00 P.M., seven days a week.

News bits

Chinese satellites flaming through the atmosphere returning from Earth orbit must smell more like a smoky barbecue pit than high-tech metal marvels. Apparently hoping to avoid the U.S. Space Shuttle's problems with loose heat-shield tiles, the Chinese are making their shields from good old reliable oak.

The Chinese report that the wooden heat shields have been used successfully on eight launches of recoverable satellites. Although they have researched other aerospace materials, engineers say a thick, charring layer of oak effectively dissipates the heat associated with reentry. A report published in the July issue of *Aviation Week* magazine gave no indication of what joinery technique is needed to fix the oak to a 10-ft.-tall nose cone. Dare we suggest dovetails?

■ If you doubt the toughness of exotic hardwoods, talk to workers replacing a 93-year-old bridge over Duxbury Bay in Duxbury, Massachusetts. When the town's 2,200-ft.-long southern pine bridge fell to the ravages of fire and marine borers, residents objected to replacing the landmark with steel and concrete. Instead, the new bridge will be wood—basralocus (also know as angelique) imported from South America and lophira alata (also known as ekki or azobe), imported from Africa. Workers quoted in the *Engineering News Record* say the wood is so hard you can't drive in a spike—in fact, you need carbide-tipped tools to bore holes. The bridge is expected to be maintenance-free for at least 50 years.

■ In the months ahead, *American Craft* magazine will publish the premiere issue of its annual *Guide to Craft Galleries U.S.A.* In addition to basic background information on individual galleries, listings—arranged geographically by state and city—will include a description of gallery space, shows hosted and artists represented. Listings are free for qualifying craft marketers. For information on the 1989 issue, contact R.C. Shade & Assoc., 900 Albany Post Road, New Paltz, N.Y. 12561, (914) 255-5840.

Product review

Dowel Crafter, *$44.95, Dowel Craft Co., 2542 Tartan Dr., Santa Clara, Calif. 95051.*
Kaufman's Dowel Jig, *$129.95, Quality Craft Tools, Inc., 1703 E. Monroe Street, Goshen, Ind. 46526.*

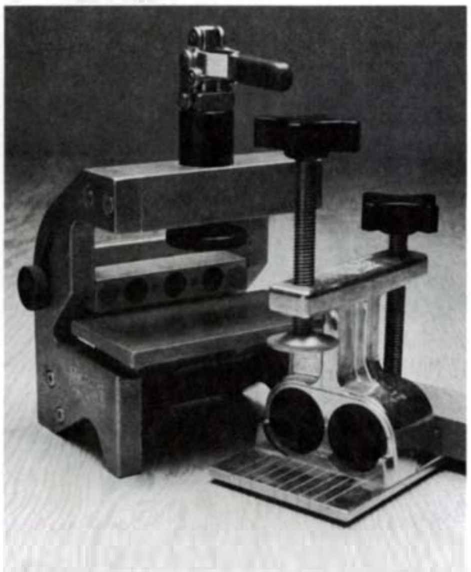
The problem with dowel jigs and work guides—and these two are no exception—is that they rarely work as they're supposed to right out of the box. The joints they make rarely go together as they should. Sloppy die castings and stampings and inaccurately machined surfaces take their toll. Fortunately, though, these devices can be put right with calipers, a mill file, a straightedge and a machinists' square.

A doweling jig generally includes some type of tubular guide to control the drill angle as it bores into the wood and some mechanism for holding or clamping the guide to the workpiece at a preset angle, usually 90°. The Dowel Crafter guides are two well-machined cylinders, much like the cylinders in a six-gun. Each has 5⁄16-in., 3⁄8-in. and 1⁄2-in-dia. guide holes. The cylinders are rotated until the desired guide hole is in position, then secured with set screws.

To use the Dowel Crafter, the woodworker makes an alignment mark across the edges of the two workpieces, clamps the workpiece to the jig and matches the alignment mark on the workpiece with one of nine lines on the face and edge of the jig. You can either bolt the jig to a piece of wood and stand it up in a woodworking vise, or stand the workpiece up in a vise and clamp the jig to it.

Reading the alignment marks on the jig is easy when the workpiece is narrower than the jig's reference surface. But when the workpiece is wider, you can't see the nine face marks and have to flip the jig over and read the marks on its edge. The jig is designed to swivel so you can read its edge markings easier when doweling

Photo: Michele Russell



Doweling jigs for use with portable drills.

wide boards, but the workpiece and jig must be swiveled as one. This is impractical for boring on large workpieces.

You may find yourself looking for longer drill bits when using this jig. When the guides are rotated to place holes near the center of 3⁄4-in. stock, even the narrow chuck on my 3⁄8-in. drill wouldn't clear the jig's reference surface. As a result, you'd have to use tape for a depth stop—a drill stop would hit the reference surface.

Unlike most other jigs, the Dowel Crafter separates itself from the workpiece to clear chips from the drill. Thus, the bit's flutes aren't plugged and you needn't back the bit out to clean it off while boring.

I tested the jig by edge-joining two boards with three dowels and joining a 1x4 rail-to-stile assembly. In both cases, the Dowel Crafter passed with flying colors. Holes aligned properly, resulting in a flushly joined face and joints without gaps. However, slight misalignments between the marks on the jig's face and edge made for some tricky eyeball positioning in setup.

The Dowel Crafter seems a bit expensive, but once you've "tuned it up" (one of its tables had a slight hump in the middle and a shoulder slightly out of square with the drill guides—both were easily corrected with a mill file), you'll find it valuable for doing flat dowel joints of consistent quality with minimal fuss.

As far as I know, Kaufman's Dowel Jig is the most expensive on the market. To use it, you adjust the height of the table, which slides on inclined ways, then secure the workpiece with the jig's overhead clamp. Next, you bore into the workpiece through bushings threaded into a guide block that slides in an arced slot cast into the sides of the jig. The jig is capable of boring holes 1⁄4 in., 5⁄16 in. and 3⁄8 in. in diameter.

Kaufman gets an "A" for two out of three of its jig's moving parts: the overhead clamp meets the work squarely and holds it well, and the table slides smoothly. However, the drill-guide block—the most important part of the jig—is full of problems.

The guide block permits the jig to do mitered edge joints for polygonal cylinders. The arced ways and the corresponding male lugs on the guide block mate with too much slop. Even with the block at the bottom of the arc, where it has the least slop, I could tighten the guide block from 1⁄4° above to 1½° below the correct axis. In the middle of its swing, the angle-to-table slop exceeds 3°. Furthermore, the sloppily cast degree scale on the side of the jig is useless.

Minor filing corrected less troublesome defects. I disassembled and filed a 0.010-in. crown out of the middle of the guide block so the workpiece met it without rocking. Next, I ground the ends of all three 5⁄16-in. and one 1⁄4-in. drill guides as they protruded slightly beyond the guide block—even before I filed out the crown.

I couldn't fix a slight misalignment between the far left and right guide holes: one was 0.003 in. higher than the one opposite it. This error is compounded because the

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low hole in one workpiece will mate with the high hole in the other piece. The effect of this offset was apparent on a test rail-and-stile joint that wasn't flush and had a 1/32-in. opening on its back. However, another test for edge-joining an octagonal cylinder met with good results. I set up the jig carefully and rechecked it while drilling, but the play in the jig's components resulted in parts being slightly in wind. Still, the results were acceptable.

The Dowel Jig is priced for the serious woodworker, who probably already has a drill press and the ability to do the jigging necessary for face frames and other doweling jobs. I didn't find the jig acceptable for precise rail-and-stile joinery, though it can work for cylindrical doweling. If Kaufman were to rework the adjustable guide block so it performs as well as the rest of the jig, it would be a more attractive tool.

—Brian Mahoney, Washington, D.C.

A woodworker's night before Christmas

'Twas the night before Christmas and all through the shop,
Not a worker was stirring, all projects were stopped.

The chisels were left by the whetstone with care,
In hopes that the elves would come sharpen them there.

The tools were all nestled and snug where they lay,
While visions of woodshavings danced on each blade.

Then up in the woodloft there came such a clatter,
The whole building shook from the weight of the matter,

And there on the creaky tin roof did appear,
A fine handmade sleigh drawn by ten dusty deer,

With a sparkly-eyed craftsman as spry as a buck,
Who went by the nickname of "Old Saint Woodchuck."

He was dressed all in suede from his cap to his shoe,
And his clothes were all covered with sawdust and glue.

A bundle of tools he had tucked in his sack,
With a Japanese saw sticking out of the back.

On his face he wore goggles and a dust-mask fit tightly,
His cheeks were like rosewood; his hearing shot slightly.

His skills were the sharpest and best in the land,
And he still had five fingers on each of his hands.

Then quick as a chainsaw his staunch helpers came,
And he hooted and hollered and hailed them by name:

"Now Router, now Ruler, now Hammer and Bitbrace;
On Shaper, on Scrollsaw, on Jackplane and Compass."

All ran to the workbench and leapt to his call:
"Now get to work, get to work, get to work all!"

So they dulled not an edge, but cut straight to their task,
And sawed, planed, pounded and scraped till, at last,

All the toys that the children were waiting to get,
Were finished and wrapped (though the paint was still wet).

There were jacks made from walnut and dolls made of yew,
And an ash rocking horse with its tail painted blue,

A set of birch soldiers all carved from one log,
And even a hand-turned oak ball for the dog.

Then the kindly crew tidied and swept every crack,
And Saint Woodchuck thanked them while stretching his back.

Then he jumped in his stout sleigh and let out a yell,
And they roared from that shop like a bat out of hell.

But these words he exclaimed as they vanished from sight:
"Merry Christmas to all—that's enough for one night!"

—Sandor Nagyszalanczy

(With apologies to Clement C. Moore, author of "A Visit From St. Nicholas.")

Match maker

My hobby—building furniture from matchsticks (see back cover)—is rooted in my high-school days, when I began building miniatures from toothpicks. My first project was a fort, which taught me how difficult it is to build with round wooden objects. Soon after, I switched to matchsticks—they're square, stackable and easier to glue.

The second project I tackled was a Western town. Soon after, I built a model boat, consisting of approximately 1,500 matchsticks. The more I worked with matchsticks, the quicker I got at assembling them. The matches I prefer are manufactured by the Diamond Company. I buy them from Pop's IGA grocery for $26 a case.

I began designing and building full-scale matchstick furniture last year. I decided that burning the matches before building with them would create a vivid contrast between the light-colored wood and the burned tips, giving my work an unusual flair. I take a handful of matches, ignite them until their ends burn off, then remove any remaining sulfur.

My first full-size furniture project was a hope chest. Its "stacked bamboo" appearance is the result of building it from heavy-duty 1 7/16-in.-dia. cardboard tubes covered with burnt-tip matches. The chest contains about 32,500 matches, and it took 500-plus hours to build. I used an ordinary backsaw in a miter box to miter the match-laminated tubes, and I substituted wooden dowels for the two frame members into which the chest's hinges are let. I also custom-built a special sanding drum to round the ends of tubes that intersect other tubes at right angles in the chest's top.

I've also completed a multi-shelf unit of about 20,000 matches and a coffee table of approximately 14,400 matches. The tabletop is constructed of five layers of matches, laminated one on top of the other. No plywood or other substrate was employed.

I'm currently 12,000 matches into what I predict will be a 30,000-match project: a 6-ft.-high, five-panel room divider. Like my other projects, I'll create only one. And if anyone wants to buy the divider, I'll do what any smart artist does: sell. □

—Jon Albertson, Millville, Pa.

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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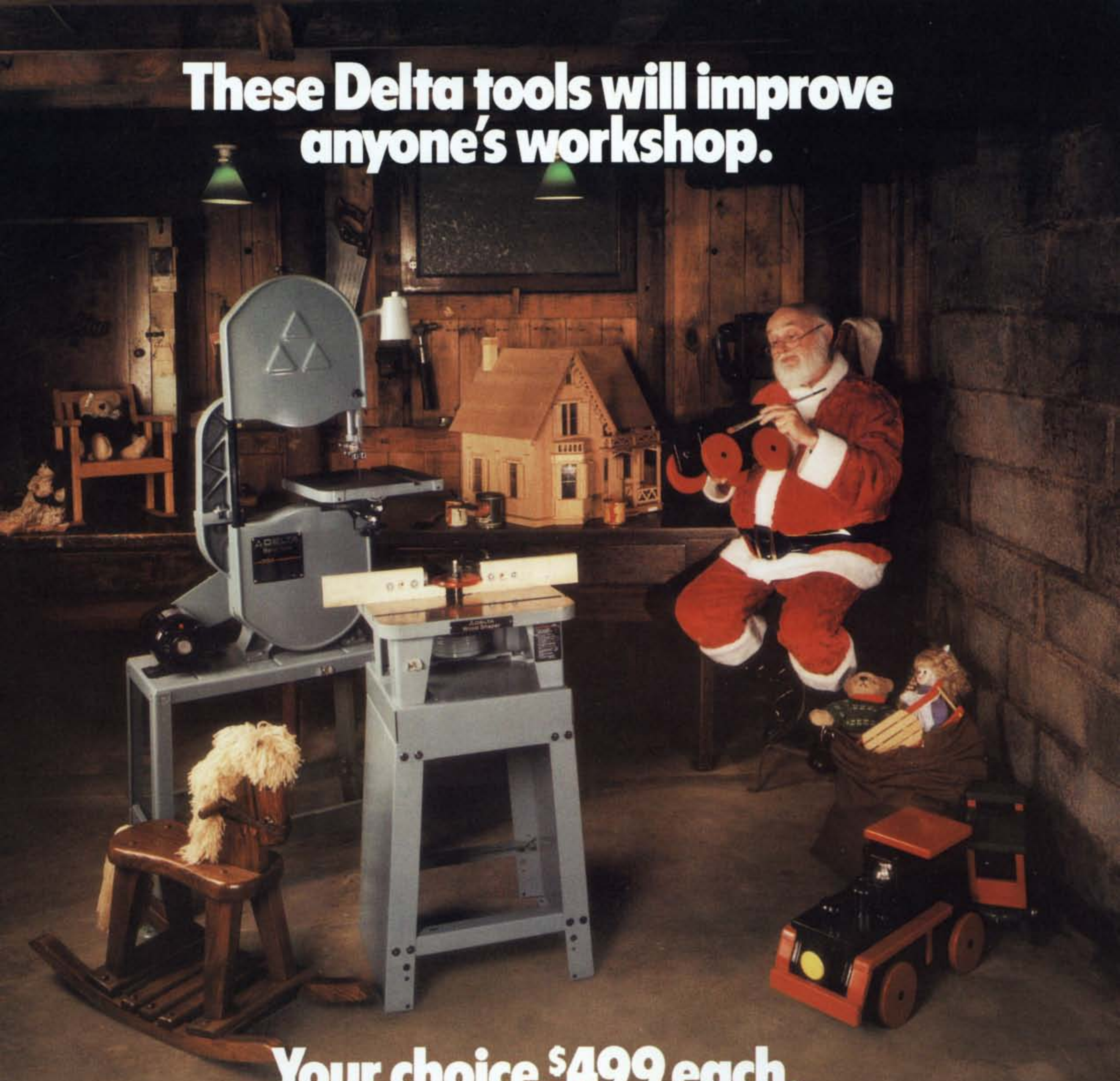

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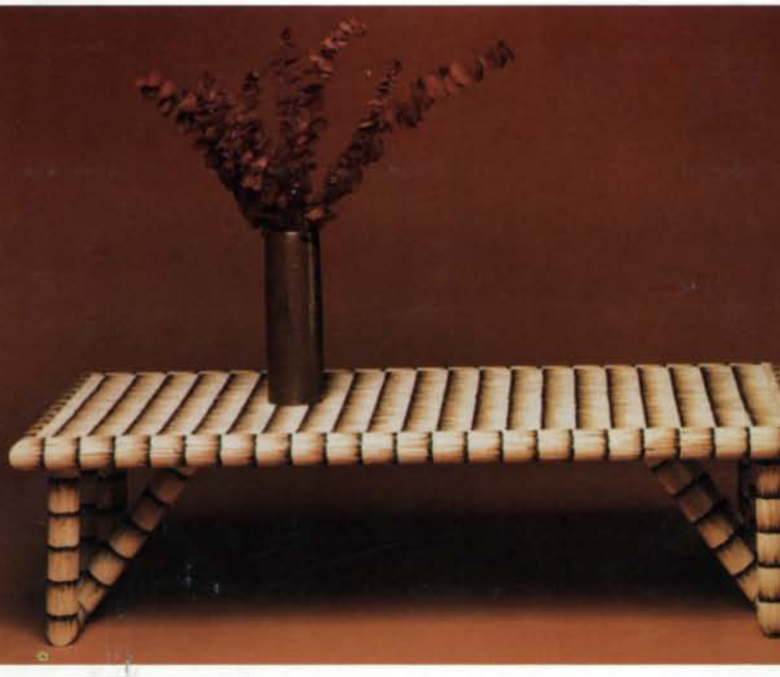
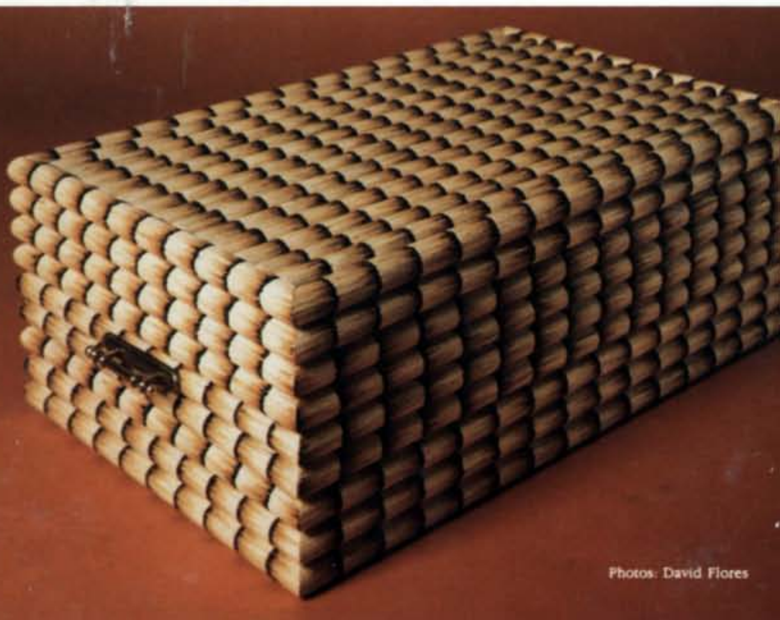
DELTA
Building On Tradition

STRIKING SIMPLICITY

You might say that Jon Albertson of Millville, Pa., has a burning desire to build furniture. But no bubinga, ebony or other exotic wood for this craftsman: Albertson's wood of choice is plain old pine—in the form of common kitchen matches with their sulfury tips burned off. Heavy-duty cardboard tubes laminated with matchsticks serve as the rounded framework for his pieces, while flat surfaces—the coffee table's top, for instance—are built up from five or six layers of matches. No nails or other fasteners are used; only white glue joins the tens of thousands of matches that constitute each piece. Albertson, whose "lumberyard" is the local grocery store, shuns requests for duplicates. Each one-of-a-kind piece consumes 500-plus hours of his time, so it's hard to get fired up to create copies. For more on Albertson's matchless style of furniture-making, see p. 130.





Photos: David Flores