Fine WoodWorking

NOVEMBER/DECEMBER 1979, NO. 19 $2.50

Making Toys

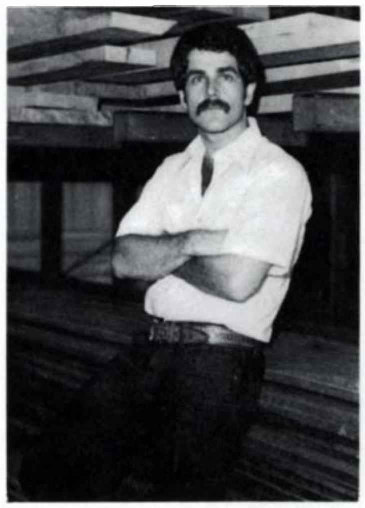
0 74470 66441 11

The Austin Hardwoods Franchising Program . . .

A SUCCESS STORY

Lubbock Franchise Owner, Galen Carr

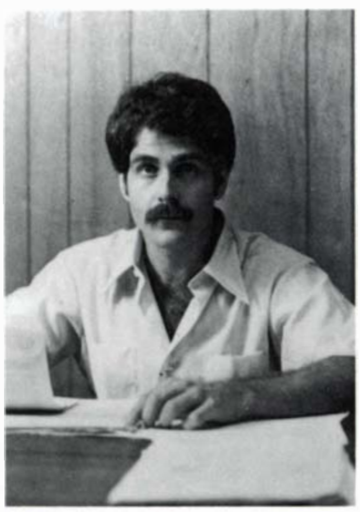
When I first saw the Austin Hardwoods franchise ad, I have to admit it sounded too good to be true. Having been an engineer for thirty years, I tend to take a good hard look at things.



Carl Lasner of Austin Hardwoods

Well, we received Galen's application and talked on the phone a few times with him right after the ad came out—and we were very impressed. But since he was interested in Lubbock, Texas, I had to give some serious thought as to whether or not a franchise could be a success in a city that small.

Here I was, a professional man over 50 years old, faced with an opportunity to finally become my own boss in a field I love. All I had to do was start over in the middle of my life. You had better believe that I examined their newly developed program pretty thoroughly. Since Austin Hardwoods already had Texas stores in Austin, Dallas, and El Paso, I knew them by reputation. The fairness of the program is startling compared to most franchise arrangements. I saw an opportunity to quickly acquire all the benefits of their years of experience and to be under the guidance of an obviously very successful company.

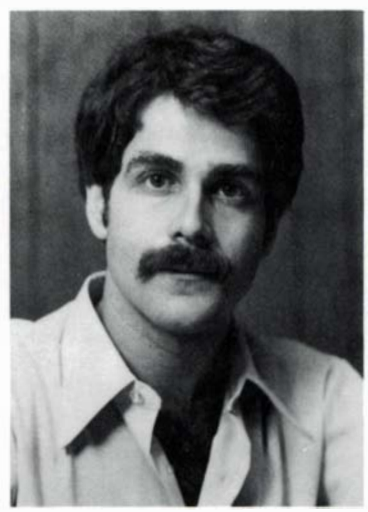


After some research, we realized that Lubbock was a flourishing area with a major university and a military base. It was also important, of course, that Lubbock was the hub of a much larger trading area than just the city itself.

We explained the training and explained the benefits of volume buying to Galen. We also went into some detail about the interplay between family stores.

I have to say we were awfully taken with the man's ability and energy. Pretty soon, we both felt confident enough in each other to make a deal.

Now, less than a year later, I have so much business, I am tripling my warehouse space. I own my own business in a field I love—hardwoods. For me, it's a dream come true. I really picked a winner.



We think we also picked a winner!

If you are a qualified applicant, your dream also can come true.

Write: *Franchise Marketing Department.*
Austin Hardwoods *P.O. Box 3096 • Austin, Texas 78764*

Outlets now open in Austin, El Paso, Tucson, Dallas, Houston, Lubbock, Atlanta, Denver, Philadelphia, Pittsburgh and Washington, D.C.

Editor
John Kelsey

Art Director
Roger Barnes

Contributing Editors
Tage Frid
R. Bruce Hoadley
Simon Watts

Consulting Editors
George Frank, A. W. Marlow
Lelon Traylor

Methods of Work Editor
Jim Richey

Correspondents
John Makepeace, Alan Marks
Rosanne Somerson, Richard Starr
Colin Tipping, Stanley N. Wellborn

Assistant Editors
Laura Cehanowicz Tringali
Rick Mastelli

Copy Editor
Ruth Dobsevage

Editorial Assistant
Mary Pringle Blaylock

Assistant Art Director
Deborah Fillion

Art Assistant
Betsy Levine Mastelli

Production
JoAnn Muir, Manager
Cynthia Lee, Assistant Manager
Barbara Hannah, Darkroom
Nancy Knapp, Typesetting
Jean Melita, Paste-up

Marketing Director
Jack F. Friedman

Marketing Representative
John Grudzien

Advertising
Vivian Dorman, Manager
Carole Weckesser

Advertising Consultant
Granville M. Fillmore

Subscriptions
Carole E. Ando, Manager
Gloria Carson, Dorothy Dreher
Marie Johnson, Cathy Kach
Nancy Schoch, Kathy Springer

Mailroom
Viney Merrill, Manager
Robert Bruschi

Accounting
Irene Arfaras, Manager
Madeline Colby

Secretary to the Publisher
Lois Beck

Associate Publisher
Janice A. Roman

Publisher
Paul Roman

Cover: There's a magic moment during the turning of a ringed rattle, when the sound of the tool on the wood suddenly changes pitch and the undercut bead of wood breaks free to spin in its own small orbit. Richard Starr caught that moment for our cover photograph. He explains the rest of the procedure on p. 58. Making toys is the subject of a number of articles in this issue.

Fine WoodWorking®

NOVEMBER/DECEMBER 1979, NUMBER 19

DEPARTMENTS

ARTICLES

Fine Woodworking (ISSN0361-3453) is published bimonthly, January, March, May, July, September and November, by The Taunton Press, Inc., Newtown, CT 06470, Telephone (203) 426-8171. Second-class postage paid at Newtown, CT 06470 and additional mailing offices. Copyright 1979 by The Taunton Press, Inc. No reproduction without permission of The Taunton Press, Inc. Fine Woodworking® is a registered trademark of The Taunton Press, Inc. Subscription rates: United States and possessions, $12 for one year, $22 for two years; Canada, $14 for one year, $26 for two years (in U.S. dollars, please); other countries, $15 for one year, $28 for two years (in U.S. dollars, please). Single copy, $2.50. For single copies outside U.S. and possessions, add 25¢ postage per issue. Send to Subscription Dept., The Taunton Press, PO Box 355, Newtown, CT 06470. Address all correspondence to the appropriate department (Subscription, Editorial or Advertising), The Taunton Press, 52 Church Hill Road, PO Box 355, Newtown, CT 06470. Postmaster: Send notice of undelivered copies on Form 3579 to The Taunton Press, PO Box 355, Newtown, CT 06470. (Four-page insert included)

The article on cutting common dovetails in the Eastern European way (Sept. '79) brought back memories to me, and solved a puzzle at the same time. After the fighting ended in World War II, my artillery battalion remained in Wurtemburg and Bavaria for some months, being billeted in various villages. We ordered some ordinary packing boxes from a village carpenter one day and were astonished when they came dovetailed. One of the men I had sent on the box procurement mission told me the cabinetmaker cut out the bottoms of the dovetails with a special saw. I never saw that saw, nor could I visualize just how it could be made, but every time since then that I have cut out the bottom of a common dovetail with a coping saw I have wondered if there might be a better way—and now I see there is.

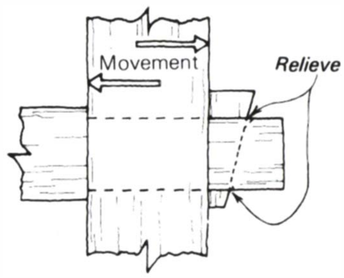
In a quiet way it is a thrill to learn something like this. My stay in Europe made me a devotee of the frame saw, but I never got full advantage of that tool until I read the article by Tage Frid that advocates filing all saws for rip, straight across, and not even turning the blade around. That works beautifully, so well, in fact, that I wonder who ever decided to file crosscut teeth on the diagonal.

—*William G. Raoul, Lookout Mountain, Tenn.*

...Regarding the great seal on the Resolute desk (Letters, Sept. '79), I had thought that the eagle is portrayed looking toward the olive branch in peacetime, and toward the arrows in wartime. I had also noted that a carved eagle on the outside of Hamilton Hall, in Salem, Mass., looks toward the left, toward the thirteen arrows. Hamilton Hall was built from plans by the noted Salem architect, Samuel McIntire, in 1805. So, I got curious and checked with the curator's office of the White House. I was told that until 1945, the eagle on the presidential seal faced toward the left, toward the arrows, for unknown reasons. In 1945, President Truman changed the seal so that the eagle faces the olive branch. There are no plans to turn the eagle's head in times of war.

—*Jacob N. Frederiksen, Chevy Chase, Md.*

You've published some sensible articles on the mortise-and-tenon joints. One point about the wedged or tusk tenon. Relieve the edge of the mortise slightly in these two places—else the wedge may catch and split out the top or bottom of the mortise. A small matter, but the pressures that build up against the wedge during insertion, removal and expansion of the major member are tremendous. During some classic humid Baltimore summers the horizontal wedges in my dining table are literally shot across the room by the expanding pedestal...



—*John D. Alexander Jr., Baltimore, Md.*

Accidents: Five years ago I severed my left thumb while using a radial arm saw as an overarm shaper. A jig clamp failed and dragged a piece of oak, with my hand, through a $3/8$-in. rabbeting bit at 3 HP. Fortunately, I then lived but two blocks from a magnificent surgeon who several hours later put the tattered remains back together and into a cast for many weeks. It works now but weakly, along with loss of feeling. I

Workbench Price Breakthrough!

At Last! A Full-Featured Workbench At An Affordable Price

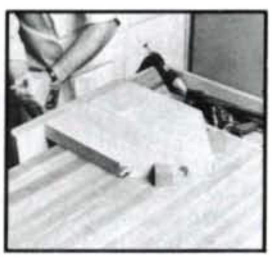
MADE IN U.S.A.

Until now, quality workbenches have usually been too expensive or too small. This huge 225 lb. Garden Way Home Workbench offers a 30″ x 60″, 2″ thick laminated work surface and is available direct from the factory at an incredibly low price. Made of solid rock maple, the Garden Way Workbench not only offers a spacious 12½ sq. ft. of work area, extraordinary sturdiness and clamping versatility, but is a fine precision tool itself that can be as useful as having an extra "pair of hands" helping you in your shop.

Unique Clamping System Holds Projects Dozens of Ways!

Our own "flip-over" vise design with 9″ x 18″ built-up hardwood faces interact with strategically located round dog holes providing secure clamping for a wide variety of projects nearly anywhere on the bench surface—even oversized items such as chairs, full-sized doors—even full sheets of plywood—can easily be secured.

1 "Flip-over" vises provide a solid workstop—yet turn over so top of vise is flush with bench surface for regular vise use.



2 Round dog holes with rotating bench blocks will grip odd-shaped work pieces and eliminate most jigs and fixtures.

3 12½ sq. ft. (30″x60″) of work surface interacting with vises and rotating bench dogs lets you hold large boards and planks — even a 4′x8′ sheet of plywood.

NEW! A Smaller, Lower-Priced Workbench From Garden Way

This new smaller Model B Workbench offers you the ideal worksurface if you enjoy a multitude of crafts instead of just woodworking, or if you concentrate on small projects and large projects are the exception. You'll also find this new smaller Workbench perfect for woodcarving, project assembly, or used as a children's project bench.

- **2′ x 4′ spacious worksurface—a full 8 sq. ft.**
- **Full 1½″ thick laminated "butcher block" top.**
- **Rugged 1½″ x 2½″ rock maple legs, stretchers and stringers.**
- **Powerful 5″ x 18″ maple vises.**
- **Sturdy enough to withstand heavy workshop jobs.**

Which Size Garden Way Workbench is Right For You?

Model A	*Model B*
☐ Size-30″x60″	☐ Size-24″x48″
☐ Weight – 225 lbs.	☐ Weight – 108 lbs.
☐ Height of Work Surface – 34″	☐ Height of Work Surface – 34″
☐ Thickness of Surface – 2″ laminated rock maple	☐ Thickness of Surface – 1½″ laminated rock maple
☐ Total Work Area – 12½ sq. ft.	☐ Total Work Area – 8 sq. ft.
☐ Vises – Two 9″x 18″x1¾″ maple laminate	☐ Vises – Two 5″x 18″x1¾″ solid maple

TO: Garden Way Research
Dept. 9111NW, Charlotte, VT 05445

YES! Please send me free details and prices on the New Garden Way Workbenches, including information on optional Tool Well and Tool Drawer and build-it-yourself Model A Kits.

Name ____________________

Address ____________________

City ____________________

State __________ Zip __________

know now to use eyeglasses, respirators, all available guards and to trust *nothing*. The thumb still hurts in cold, wet weather. —*H. Ivan Hentschel, Kingston, N.J.*

Regarding routing for inlays (July '79), Eric Schramm's article is very fine, but he neglected to mention that his system of template routing will not work on any shape that may involve an angle of less than 90°. Using a small pattern to produce a larger template (with a ½-in. guide) and then reducing the cutting area by using a 1-in. guide will only produce a cut smaller than the pattern whenever an acute angle is involved, i.e., a diamond shape or a triangle...
—*Bob Osbahr, Tucson, Ariz.*

On that reversing motor operation (Methods, May '79), the rating of that switch might cover some ¾-HP motors, but no larger, and would probably be better used on ½ HP or less. For whoever is interested, I can supply Square-D reversing switches at $23.50 ppd. in the U.S. and they are rated 1½ HP at 115V and 2 HP at 230V. They also come with an enclosure, which it appears the one you show may not have.
—*Russ Zimmerman, RFD 3, Box 57A, Putney, Vt.*

Re Norman Capen's tin-can drying oven (Methods, July '79), the proper drying temperature should be 212° to 220°F, in order to eliminate all moisture. At 120°F and a room temperature of 75°F and 50% relative humidity, the equilibrium moisture content is about 2%. The calculation is:

$$MC\% = \frac{\text{initial weight} - \text{oven-dry weight}}{\text{oven-dry weight}} \times 100.$$

—*Eli S. Eisenhard, Boyertown, Pa.*

I have found that after applying a good satin finish varnish, particularly a polyurethane type, that the mixing of a small amount of pumice powder with a heavy liquid paste wax such as Preen really develops a beautiful satin sheen. Rubbing much in the manner of spit-shining shoes, that is, a small cir-

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Required by 39 U.S.C. 3685)

1. Title of publication: Fine Woodworking. 1a. Publication no. 105190. 2. Date of filing: October 1, 1979. 3. Frequency of issue: Bimonthly. 3a. No. of issues published annually: 6. 3b. Annual subscription price: $12.00. 4. Location of known office of publication: 52 Church Hill Road, PO Box 355, Newtown, CT 06470. 5. Location of the headquarters or general business offices of the publishers: 52 Church Hill Road, PO Box 355, Newtown, CT 06470. 6. Names and complete addresses of Publisher and Editor: Paul Roman, Publisher; John Kelsey, Editor; 52 Church Hill Road, PO Box 355, Newtown, CT 06470. 7. Owner: The Taunton Press, Inc., 52 Church Hill Road, PO Box 355, Newtown, CT 06470. Stockholders owning or holding 1 percent or more of the total amount of stock: Paul Roman, Janice A. Roman. 8. Known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None. 9. Not applicable. 10. Extent and nature of circulation:

	Average no. copies each issue during preceding 12 months	Actual no. copies of single issue published nearest to filing date Sept. 1, 1979
A. Total no. copies (net press run)	146,820	167,484
B. Paid circulation		
1. Sales through dealers and carriers, street vendors and counter sales	12,574	13,913
2. Mail subscriptions	117,895	122,608
C. Total paid circulation (sum of 10B1 and 10B2)	130,469	136,521
D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies	665	701
E. Total distribution (sum of C and D)	131,134	137,222
F. Copies not distributed		
1. Office use, left over, unaccounted, spoiled after printing	15,443	30,262
2. Returns from news agents	243	
G. Total (Sum of E, F1 and F2—should equal net press run shown in A)	146,820	167,484

11. I certify that the statements made by me above are correct and complete. Paul Roman, President and Publisher. 12. In accordance with the provisions of the Postal Service Manual, Section 132.121, I hereby request permission to mail the publication named in Item 1 at the phased postage rates presently authorized by 39 U.S.C. 3626. Paul Roman, President and Publisher.

Five major power tools packaged into one unique, big-capacity unit.

Now you don't have to spend a fortune to enjoy a complete woodworking shop

Whether you're an experienced craftsman, a dedicated hobbyist, or a week-end "do-it-yourselfer", at one time or another, you've probably dreamed of owning a complete woodworking shop. And as anyone who has ever tried any woodworking project more complicated than nailing together a birdhouse knows, a table saw and maybe a couple of hand-held power tools just can't hack it!

At a minimum, you should have—in addition to that table saw—a top-quality vertical drill press, a lathe, a boring machine, and a disc sander. So equipped, the world of the true woodworking expert, and all its rewards, becomes your oyster!

But there are two problems. One is space. A woodworking shop with five separate major power tools takes up more space than a lot of people can manage to find in their basement or garage.

The second and larger problem is sheer cost. Those five precision power tools, purchased separately, have got to run you at least a couple of thousand dollars.

The Perfect Answer

Insurmountable problems? Not at all! In fact, some 300,000 woodworkers have already discovered the perfect answer–a single, precision tool that combines all five of the major power tools in one unit that actually takes up less space than a bicycle. . .and that can be yours for about ONE-THIRD of the price of the five separate units!

This is the world-famous Shopsmith Mark V. Invented back in 1953, the time-tested Mark V is the only true multi-purpose professional tool. It's enjoying a remarkable boom in popularity as more and more people discover its amazing versatility, and utter simplicity of operation.

Outperforms Individual Tools

Even if you have plenty of space and an unlimited budget, the Shopsmith Mark V can outperform a shop-full of individual tools. It's unique design not only gives you greater accuracy and more convenience-it allows you to do things you just can't do with other power tools.

This truly ingenious woodworking system combines a 10" table saw, a 12" disc sander, a horizontal boring machine, a 16½" vertical drill press, and a 34" lathe—all powered by a rugged 13.5 amp, 110-volt motor that develops 2 h.p. That's more than enough power for the toughest jobs. And an exclusive speed dial even lets you change operating speeds without turning off the motor.

After only a half-hour of practice, even a novice can change over from one tool to any of the other four tools in less than 60 seconds.

With the 5-in-1 Mark V, you can perform literally dozens of sophisticated woodworking operations—including sawing, rabbeting, beveling, mitering, grooving, concentric drilling, spindle turning, doweling, edge sanding, and metal drilling. With optional accessories, you can perform more specialized operations such as mortising, dadoing, shaping, routing, molding and many others.

And the Shopsmith Mark V is so simple to operate that even beginners can easily build their own furniture and cabinets, make gifts, and do money-saving home repairs and complex remodeling projects. The skill. . .and above all, the accuracy. . .are built into the machine.

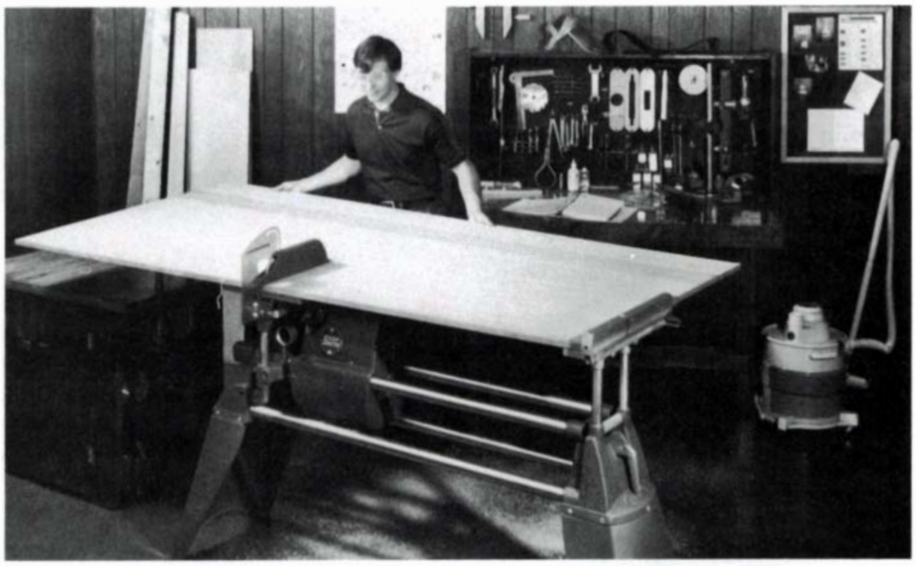
Send Today for Free Facts

And now you can use the coupon below to receive, by return mail, an informative free booklet, "What to Look for When You Buy Power Tools", plus all the facts about the Shopsmith Mark V and its "big-job" capabilities-and how you can actually test-use it in your own home without risk, for a full month.

There's no cost or obligation for this free information. It can help even inexperienced amateurs become skilled woodworking experts whose projects show a professional touch. For the real craft "buff", it's the low cost answer to a lot of frustrating problems.

Shopsmith

Dept. 1969. 750 Center Dr., Vandalia, OH 45377



The Mark V as a 10" table saw offers a 3¼" depth-of-cut with a 48" ripping capacity. The exclusive Speed Dial permits power sawing of hardwoods.

The Mark V as a 12" disc sander gives you operations not possible on other sanders. . .like finishing edges to precise dimensions.

The Mark V as a lathe offers exceptional capacity with a 16½" swing for face-plate turning. Speed Dial allows a speed range of 700 to 5200 rpm.

The Mark V as a horizontal boring machine permits perfect doweling. The exclusive feed stop assures all holes will be exactly the same depth.

The Mark V as a 16½" vertical drill press can be set up to drill perfect screw pockets. The Mark V has an accurate depth control dial, ready make jigs, and the right speed for every operation.

Shopsmith Inc.

Dept. 1969, 750 Center Drive, Vandalia, Ohio 45377

Yes, please mail me your **Free Information Kit** on the Shopsmith Mark V. I understand there is no obligation and that no salesman will visit.

Name ____________

Address ____________

City ____________

State ________ Zip ________

cular motion, then buffing with a soft rag, really brings up the finish.

A tip from an old local cabinetmaker for disc sanders: Sandpaper can be quickly and securely stuck to the disc by using old-fashioned water glass. This can be found in most drugstores, and if they don't stock it most will be happy to order it for a customer. Simply apply it to the disc and press the paper to it and hold in place for a few minutes. Presto—no more flying discs or sticky, hard-to-remove adhesives. *Edward A. Lenz, Saratoga Springs, N.Y.*

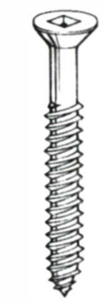
It's amazing how many little tricks and tips we use in woodworking without realizing that we use them until someone else points them out to us.

Your magazine recently mentioned that sheet-metal screws are superior to wood screws. I've been using them for years but only think of telling anyone when I see him break off a wood screw trying to tighten it.

But I do have a question on the subject. Brass screws are even more notorious for breakage, and I have found no substitute. Does anyone know if these stronger sheet-metal screws are available in an "anodized" form, or of any process whereby they look good? The shiny silver screws in an exposed location simply don't make it.

—C. Housego, Milton, Wash.

My father suggested to me the idea of using a Robertson screw as a fastening device. It is similar to the Phillips screw, but may have some advantages.



First, the Robertson has a square hole in the flat head of the screw. The Robertson screwdriver fits rather snugly into the screw so that once positioned on the screwdriver, the screw will not slip off, thereby freeing one hand. An important advantage is that maximum turning pressure may be applied and the screwdriver will never slip from the square hole. Bits are available for variable speed drills. As noted, the threads come partially up the shank, similar to the wood screw, so that the screw will not be bound up by the threads as it passes through the first piece of wood. . . .

—Rob Sheppard, Calgary, Alta.

I would like to offer my contribution to the continuing controversy on how to screw two pieces of wood together:

I use two drills in combination, one fitted with a Screw-mate to drill the pilot hole, clearance hole and countersink simultaneously; the other fitted with a screwdriver bit. The first drill is an inexpensive ⅜-in. drill. (It has, by the way, the collar of a Portalign drill stand permanently installed on it, so that I need only slip the stand itself onto the collar to ensure the trueness of a hole drilled away from the drill press.)

A #8 Screw-mate, set to drill a 1½-in. pilot hole and a ½-in. clearance hole, is used to fasten any ½-in. thick stock or plywood. A #10 drills a 2-in. pilot hole and a ¾-in. clearance hole for fastening any ¾-in. thick stock. It makes no difference whether you use wood screws or sheet-metal screws. You need to stock only two sizes of screws: 1½ in. x #8 and 2 in. x #10. Sometimes 1 in. x #8s come in handy. It is usually unnecessary to readjust the Screw-mate for them.

The second drill is a variable-speed reversible drill, fitted with a standard or Phillips bit—either can be a screwdriver with the handle cut off. Pulsing the trigger intermittently facilitates control without sacrificing speed.

The system is especially advantageous when you need to hold a board in place, drill and screw one end, check or adjust

Woodworking books extraordinary...

THE IMPRACTICAL CABINETMAKER

James Krenov. Completing a trilogy that includes *A Cabinetmaker's Notebook* and *The Fine Art of Cabinetmaking**, master cabinetmaker James Krenov has written a book that provides a wide scope of useful information and relevant reflections. Concerned as always with the personal experiences of his fellow craftsmen, Krenov discusses the careful fitting of doors, the making and use of what he calls "real" veneer, basic considerations about working with solid wood, and the challenge of making showcase cabinets. He thoroughly describes the step-by-step making of a very special chess table as well as his adventures in "composing" several other pieces — among them, a sensitively proportioned writing table and a whimsical showcase cabinet made with precious woods. Through example and anecdote, Krenov brings us into his workshop and shares with us what has been called "the tingling reciprocal relationship between inspiration and result, doubt and decision, and anxiety and elation." "There are too few woodworkers who work with Krenov's uncompromising quality and intense sensitivity." *— Craft Horizons (American Craft)*

164 pp., 220 illus., 4 pp. in color, 8½ x 11, $16.95

THE FINE ART OF CABINETMAKING

James Krenov. Here are the actual techniques that James Krenov uses to create his museum-quality cabinetry. In his own highly individual way he covers everything from choosing wood to coopering, doweling, and dovetailing, from frame and panel work to drawer latches, hinges, and handles, from hand and power tools to making a plane and sanding. "Krenov has done it again! He has written a remarkable book on wood."
— The Working Craftsman

192 pp., 300 illus., 8½ x 11, $15.95

***SPECIAL OFFER:** *Order the Krenov Trilogy and save $6.45 on the combined price of the individual books. Books may be purchased separately as well. See coupon below.*

A CABINETMAKER'S NOTEBOOK

James Krenov. A master craftsman discusses and illustrates his unique approach to cabinetmaking and shows why his artisanry is regarded as the finest of its kind today. "There are too few woodworkers who work with James Krenov's uncompromising quality and intense sensitivity. He loves wood; loves to work with it, and is selective and skillful with his words about it."
— Craft Horizons

132 pp., 188 illus., 13 color plates, 8½ x 11, $13.50

WOOD TURNING

Stephen Hogbin. Stephen Hogbin is an innovative and revolutionary craftsman who makes functional and sculptural objects on a wood-turning lathe. *Wood Turning* is a rare glimpse of a master craftsman at work pursuing the potential of his raw material — native Australian wood — as an aesthetic statement, from designing and re-forming an object through its completion. Illustrated are more than 50 of his beautiful pieces, including bowls, a bird-shaped table, a ceremonial gavel, abstract forms and more. *96 pp., illus., including 8 pp. in color, 8½ x 11, $14.95*

COUNTRY INSTRUMENTS
Makin' Your Own

Andy DePaule. Using woodworking tools and several other instruments — such as a bending iron and a circle cutter (which the author shows how to make) — ordinary lumber can be transformed into a personally designed and decorated guitar, fiddle, dulcimer, or mandolin. Clear photos and diagrams demonstrate the tools and techniques needed, and a special foldout pattern is included that diagrams the actual size and shape of instrument pieces. *208 pp., illus., 5¼ x 8¼, $5.95 paper*

RUSTIC FURNITURE

Sue Honaker Stephenson. The natural quality of wood — gnarled roots, unfinished limbs — predominates in rustic furniture. In this delightful book, Sue Stephenson shows how easy it is to make chairs, tables, and other items from unhewn and unfinished woods. She explains general principles of designing rustic furniture and specifies what materials to use; how to bend, preserve, and season wood; how to find materials; how to weave rattan seats; and much more.

128 pp., 160 illus., 8½ x 11, $15.95

AMERICAN SHAKERS AND THEIR FURNITURE
With Measured Drawings of Museum Classics

John G. Shea. All about the Shakers and their remarkable workmanship. Describes and illustrates not only the larger pieces, but also small craft and utility designs. Museum-measured drawings make it possible for the home craftsman to make exact reproductions of classic designs. "A welcome and valuable source of information . . . indispensable to anyone interested in Shaker furniture."
— Fine Woodworking

224 pp., illus., 8½ x 11, $16.95

VNR
Van Nostrand Reinhold
Mail Order Service
7625 Empire Drive
Florence, Kentucky 41042

Please send me the books checked at right on 15-day approval. At the end of that time I will pay the purchase price plus postage and local sales tax, or return the books and owe nothing. (Offer good in U.S. only and subject to credit department approval. Payment must accompany orders with P.O. box addresses.)

Name ______________________

Address ______________________

City ______________________

State ______________ Zip ______________

☐ **SAVE!** Check here if enclosing payment with order and publisher pays postage and handling. Same 15-day return-refund guarantee. Be sure to add local sales tax.

____	**24521-1**	**The Krenov Trilogy (includes *The Impractical Cabinetmaker, The Fine Art of Cabinetmaking,* and *A Cabinetmaker's Notebook*)**	**$39.95**
____	24558-0	The Impractical Cabinetmaker	16.95
____	24555-6	The Fine Art of Cabinetmaking	15.95
____	24551-3	A Cabinetmaker's Notebook	13.50
____	25775-9	Wood Turning	14.95
____	26117-9	Country Instruments ... paper	5.95
____	27974-4	Rustic Furniture	15.95
____	27541-2	American Shakers and Their Furniture	16.95

Prices subject to change

F 7524

the alignment of the other end and drill and screw it, and finally add a series of screws between for strength.

—*Timothy Howe, San Francisco, Calif.*

Lelon Traylor's shaper spindle assembly design (July '79) . . . stresses the precision machining of the spindle and then proceeds to throw it all out by crudely assembling the spindle in pillow blocks whose bearing center-to-base dimension tolerance is questionable, to say the least, and finally, by mounting the assembly on wood.

—*Frank Culmone, Westbury, N.Y.*

Traylor replies: Self-aligning ball-bearing pillow blocks will operate on an uneven surface as well as on ground surfaces because of the self-aligning factor. The outer race of the ball bearing is spherical through the axis of the bore. It can be turned 90° and removed from the cast-iron housing for replacement.

The accuracy we are concerned about isn't absolute precise vertical alignment, but rotary accuracy. In order to get this rotary accuracy, one must proceed as I pointed out in the article. Industry uses literally millions of pillow blocks, many mounted on welded or fabricated structures or frames. Farm machinery uses many such bearings mounted on uneven surfaces. If a very high RPM is involved, then one is compelled to have a very close fit between the shaft and bearings, otherwise two things will happen. First, you will get vibration because the center of mass is thrown off balance, and second, the bearing will work itself loose from the shaft. Bearings designed with set-screw locking systems are worse about this than the Fafnir type, which use the cam-ring locking system.

Self-aligning ball-bearing pillow blocks go well with fabricated designs. Bolted and pinned in place they will last indefinitely. . .If you've never built anything using pillow blocks you will be amazed at the time saved. At one time I precision-bored all my housings, very carefully dial-indicating the second end with the first, complete with retaining rings, etc.; it was quite a job.

I enjoyed reading Tage Frid's article on solid doors (July '79). However, I would go about drilling the holes for the through-bolted door in a different manner. It is difficult to bore through a board edgewise and have the drill come out dead center on the opposite edge. If not, the boards won't align in the same plane when assembled. It is better to drill in halfway from each edge.

First, before routing the grooves for the splines, dry-clamp the door together and mark on the top along where each bolt is to lie. Unclamp and square the lines down on each edge. Spot with a punch the center of those edge marks to give a place to start your bit. Lay the first board flat on the bench and clamp a straightedge along one of the bolt lines, hanging out past the edge about 8 in. Using the straightedge to align the drill (another person to help sight is handy but not necessary), bore halfway into the board. Repeat for the rest of the holes on that edge, then turn the board around and bore halfway in from that edge, meeting the first holes dead on. It's not a calamity if they're off a bit. Do the other boards similarly. Plug the holes where the nuts will go and countersink. Rout for the splines.

This is the method used in the boatbuilding trade, especially for large, flat surfaces such as rudders and centerboards. Bell-hanger's bits work well, but those ⅜ in. and larger require a ½-in. drill with a lot of torque. A ship auger with screw seems to have an easier bite. They're made by Greenlee.

—*Charles Durfee, Cushing, Maine*

Re "Finishing Materials" (July '79): After trying many ways to obtain a hard, glossy sheen with natural oil finishes, I followed some advice from an 80-year-old woman. Place the piece in the sun just after application of the oil. Some experi-

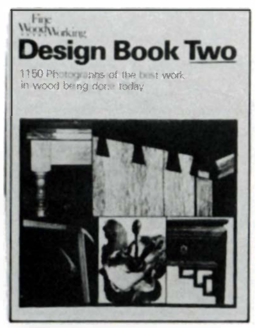
The better you are, the more there is to know.

Start your Fine Woodworking Library— a shop reference like no other.

Don't miss the pleasure you'll get from *books* that can help you expand your knowledge and appreciation of working with wood, just as *Fine Woodworking* magazine does. They're the Fine Woodworking Library, unusual books from The Taunton Press. All are filled with crisp photographs that bring out the loving detail master woodworkers delight in.

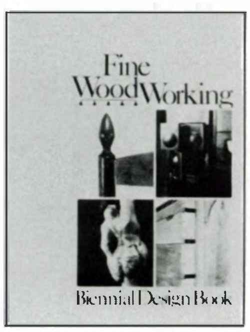
Design books: the state of the art in America

Both of the design books in the Fine Woodworking Library are a joy just to leaf through. . .likely to start you dreaming of new projects. Both are exciting galleries of the finest woodwork being done in America today. *Design Book Two,* just published, contains 1150 striking photographs of work by 1000 gifted woodworkers. You'll turn to this volume again and again for challenge and inspiration. *Design Book Two* even includes a directory of these outstanding fellow craftsmen.



NEW

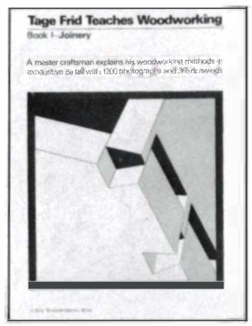
And no serious woodworker should be without the first *Biennial Design Book.* Already a classic, with 60,000 copies sold to date, it includes 600 photographs of beautiful things in wood—from the chaste elegance of a pearwood side chair to the whimsy of a kinetic sculpture.



Technical books: creative woodworkers' best helpers

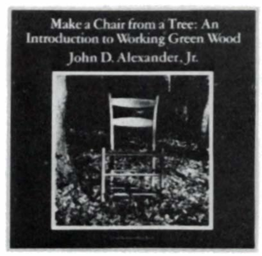
The three workshop books in the Fine Woodworking Library show how readable technical information can be. They're full of solid expertise, carefully presented with all the illustrations, diagrams and charts you could ask for.

Just released is the first of three books by Tage Frid, the dean of woodworking teachers and a contributing editor to *Fine Woodworking.* Frid's experience is just too rich and varied ever to be captured completely in the magazine's pages. So he's written this book on tools and joinery which shares many of the ingenious methods he's learned. It includes 900 step-by-step photographs and 365 drawings—everything he's found necessary and useful on these subjects in his 50 years of cabinetmaking.

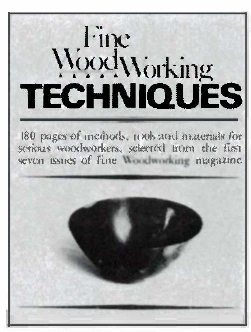


NEW

Fine Woodworking Library books also break into new areas. Take John Alexander's book on working green wood. Alexander is a serious student of the old ways of working wood—taking it directly from the tree and shaping it into useful objects before it has a chance to dry. *Make a Chair From a Tree* focuses on a simple but elegant chair, but the information and techniques it presents have much wider application.



Finally, there is *Fine Woodworking Techniques*, a collection of all the technical articles from the first seven issues of *Fine Woodworking* magazine. It's important, but hard-to-come-by information, and we want to make sure it stays in the literature. It would be a shame to have to rediscover it all again some day.



The Fine Woodworking Library will keep on growing. Coming next spring is a book on wood by contributing editor Bruce Hoadley. So be good to yourself. Use the handy order form bound into the magazine, or write to:

The Taunton Press 52 Church Hill Road, Box 355C4, Newtown, Connecticut 06470 menting gave me good results. Depending on the wood, I put one or two coats of tung oil or linseed thinned with turps and white vinegar. I allow the initial coats to dry slowly in the shop. After a final full-strength coat I put the piece in direct sun. In 20 to 30 minutes I check for excess and wipe with a clean cloth. In an hour or so the piece is finished. The heat of the sun sets the oil, producing a hard, varnish-like sheen. Both old and new wood take this natural finish beautifully.

—Renato De Rita, Broomall, Pa.

I was somewhat surprised by an item in your July '79 issue. In "Editor's Notebook" you dealt with some matters having to do with dangers in the shop. Yet on p. 71 ("Precision," by Fred Johnson) you presented an item on ice-pick technology that even points out the fact that the pick can come in contact with the blade, an observation that seems perfectly apparent to me. It is further apparent that if the pick comes in contact with the moving blade, there exists the distinct possibility that the pick is sent flying across the shop, either towards a bystander or back towards the operator. A flying ice pick is a lethal weapon, and it would appear that the procedure is fraught with danger. . . .

—J. Philip Bromberg, Philadelphia, Pa.

Johnson replies: I would like to relay a discussion that I had with Harry Hintergard, our head die-maker. I asked Harry how long he has been using ice picks to push wood past cutting blades, and how often the ice pick comes in contact with the blade. He said that they were using ice picks in the steel-rule die-making trade when he apprenticed over 30 years ago. He knows of no one ever getting hurt by an ice pick contacting a blade. To the best of his knowledge, there have been three times in the last fifteen years that ice picks have been run through cutters and the results have been damaged cutterheads and ice picks. He says the reason they use ice picks is to save hands when cutting small stuff.

I have seen an ice pick thrust into the blade of my 10-inch Powermatic table saw. A friend was using it to rip the shaped edge off of an oak plank. When the pick hit the blade, sparks flew, the ice pick lost about ¼ in. off of its tip, which went through the table slot, and the blade was in serious need of resharpening. As he stood there with the broken ice pick in his hand, we were frightened at the thought that but for the ice pick, his momentary inattention would have cost him dearly. . . . If the ice pick is held firmly in the hand. . . there is no way to lose it so that it can be "sent flying across the shop."

John S. Carroll writes (Letters, Sept. '79) that the top tread of my library steps, described in *Fine Woodworking*, July '79, is weak and should have been joined in some other way. Well, the proof of the pudding is in the eating—or in this case, the standing. The steps are still giving good service and here's why: The maximum allowable shear stress parallel to the grain for black cherry averages 1,415 pounds per square inch and across the grain considerably more. Taking this figure and multiplying by the total area of the pins (on both sides) I arrive at 3,113 pounds—a ton and a half—as the maximum load on the top tread. An adequate factor of safety, even for a civil engineer.

As for Carroll's suggestion that the top tread should have been "fastened on in exactly the same manner as the other two steps," I can't visualize two non-intersecting surfaces being joined by a wedged mortise-and-tenon joint. True, the top tread could have overlapped, but then it would have been Carroll's design, not mine.

My stress data is from *The Wood Handbook* put out by the Forest Products Laboratory and available from the U.S. Government Printing Office, Washington, D.C. It is well indexed and contains a great deal of useful information.

—Simon Watts, Putney, Vt.

Table-saw sliding crosscut fixture

Crosscutting wide panels using the table saw's miter gauge is awkward at best. Faced with a project requiring accurate crosscuts on 2-ft. wide, 6-ft. long panels, I investigated commercial sliding-table crosscut setups. Finding these too expensive for the flexibility and accuracy delivered, I designed and built an inexpensive all-wood sliding crosscut fixture. It's quite accurate and, depending on how it's mounted, has the capacity to crosscut pieces over 4 ft. wide.

The fixture consists of three parts: a sliding table, a guide bed and a support stand. For stability, I selected mahogany for the solid-wood pieces and ¾-in., 14-ply aircraft plywood for the table and guide bed; any good-quality hardwood and hardwood plywood could be substituted. You'll need a 4x4 sheet of plywood and several 4-ft. lengths of hardwood in various dimensions for the sliding table and guide bed. Make the support stand from pine or whatever is available.

The guide bed attaches to the left side of the table saw (in place of the left extension wing) using existing mounting holes and hardware. The mounting bracket for the bed also doubles as a retainer hook to keep the sliding table from tipping with long, heavy pieces. A guide rail on the bed keeps the sliding table parallel to the sawblade.

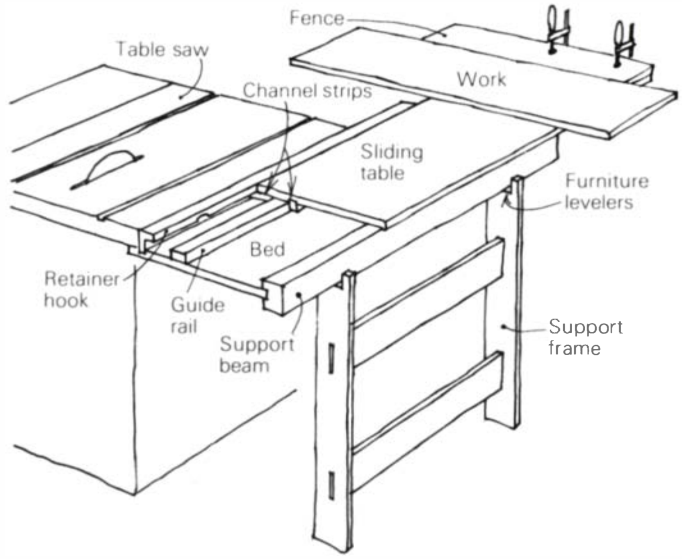
The sliding table is a plywood panel with two strips on its bottom to form a channel for the guide rail. One of the channel strips doubles as a lip to fit under the bed's retainer hook.

The support stand is an *H*-frame dimensioned to support the bed. I used mortise-and-tenon construction. Furniture levelers in the top give needed adjustment capability.

To construct the fixture, first rip the bed, table and retainer hook strips from the plywood. Glue up the retainer hook and glue and screw it in a dado cut in the bed. Cut a groove in the support beam and install it on the left edge of the bed with glue and screws. Cut the guide rail to size but save the installation for later.

Next, cut a dado in the bottom of the sliding table and mount the left-hand channel strip in the dado, screwing from the bottom without glue so the strip can be replaced when worn. Now, to set the channel gap accurately, place the guide rail temporarily against the left-hand channel strip and glue the right-hand channel strip in place on the table bottom.

Complete the support stand, mount the bed to the saw and



level it, using the furniture levelers between the stand and the support beam. Set the sliding table in place and shim out 1/16 in. or so from the retainer hook. Now slide the guide rail into its channel and carefully fasten in place with screws through the bottom of the bed. To complete the fixture, paraffin all contact surfaces to cut down friction.

You can mount a permanent fence to the sliding table top. (Be sure to shim it off the table slightly so it won't catch on the front of the saw table.) I've found it convenient, however, to use temporary fences clamped to the sliding table. The gap between the bed and table leaves plenty of room for *C*-clamps or sliding clampette heads. To square a temporary fence, push a scrap of wood of the right thickness into the miter-gauge channel and use a framing square.

I mounted the fixture so that the back of the base lines up with the back of my saw. Although this gives maximum capacity, it is slightly inconvenient because the fixture projects about a foot in front of the saw. Others may want to consider shortening the fixture (thus lessening capacity) or mounting differently to minimize inconvenience.

—*Roger Deatherage, Houston, Tex.*

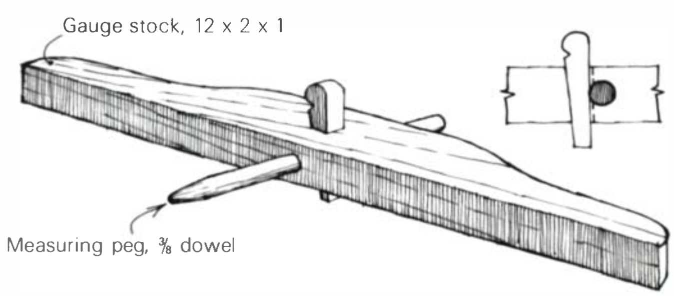
Protecting sawblades

Plastic backbone strips (sold by office-supply stores for binding reports) make inexpensive but effective sawblade guards. Cut a strip to length with a razor blade. If a longer strip is needed, epoxy two strips together using a short portion of the strip for reinforcement at the joint. The backbone grips the blade and will not fall off easily; to remove the strip, just slide it forward. —*B.A. Cartwright, Milwaukee, Wis.*

Bowl-turning depth gauge

When turning a hollow, as for a bowl, it is difficult to estimate how deep a cut has been taken. Although the best curves may be made by eye, it is necessary to know the depth to check on the remaining thickness of wood and avoid turning through. A ruler can be held against a straightedge across the rim of the bowl, but that is an improvisation. The tool described here is a more efficient way to check depth.

Make the stock wide enough to span the largest-diameter bowl your lathe can turn. The base must be flat. The other



parts can be shaped as you wish, but edges should be rounded for a comfortable grip. It is easier to get the peg hole perpendicular to the base before other shaping is done. The wedge hole can be cut at the same time.

The peg may be a length of dowel rod. Its working end should be slightly tapered and finished with a little doming where it will touch the bowl.

The slot for the wedge has to be made with its edge cutting through the peg hole by a small amount, so pushing the wedge in tightens it against the peg. An overlap of 1/32 in. should be enough. Make the wedge and measure the thickness of the stock centrally on it. From the distance across the

Unicorn Universal WOODS Ltd.

SPECIALTY FOREIGN & DOMESTIC HARDWOODS & SOFTWOODS VENEERS

LUMBER FOR EVERY WOODWORKING APPLICATION

OVER 80 SPECIES AVAILABLE:

EUROPEAN BOXWOOD • ENGLISH BROWN OAK
PERNAMBUCO • CORDIA • ROSEWOODS • EBONY
ENGLISH CHESTNUT • LABURNUM LOGS • EUROPEAN PLUM

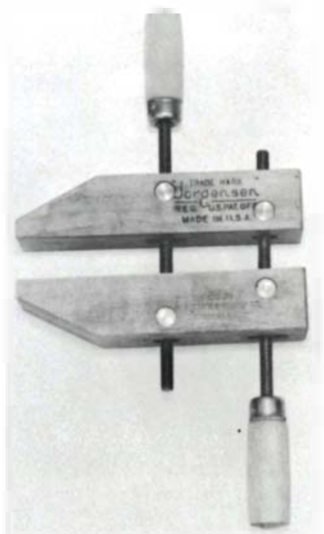
AIR DRIED & KILN DRIED FLITCH CUT LOGS
COMPREHENSIVE STOCK AVAILABLE FROM 1" TO 6"

WRITE FOR FREE PRICE LIST
MINIMUM MAIL ORDER $100.00

137 JOHN STREET, TORONTO, CANADA M5V 2E4 · 363-1161

HANDSCREWS!

Although handscrews are among the most versatile clamps in a cabinet shop, they haven't changed much in 200 years. The non-marring jaws of these are of fine hard maple and the steel screws are handled with reinforced hardwood. The swivel nuts in the jaws are the one innovation your ancestors didn't have and they add significantly to versatility. The jaws may be set parallel or, if required, askew. Thus, you can distribute pressure narrowly or widely and you can clamp angled workpieces.



	Jaw Size	Open Size	
30010	4"	2"	$ 7.80
30020	5"	2½"	$ 8.40
30030	6"	3"	$ 8.90
30040	8"	4½"	$10.75
30050	10"	6"	$12.30
30060	12"	8½"	$14.10
30070	14"	10"	$17.90
30080	16"	12"	$23.10

**Estimate Shipping Charges ($1 to $3 in U.S.)
We'll Refund Excess**

**Send 50¢ for our 1979 Catalog
(free with order)**

Californians add 6% sales tax

FAIR PRICE TOOL CO.

P.O. Box 627Q, La Cañada, California 91011

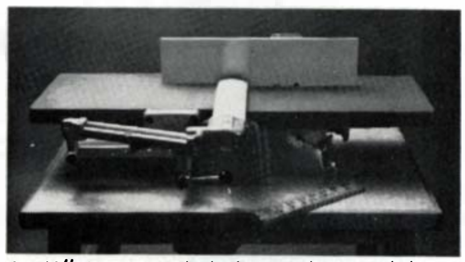
If you thought "Swiss-Precision" could only be found in watchmaking, then you don't know about our power tools.

Only you know how good your tools have to be. When it comes to woodworking machinery, they should be better than you are—even if you're already an accomplished craftsman. Therefore, you owe it to yourself to learn more about our Swiss-made line of INCA stationary power tools which we sell throughout these 50 states.

Take the 10" Cabinetmaker's Saw, for example. It has a 20mm (25/32") arbor at the blade for strength and rigidity where it counts. The table castings are tough, precision milled alloys and the guide rails are aircraft quality extrusions. All the major rotating parts are dynamically balanced. The bottom line is a machine that takes higher loadings and gives you less vibration with a truer running saw blade.

If fact, every one of our INCA saws, jointers, planers and shapers are built to quality standards which are becoming increasingly hard to find in this country. That's because they're made with the same pride of workmanship as the Swiss put into their watches.

Our catalog is a good place to begin your comparisons. We want you to be as good as you can get.



8 5/8" Jointer with thickness planing ability

GARRETT WADE COMPANY · The Yankee Ironman · INCA

Garrett Wade Company, Dept. FW-11-9
302 Fifth Avenue, New York, N.Y. 10001
National Distribution

Gentlemen:
☐ Send me your INCA catalog. Enclosed is $1.
☐ Here's another $1 for your 108-page catalog of quality hand tools.

Name________________
Address________________
City________ State________ Zip______

wedge at these points, mark the width of the hole at each side. The ends of the wedge can be rounded and decorated, but a plain wedge works just as well.

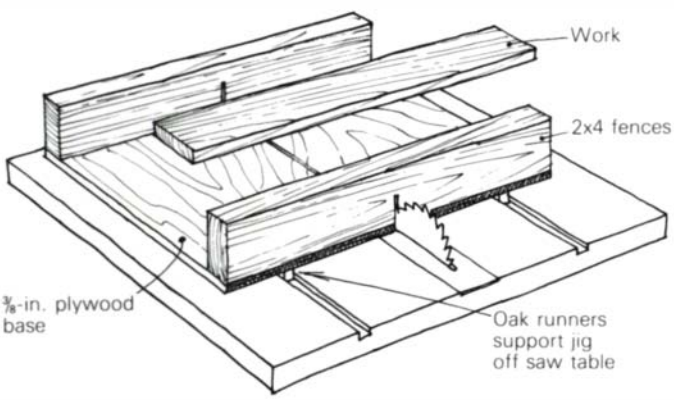
—Percy W. Blandford, Stratford-on-Avon, England

Cutoff box

This easy-to-build box is superior to the miter gauge for simple 90° cutoff work on the table saw. Right-angle accuracy is built into the fixture; there's no adjustment necessary. Also, because the work is supported on both sides of the cut, there is none of the creeping that plagues cutoff work with the miter gauge.

Although the size of the fixture is discretionary, I suggest you make it just a little smaller than the table-saw top. For a typical saw this will give you room to handle work that's 18 in. to 24 in. wide. Make the bed from ⅜-in. plywood and the fences from 2x4s. Glue and screw the fences to the bed (avoid putting a screw in the path of the blade). Cut the oak runners so that they slide easily in the miter gauge tracks and support the bed about ¼ in. off the table. Be very accurate in attaching the runners and you'll always get a square cut.

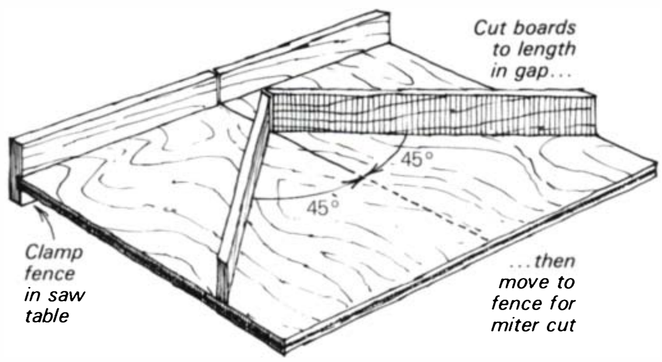
—Jon Gullett, Washington, Ill.



Improved miter fixture

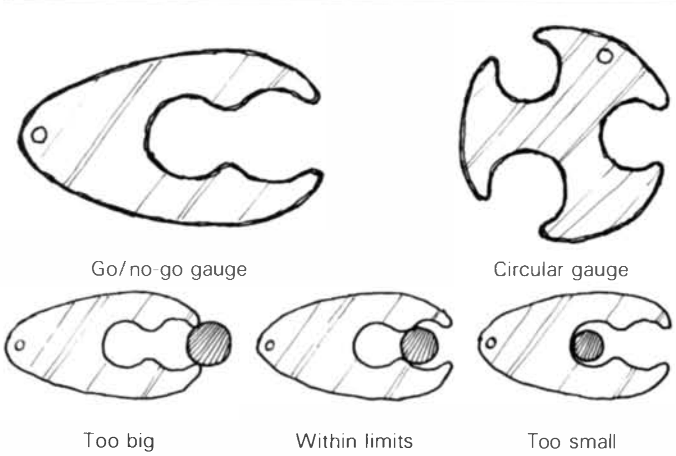
C.H. Dimmick's miter fixture for the radial arm saw ("Methods of Work," May '79) is very useful as described. But by leaving a 4-in. gap between the fence and the 45° guides, boards can be cut to length, then shifted to the 45° guides for mitering. Without the gap, the boards can be cut to length only by using another saw or by removing the jig.

—M.B. Williams, Potomac, Md.



Go/no-go turning gauges

When turning spindles, finials and other pieces having several diameters, it is frustrating to have to reset a caliper to



each of the different dimensions—especially when multiple parts are required. The metalworking industry uses "snap gauges" or "go/no-go" gauges to solve similar problems.

A snap gauge is one whose points are fixed at a given dimension. In precision metalworking, tolerances of ten thousandths of an inch are not uncommon. In woodturning the dimensions are not that critical, and a gauge can be readily made to within 1/64 in.

More commonly, a snap gauge is made with two pairs of points and is called a go/no-go gauge (also a limit gauge or snap-limit gauge). Each pair of points is fixed at different dimensions. The difference between the two dimensions is the tolerance of the dimensions of the workpiece. This is especially handy when turning tenons or dowels.

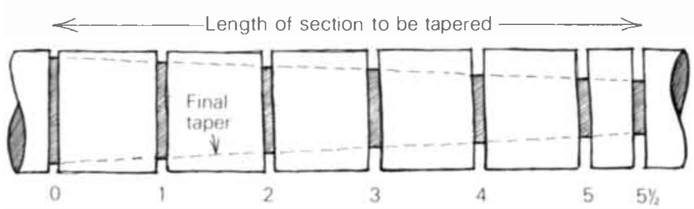
If you have a good eye for turning and prefer a single set of points (as normally used with a standard outside caliper), several gauge variations are possible. A circular gauge, for instance, can be made to include all dimensions (three in the example shown) for a given turning. Or, a whole set of gauges with, say, 1/16-in. increments can be made.

Infrequently used gauges can be made of ⅛-in. tempered Masonite, but Masonite will wear rapidly if used while the work is turning. For a permanent, accurate gauge (with a touch of elegance) make the gauge from 1/16-in. or thicker hard sheet brass. Mark the size on each set of points and see what a difference a gauge makes. (See also John Rodd's gauges, pp. 74-75.) —*John R. Beck, DeKalb, Ill.*

Turning long tapers

Here is an easy way to turn long tapers on the lathe. First, turn the workpiece to a smooth cylinder and mark the length of the taper. With a parting tool, cut the larger diameter on one end and the smaller diameter on the other. Set your outside calipers to the larger diameter and scribe a mark on the caliper knob (so you can count the knob's rotations later). Move the caliper to the smaller end and count the knob rotations as you close the caliper to the smaller diameter.

Suppose, for this case, you counted 5½ rotations. Divide the length of the workpiece into 5½ parts, mark each division with a pencil and return the caliper to the diameter of the larger end. Turn the caliper knob one rotation. This will be the correct diameter at the first line. Use the parting tool to



Divide length into caliper knob rotations (example: 5½)

turn the workpiece down to that caliper setting at the first line. Then turn the caliper knob one more rotation and repeat at the second line. Continue the process across the workpiece. Complete the taper with a gouge or skew, using the parting tool cuts as a guide.

For a long, flat taper it might be necessary to base the divisions of the tapered length on half or even quarter-rotations of the caliper knob. This will keep the divisions closer together and facilitate the job of cutting the taper between grooves. *—Frederick C. Weisser, Houston, Tex.*

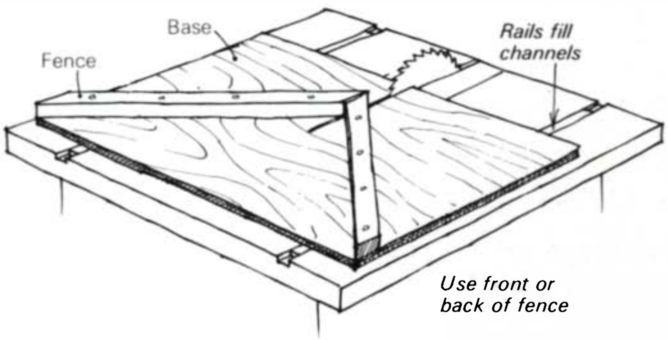
Two table-saw miter jigs

This table-saw jig, below, has helped me to cut accurate miters for 25 years. To make it cut two table-length rails from well-seasoned oak or hickory and sand to a sliding fit in the miter-gauge channels. With the rails in place in the channels, set the ½-in. plywood base (cut a little smaller than the saw table) on the rails so that the midpoint of the forward edge is aligned with the sawblade. Fasten the base to the rails with ¾-in. flathead screws. Now slide the jig back, raise the sawblade and saw into the jig 3 in. or so. From the center of the kerf, extend the saw-line to the back side of the jig. Mark two lines 45° from the saw-line with a draftsman's triangle and fasten the two 1-in. wide fences on the lines with screws.

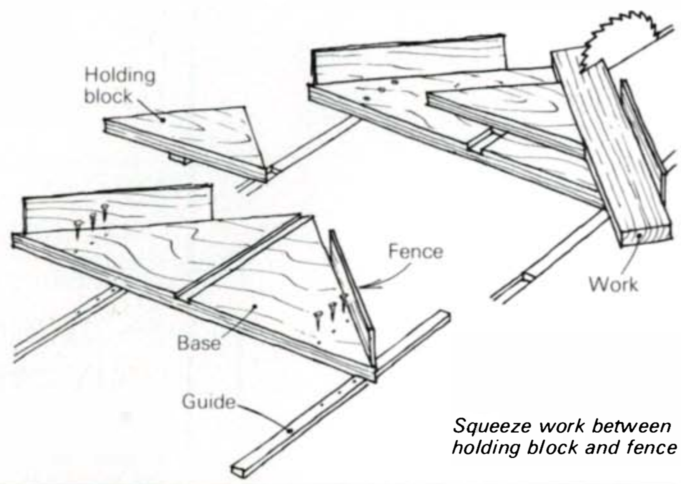
Ordinarily, I use the front edges of the fences to hold the pieces to be cut. But to cut, say, the four pieces for a picture frame, cut the pieces square to length plus twice the thickness of the saw kerf and use the back edges of the jig fences. One fence aligns the work, the other serves as a stop.

—Bayard M. Cole, Marietta, Ga.

I use a table-saw miter jig that includes a holding block in a channel, shown below, to press the work against the fence. Be sure to cut the holding block large enough to secure the



Use front or back of fence

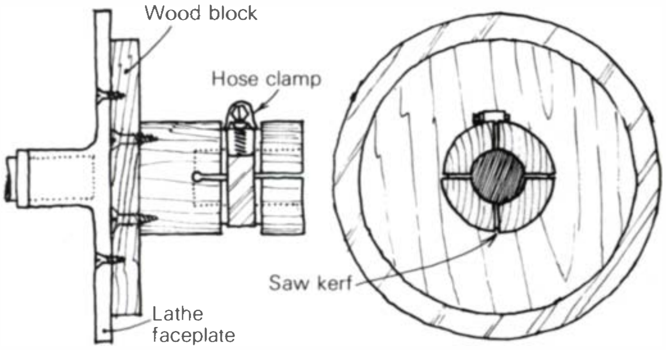


Squeeze work between holding block and fence

stock against the fence and to keep your fingers away from the blade. —*John C. Ort, Portsmouth, R.I.*

Hose-clamp lathe chuck

This lathe chuck uses an inexpensive worm-gear radiator-hose clamp to tighten the collar around the work. Four saw kerfs provide the flexibility needed for loosening and tightening the chuck. —*Ernest Moyer, Royersford, Pa.*



Jointing circular-saw blades

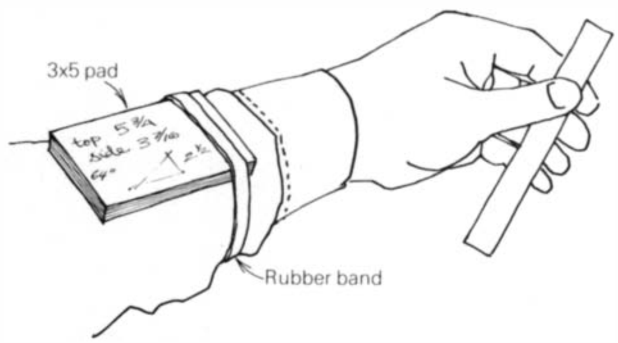
For a circular saw to cut with all of its teeth, it must first be jointed and thereafter mounted the same way every time.

To joint, mount the blade with the trademark up. Then tighten so that all the slack between the arbor and the saw-hole stays opposite the trademark at top. It is a good idea to mark the arbor too, so you can also keep it always in the same position when mounting. With the saw running, slowly raise the blade into a grindstone lying flat on the table surface. When you've gotten a shine on all teeth, carefully sharpen each tooth (file or grind) until the shine disappears. When you return the blade to the machine, always mount it with the trademark up. The blade mounted in any other way will run in an orbital pattern; only a few teeth will cut.

I always joint and file even new blades—they need it as much as used blades. —*Norman Brooks, Greenville, Pa.*

Are you taking notes?

A small 3x5 pad of paper anchored to the wrist with a large rubber band is invaluable when taking measurements, sketching details or working in cramped quarters. The arrangement leaves both hands free for work yet provides an instantly available writing surface that never gets misplaced. —*James Vickery, Garrison, N.Y.*



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.*

I build Chippendale side-chair reproductions. My problem is finishing—I understand that the two most suitable finishes for antique furniture or antique reprodutions are shellac and wax or hand-rubbed varnish. . . . My chairs are made from Honduras mahogany—how do I match the soft luster of the original chair and at the same time provide a protective coating? I am also concerned that I don't reveal a hairline at my glue joints (I use Elmer's Carpenter's Wood Glue).

—*Edward E. Long, Rockville, Md.*

Before finishing you must eliminate the hairline of glue. You can do that with warm water and an old toothbrush. Wipe and dry the wood, sandpaper it, and you are ready to stain and finish. The chair you are copying was probably made of Cuban mahogany, the best and densest species. It can be stained with potassium dichromate—a concentrated solution would turn the wood a deep, rusty red—or with quicklime water (freshly slaked lime strained), which would give a more purplish hue. However, these chemicals do not work on lower-grade mahoganies unless the wood is prestained with mordants. The best mordant is a brew made of the extract of campeche wood, although one of acorn shells (easier to obtain) may work.

While the original was probably dyed by one of these methods, your best bet is to use water-soluble aniline dyes, which you can mix to the shade of your liking. Whichever method you use, I advise you not to try to obtain the final color or shade in one single staining operation. When I work on precious, fine pieces, I stain them sometimes five times with a weak solution rather than once with a strong one. This gradual staining is far safer.

After dyeing the wood, the craftsman of yesteryear oiled it and his favorite oil was made from linseed. When working mahogany, the craftsman soaked alcanet root in the oil, which gave it a pleasant red color. The root is not easily available, but it can be replaced by oil-soluble aniline dye. Dissolve the dye in lacquer thinner and filter through a paper towel before coloring the oil with it. The tinted oil can also be your finishing material—it is up to you how many coats to apply.

When I use oil, I use boiled linseed oil, color it with aniline dye, and add to it about 10% spar varnish to hasten drying. I apply this very generously to the wood, leave it on for a full half-hour, and then, with a rough, burlap cloth, I take off as much as I can. Oil, if left on the wood, can become gooey, but when it is rubbed off, the remaining thin film acquires a pleasant luster. Don't be scared to use some grease with your oil: elbow grease. —*George Frank*

Sheraton explained his finishing process thus: Procure fine red-brick dust (for color and grain filler). Add a mixture of beeswax dissolved in turps to use as a rubbing paste. The first coat is applied with a cloth, allowing one or two hours drying time. Rub vigorously with the same cloth; finish rubbing with the grain. Allow two days drying time between coats. Repeat with a second coat. When the brick dust seems to have served its purpose, continue wax and turps only. The more you work on it, the better it will look. This finish will need occasional maintenance. For the glue joints: Have your glue thinned sufficiently so none shows between joined surfaces, and clamp tightly. A hairline will always show unless grain structure matches fairly well.

—*Andy Marlow*

I have a Stanley 55 plane, which I am finally learning to use. Are there any tricks for holding molding pieces at the edge of the bench?

—*Mike Townsend, Canton, Mich.*

There are several ways. You could lightly glue them to a wide board using thin cardboard in the glueline. The cardboard will break with moderate pressure and release the work when required. You could tack strips to the bench with panel pins, setting them as necessary. You could use an end vise and bench dogs. If the work is flexible you might have to tack small strips or blocks on either side. You could also use a bench clamp with a suitable block, moving the work along as necessary. Of these alternatives I think that the first is the best. —*Simon Watts*

From a 2-ft. board of air-dried maple I cut 5-in. lengths and glued them together for a large candleholder. I left the clamps on overnight and let the glue dry for two days before turning. Everything went fine until I started to smooth-cut. I was about ½ in. to ¾ in. down the face of a cove, making a very fine cut, when my chisel dug into the

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

wood. I could clean up with the front point of the skew, but when I went in with a small gouge it dug in every time. What am I doing wrong?

—Roy A. Meier, Altadena, Calif.

Rude Osolnik, longtime head of the Berea (Ky.) College industrial arts department replies: Chatter, which can result in dig-in, comes from not fastening the wood securely to the faceplate, or from overextending the tool past the tool rest, or from having too much of the chisel's cutting edge in contact with the turning wood. You might begin with a parting tool to the desired depth, then use a small gouge pulling from the left side down to the center, then from the right side down to the center. Make sure the gouge is turned so the "ears" don't touch the wood.

After making the gears, I assembled my clock and it worked beautifully. Then I finished it with Watco and the clock stopped running. The finish felt smooth, but apparently the surface friction between the gears increased greatly. I rubbed graphite on the gears and the gears started to run again, but it required more than twice the weight it did before. I am making another clock and I wish to apply a finish that will not increase surface friction between gears. Any suggestions?

—Rod F. Gimpel, Idaho Falls, Idaho

Your problem could have a number of causes. Did you notice if one gear and pinion would stop at a given spot each time? If so, not enough tolerance was allowed in that area. If, on the other hand, the clock ran evenly for an hour or more with the addition of weight, insufficient tolerance overall is indicated, which will cause you trouble seasonally with or without finish. I doubt the finish itself caused enough friction to stop the movement. Unless you must finish your new clockworks, I suggest using WD-40, a lubricant available from auto-supply stores. If color is necessary, try a water stain, let dry thoroughly, spray lightly with sanding sealer, sand with 240-grit paper, spray no more than two coats of lacquer cut 50% with thinner, and finish with a shot of WD-40. *—Andy Marlow*

Last month I made a kitchen countertop using 2¼-in. tongue-and-groove red oak flooring. It was purchased from a mill specializing in hardwood flooring, then further dried in a school workshop. An ample quantity of nonwaterproof white glue was spread on a panel of ¾-in. fir ply and the pieces of oak assembled on it. The pieces were *pulled together by clamping across the counter temporarily, but no glue was applied between the pieces. At the same time, by using 2x4s on edge over and under, the oak was clamped to the ¾-in. ply. Several days later, after vigorous planing, scraping and sanding (during which time no ridges were evident), I applied successive coats of Watco Exterior Danish Oil (still no ridges). After another two-day wait, the first of four coats of #91 clear satin Flecto Varathane was applied.*

The counter is earning its keep now, but there are slight ridges at most of the seams. I don't think they're oak or glue, so that leaves finish. My first guess was that the Watco had penetrated down into the joints and did not dry thoroughly before the Varathane went on. Thus, as solvents from the oil were released, they forced up a long Varathane bubble—the ridge. But a front lip of oak was glued to the assembled oak-ply panel before finishing, leaving no trench into which the Watco could pool. However, along this seam there is also a ridge.

—Gary Buchfink, Telkwa, B.C.

From the information given, I would guess that the oak strips were fairly dry when installed. During sanding, sealing and finishing, the strips may have dried a little more, increasing the opening at the joint slightly. This joint would have become filled with a combination of finishing material and sanding debris. The finish may have set hard but not absolutely rigid, and as later increase in moisture content caused the strips to swell (red oak is a fairly unstable and responsive wood), the cracks would close up and force the finishing material upward along the joint. I believe that the physical squeeze-out of material, rather than solvent release from the material, is responsible for the ridge. A light sanding with fine abrasive paper should remove it. *—R. Bruce Hoadley*

I make exterior redwood signs, and when the customer desires a natural (uncolored) finish on the wood, I have been using Pratt & Lambert #61 spar varnish. I find, however, that after six months the finish deteriorates, particularly on surfaces receiving the most direct sunlight. Is there a product that better resists ultraviolet deterioration?

—David McWethy, Fayetteville, Ark.

For a clear finish that resists sunlight, use a spar or super-spar varnish listing ultraviolet absorber on its label. Ultraviolet rays will eventually destroy the film, however, no matter how durable it is. This, plus the expansion and contraction of the wood that weakens the film and permits it to crack, lets moisture creep in. Peeling and lifting result. To maintain decent appearance don't build up a heavy surface film. Use two or three coats of well-thinned varnish, with drying time between, to get the film down into the wood. You could also try an oil-based pigment stain such as wood-shingle coating. The pigment acts as a shield against ultraviolet light, and the oil base stays fairly flexible. But unless you use a lot of pigment, warn your customers that they should plan on recoating every six or nine months. Clear marine epoxy varnish is sometimes mentioned for this purpose, but epoxy tends to chalk under ultraviolet. A better alternative would be Watco Redwood Finish and Waterlox Redwood Preserver, both in-surface finishes. Even with these you'll probably have to recoat in a year or so, but at least you won't have to sand off peeling surfaces. —*Don Newell*

My father returned from Mexico with a beautifully carved quail in ironwood. I was admiring the finish, a fine semi-gloss with depth, and imagined oil being rubbed in with care. He told me, smiling, that it was shoe polish. Immediately I tried neutral shoe polish on a damaged marquetry piece, over Watco. It is beautiful. Something has to be wrong; it is all much too simple.

—*Gary Wright, N. Conway, N.H.*

You can apply the best possible finish to roughly sanded wood and you will not be proud of the effect. On the other hand, you can apply shoe polish (which usually is composed of fine waxes) to a well-sanded piece, and feel it is so beautiful that something must be wrong. No, fine finish nearly always can be equated with superior smoothness. Try to finish an unsanded piece with shoe polish and you will agree.

—*George Frank*

Nothing is wrong with shoe polish as a finish for surfaces not subjected to wear. It starts out and stays harder than most other wax finishes and buffs up nicely. Eventually it will soften, and it will have to be renewed to maintain a soft luster. —*Don Newell*

Could you explain why a thickness planer tends to dip its cut in the first 4 in. to 5 in. and if there is a way of preventing this?

—*Ken Corbett, Proctor, Vt.*

If the lower feed rolls on a planer are set higher than normal, uneven cutting occurs on both ends of the board. As the lumber passes over the infeed roll, the chipbreaker pushes the wood down against the bed of the planer. After passing under the cutterhead it comes in contact with the pressure bar, which also holds it down, but as it comes to the outfeed roll it must climb up and over the roll, thereby raising the board into the cutterhead. As the board passes out of the planer it drops off the bottom infeed roll, causing uneven cutting; so adjust your rolls. Roughsawn and uneven lumber requires a higher setting on the lower rolls than finish planing—for finish planing, try 1/32 in. or less for roll height above the bed.

—Lelon Traylor

Follow-up

In response to the person looking for a honey-tan stain for pine (May '79), I would like to share two good staining methods. The first is perfect for pine because it doesn't darken the end grain more than the surface. Buy a bag of chewing tobacco and soak it overnight in a quart jar filled half-and-half with ammonia and water. Decant it and it's ready to apply. Because the stain is weak, I use 10 to 12 applications, but I can do three applications on a winter evening. The stain is transparent and unaffected by subsequent wetting. It raises the grain, so I steel-wool after every three or four coats. Final finish is the woodworker's choice. I generally use wax or urethane.

My other finish formula is apparently unique to maple. I oil the wood with bacon fat and place it in my barbeque smoker with a small green twig in one corner. After half an hour the maple turns brown-black. Wipe it clean and seal with linseed oil. I tried this with pine and it turned a horrible yellow color, so I conclude that maple darkens through chemical action.

—P.L. LaMontagne, New Britten, Pa.

Re Don Carbhoff's question (July '79), as professional refinishers we have had great success overcoming the problem of a veneer absorbing more stain than the solid stock it's next to. We use sealer made of 70% thinner and 30% lacquer, lacquer-shellac or varnish (we usually use lacquer). We spray this watered-down sealer lightly on the veneer, just enough to seal the porous surface. When the surface has dried we use "tired" sandpaper (worn-down 220-grit silicone carbide) on the veneer until the surface is cleaned of lacquer. When we apply our stain, there is still some porosity in the veneer, and you can control the stain variation almost to the match.

—*Lewis Stein, Chatham, N.J.*

Supplies:

Exotic materials and hard-to-find supplies are a constant problem for the woodworker. Here are more leads to inquiries from previous issues:

—Ash splints: The Country Seat, Box 24, R.D. 2, Kempton, Pa. 19529.

—Hardware for drop-side cribs: The Stork Shop, 1868 S. La Cienega Blvd., Los Angeles, Calif. 90035.

Readers can't find:

—Mechanisms for a jack-in-the-box;

—Hinges for a drop-leaf desk, with two pivots and a flat barrel;

—Glass ball-and-claw feet;

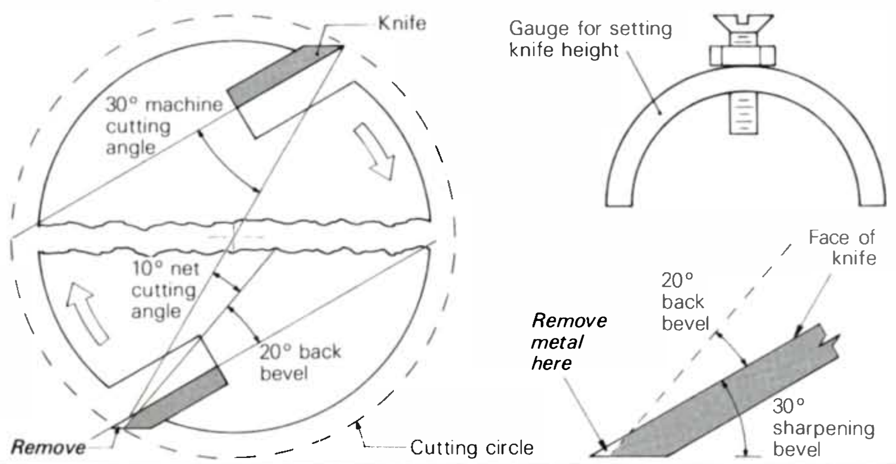
—Plans for an Aaron Willard coffin clock.

Follow-up on planers

I have been enjoying Lelon Traylor's articles on planers and share his enthusiasm for the machine. For me it's the closest thing to magic in woodworking. I run a one-man production shop and would like to pass along my experience with cutting angles and with the Belsaw planer in particular.

First the good news. It's possible to virtually eliminate chip-out with a planer or jointer by back-beveling the face of the cutting knives to give a smaller cutting angle. With the hard maple that I use there is no "right" direction to feed a board, as grain direction will usually change several times in its length. . . . Slow feed and shallow cuts help, but don't eliminate the problem. Back-beveling does, and makes it possible to feed boards from either end. An additional benefit is that the knives stay sharp much longer, because the cutting edge is beefier and doesn't flake when it hits a knot.

Cutting angle is the amount of forward tilt given the knives by the machine manufacturer when milling the knife slots in the cutting head (see editor's note, below). Most manufacturers seem to make their planers and jointers for working softwoods by building in cutting angles of 30° to 40°. At this angle the knives tend to slide under the chip and lift it up. This works great on softwoods but on hardwoods it can tear out anything from small chips to large chunks in figured areas. Hardwoods need cutting angles in the range of 5° to 20° to give more of a scraping action and less of a slicing and lifting action. To reduce the cutting angle it is necessary only to grind a second bevel on the face of the knives. The angle of back-beveling is determined by the cutting angle built into



EDITOR'S NOTE: The cutting angle of a planer or jointer corresponds to the hook on the teeth of a circular ripsaw. The normal cutting angle is measured from a line drawn down the face of the knife (the side opposite its bevel) and a line drawn from the tip of the knife through the center of the cutterhead. The sharpening bevel on the back of the knife has nothing to do with cutting angle. The larger the cutting angle, the more efficient the knife in terms of wood removed and power consumed.

When a second bevel is ground on the face of a knife ("back beveling"), the cutting angle is calculated from the face of this extra bevel to the center line, as shown in the diagram. In this way it is possible to reduce the cutting angle to nothing at all—that is, a line drawn down the new bevel passes through the center of the block.

A back-beveled knife turns the chip more sharply than does a normal knife, and breaks it off before it can tear out of the wood. The price is efficiency. You must take a lighter cut, reduce the feed speed, or both.

Another strategy is to reverse the knives in the cutterhead, which usually yields a cutting angle close to zero and a scraping cut. This method is useful for curly hardwoods and bird's-eye figure, but the knives are liable to chip. Take very light passes, and feed slowly.

the machine and the net cutting angle you want to end up with. Wisconsin Knife Works recommends a net of 5° to 10° for people who mill mostly hard maple. A friend of mine who mills mostly cherry uses 15°, and our knife grinder says a lot of people use 20° as a general-purpose angle. My own preference is for a net cutting angle of 10° for both my planer and jointer, as it does an acceptable job on softwoods and a superb job on hardwoods.

The way I determined the cutting angle built into my machines was to cut a thin piece of cardboard so that it would slip down over the shaft at one end of the cutting head while allowing enough access to make a tracing of the end of the head. I removed a knife so I could get a good tracing of the slot. I used drafting tools to complete the circle of the head, find its center and measure the angle. To be really precise, draw a "blade" sitting in the slot and measure the angle to its cutting edge.

I included a scale drawing of the end of the knife with all the angles I wanted clearly marked when I sent my knives out for sharpening. One grinder refused to do the job—he said that it wouldn't work. But it does. Everything from curly maple to walnut burl now comes through fine.

As for the Belsaw planer, I owned one and used it for three years and would advise against buying one. If you already have one, here are cures for some of its various ills:

Problem 1—Poor feeding of stock and blackening the underside of boards. I put a piece of ½-in. marine plywood (no voids) faced with paste-waxed Formica on the table. This worked but required drilling and tapping holes into the table at several points and machine-screwing the plywood down snug to keep it flat.

Problem 2—Inaccurate thicknessing edge-to-edge and intermittent "washboarding." It turned out that the cutting head on my Belsaw could be moved up and down at the feedworks end about 1/16 in., due to sloppy machining of the housing for the self-aligning bearing shell. . . . I drilled and tapped holes into the castings and pressed nylon plugs against the bearing shells with bolts to make the bearings stay put without affecting self-alignment.

Problem 3—Inaccurate thicknessing of 6/4 or thicker stock lengthwise, that is, same thickness edge to edge but varying plus or minus 1/16 in. end to end. No cure. I carefully built a spring-loaded pressure bar and installed it on the outfeed side of the head, weighted the lid to put more pressure on the chipbreaker and tightened all the feed-roller springs. . . .

Problem 4—Difficulty adjusting knife height. Two problems arose in accurately adjusting knife height. The poor man's way to adjust knives is to use a *C*-shaped piece of metal with an adjustable feeler screw through the center. The two legs are placed on the head, the screw is locked at the right height and is used as a feeler gauge to test the heights of both ends of all of the knives. The Belsaw head, however, turned out to be 0.008 in. out of round. An error of even 0.004 in. between knife heights produces a poor finish, so I bought a dial gauge designed for setting up planers and jointers. It was expensive but accurate and convenient. The second problem was to get the knives to stay down in the slots while tightening the gibs. These wedge-shaped blocks hold the blades tight in the slot, and Belsaw makes them from soft aluminum. Tightening their set screws draws them up in their slots, and being of a soft metal, they stick to the knives and draw them right up off the adjustment screws. Buffing the faces of the gibs to a mirror finish helped them slide on the knives and combined with a board levered down on the knife edge from above, made it possible to tighten the blades in place accurately.

There were numerous other small problems like excessive wear on the thickness adjustment screws, replacement feed rollers ¼ in. out of round, and a flimsy aluminum base casting that broke when overloaded.

My present planer is a 1943 Buss 30 in., which I am happy with. I would suggest that the owner of a small shop consider going into hock for three-phase power and a large, older machine like an Oliver, Newman Whitney or Buss. These machines are frequently underpriced because they are considered obsolete by industrial standards and there is no market for them as a home shop machine. When I leased mine, an Oliver 18 in., which two people could easily pick up, was selling for $2,400, while the Buss, which weighs 5,500 lb., was $2,900 in "good running condition." For the home shop I'd choose the Parks 12 in.

—*Brian Burns, Palo Alto, Calif.*

Ed Dunn replies for Belsaw Machinery Co.: Belsaw agrees that there are instances. . . where grinding a back bevel on the face of the planer knives would be desirable. This procedure is detailed on p. 35 of our current operator's manual. Most planer knives are standard with 30° to 40° cutting angles because the knives are finished as general-purpose knives. A decreased cutting angle is advantageous in certain hardwoods and can easily be obtained by placing a back bevel on the planer blades. . . . However, once this angle has been ground in, it cannot be practically removed. With this type of beveling, these knives will require more motor power than ordinary knives.

The beds on all Belsaw planers are machined flat. The grooves in this machined surface can accumulate a dirt build-up, which will tend to blacken wood passing over this surface under pressure. . . . Periodic maintenance and cleaning of the bed will eliminate this problem. The operator's manual suggests the addition of a hardwood board attached directly on top of the planer bed. For best operation we recommend oak or cherry. . . . Predrilled holes are not supplied on the extension tables, as this would not fit every application.

Inaccurate thickness-planing on any thickness planer is most often caused by inadequate support of the stock. Supporting stock as it is fed into the planer and adequate support as it is removed are very important for accurate thicknessing. Burns mentions considerable end-play in the cutterhead bearing of 1/16 in. A bearing housing causing this type problem certainly does not comply with any approved Belsaw quality-control standards or specifications.

The Belsaw was designed and engineered primarily as a thickness planer, with the added ability to produce moldings. . . . Belsaw makes no claim that this machine can replace or perform the functions of a jointer. The function of any planer is to finish stock to uniform thickness. Extremely warped or twisted stock cannot be straightened on any thickness planer. One surface must first be flattened on a jointer. . . .

While Belsaw does not object to individuals using a dial gauge such as Burns recommends, we do feel that these measures are extravagant and unnecessary. Belsaw recommends two methods for setting the knives in the cutterhead. The first involves using our No. 953 knife setting gauge (optional). . . . The second method is to follow the instructions on pp. 19 and 20 of the operator's manual. . . . Applying a few drops of oil where the gibs contact the planer knives will also help eliminate the knives raising as the gibs are tightened. We strongly recommend against grinding or polishing the surface of the gibs, as this can decrease the positive wedge action that holds the knives in the cutterhead.

Our planers have rubber-bonded spring-tensioned feed rolls, which don't require the accuracy of steel rollers. The flexibility and floating action of rubber rollers also allow uniform planing of uneven thickness stock.

Belsaw has been making planers for well over 40 years. We feel that this in itself indicates that our quality products have made a significant contribution to the woodworking industry.

* * *

I make new furniture, restore antique furniture and do general furniture repair. In choosing a thickness planer I secured literature from most of the manufacturers, and I purchased a Williams and Hussey model W7-S power-feed planer-molder.

With my Sprunger 6-in. jointer I have what I consider a good working combination to prepare lumber for furniture-making. I chose separate machines rather than a combination machine for the versatility and economy of operation (lower horsepower motors required). I always prepare lumber by first face-surfacing one side on the jointer, and then surfacing one edge at a true 90°, also on the jointer. The opposite side and edge are surfaced on the W&H planer. This procedure gives a board true in thickness and width its entire length, with no winding or twist, and all sides and edges are 90° to the adjacent side or edge. The only reason for having a planer with wider capacity would be to have a jointer of like wider capacity. I never prepare lumber any other way because my procedure saves time and eliminates problems.

I have constructed many wide tops using 6-in. boards glued together that only required sanding with an orbital sander at 120-grit. The 8-in. thickness capacity of the W&H planer gets much of the credit for the almost perfect glue joints required in fabricating wide tops from boards 6 in. wide or less.

I am presently starting a project that will require surfacing 6x6 beams on all sides, and again the 8-in. thickness capacity is a must.

I think the above is reason enough to own a W&H planer. The machine is also a molder that will produce small production runs such as special picture-frame molding, baseboard molding and window and door casing for a house. These I have done with great success. I trust my analysis will help others in the market for similar machines. *—Roy Dreyer, Wentzville, Mo.*

Books

Wood Structure and Identification (2nd edition) by H.A. Core, W.A. Cote and A.C. Day. *Syracuse University Press, 1011 E. Water St., Syracuse, N.Y. 13210, 1979. $11.95, cloth; 182 pp.*

What Wood Is That? by Herbert L. Edlin. *The Viking Press, Inc., 625 Madison Ave., New York, N.Y. 10022, 1969. $16.50, cloth; 160 pp.*

Commercial Foreign Woods on the American Market by David A. Kribs. *Dover Publications, Inc., 180 Varick St., New York, N.Y. 10014, 1968.*

Textbook of Wood Technology, Volume 1 (3rd edition) by A.J. Panshin and Carl de Zeeuw. *McGraw-Hill Book Co., 1221 6th Ave., New York, N.Y. 10020, 1970. $22.50, cloth; 705 pp.*

Woods We Live With by Nancy and Herbert Schiffer. *Schiffer Publishing Limited, Box E, Exton, Pa. 19341, 1977. $16, cloth; 202 pp.*

Sooner or later every woodworker faces a situation calling for wood identification. Usually, difficulties are soon encountered, for there are close to 100 domestic species in common use among woodcrafters, and even more foreign woods. But with a good book, a razor blade and a hand lens, even the beginner can achieve impressive expertise in hardwood identification.

Wood identification is inseparably linked to wood anatomy. Density, color, odor, taste and luster are helpful, but anatomical structure is the most reliable indicator. A good book will therefore approach wood identification through anatomy, using standard terminology. Nowhere is the old cliche, "one picture is worth a thousand words," more applicable than in wood identification. Views of longitudinal board or veneer surfaces are helpful, but cross-sectional photographs are irreplaceable. Every wood should be designated by standard Latin or "scientific" botanical name, in addition to trade and common names. A specific group of wood should be covered thoroughly—books that present a sprinkling of woods from around the world and treat them in simplified terms are useless.

Panshin and de Zeeuw's *Textbook of Wood Technology* covers nearly 100 of the most common North American species. First published in 1949, it is *the* text for formal courses in wood anatomy and identification. Its format has changed little through two subsequent editions, but changes in details have kept it up to date.

Textbook is really two books in one. Part one includes formation, anatomy and properties of wood with detailed chapters on the comparative anatomy of softwoods and hardwoods, variability in wood, natural, processing and biological defects, wood-moisture relationships and other physical and mechanical properties.

Part two begins with a valuable summary by species of characteristic features and figure patterns. Thorough identification keys for gross and microscopic features for both conifers and hardwoods are accompanied by low-power (5x) cross-sectional views. Then the physical properties of each species are described and illustrated with photomicrographs (75x). Even a rank amateur can make a razor cut on a cross-sectional surface of unknown hardwood and examine it with a hand lens, compare it to the key illustrations and quickly narrow it down to one or more of the closest look-alikes. These in turn can be cross-checked with the detailed species descriptions.

The novice might be frightened at first by the amount of detail in this book or by its pedantic rhetoric (things are said to be "orbicular" rather than round, or "wanting" when not present). But with a little effort one can skim past the academic trivia and sort out the useful information. Unknown terms can be found in the glossary or in the complete index.

Anyone with serious interest in wood identification will eventually want to own this volume, but even with its apparent completeness and depth, it still leaves gaps. These gaps can be filled with *Wood Structure and Identification*, a simplified, yet sophisticated book geared to the practicing woodworker. Most impressive are the magnificent photomicrographs taken with the electron microscope, which give realistic, breathtaking insight into the complexity and beauty of the ultrastructure of wood.

The book begins with clear explanations of the anatomical and physical characteristics of wood, followed by a section on detailed macroscopic and microscopic features of hardwoods and softwoods. Traditional dichotomous keys, in which one is led through a series of questions with two possible answers, each leading to yet another, more specific question, are included, as are simplified chart keys for each species. This second edition also has an appendix of low-power photographs of cross sections of woods with concise summaries of identifiable features. The glossary defines terms in reasonably plain English and cross-indexes them to the rest of the book.

My only negative comment is that the quick reference guide to individual species—intended for self-study—has woods arranged by alphabetical order of family, which means little to most users. I would prefer an arrangement by common or generic name, or, even better, by grouping look-alikes together. Nevertheless, it is the best bet as well as the best buy for anyone about to launch into wood identification.

Once you're comfortable with the anatomical approach to identifying domestic woods, you'll want to refer to *Commercial Foreign Woods on the American Market.* This book is unfortunately out of print, but probably can be borrowed from major libraries. Foreign wood identification involves some additional anatomical variations, but these are summarized with photographs at the beginning of the book, and anyone familiar with the anatomy and jargon for domestic woods will quickly catch on. For each of 420 woods, photographs of a 10x view are given. Each wood is designated by scientific, trade and common names and thoroughly described—a dichotomous key for identification draws upon both macroscopic and microscopic features. Notes on uses and geographic origin are also included. The technical and photographic depth of this book earns it a place in the front row.

Anyone shopping for a book on identification will eventually come across Edlin and Schiffer. Their dust jackets boast actual wood samples. Each book contains a fold-out display of actual veneer chips, admittedly irresistible to most wood buffs, but don't make the mistake I did and buy before you really look.

Edlin's book is the better of the two but it still has serious limitations. The sparse information presented is illustrated with a few poor photographs and sketchy drawings. Many descriptions are misleading, overly simple or inaccurate, such as, "[resin] canals run through the wood in several directions. They are too small to see without a microscope, but most softwoods can be named as such by their characteristic 'turpentine' smell."

The approach to identification is to match the unknown wood to the appropriate group in a special color key. The wood is then tested against keys for ring characteristics, rays, leaf shape (if you are lucky enough to have the whole tree), country of origin, etc. But you might have trouble verifying a likely choice, because when you look it up in the expanded description, you discover superficial, arbitrary anatomical data, a description of the tree, historical facts and use of the wood. No photographs of wood structure are included. Although the keys were apparently designed to separate the 40 species covered in the book, it is possible that other unknown but similar woods could make it through the system. Unfortunately, pictures of leaves and fruits, which accompany the species descriptions, are poor to inaccurate.

At first glance, the Schiffers' book looks like Edlin's. In addition to the dust jacket and the fold-out wood display, it even presents maple and bird's-eye maple as separate woods. But there are only 26 actual wood samples; in my copy they were sloppily cut and carelessly pasted in. Many are not good representatives of the species. The several color plates look impressive, but only 18 woods are shown and the views are not consistent with the labeling. The accompanying write-ups do little to help the uninitiated: "Sugar pine is light pink with brown streaks." Another example: "Oak [not further specified] is tight-grained, heavy and strong. The wood looks like chestnut, hickory and ash, but is grayer." The introductory description of tree structure is sketchy.

Other chapters discuss forest management and the modern lumber industry. Those who share the authors' fascination with antique furniture and old-time or tropical logging will find these subjects profusely illustrated, but for wood identification, this book strikes out.

If you are about to begin some serious identification, try Core, Cote and Day first; plan to add Kribs when you are ready. By then, you'll know what you need next. —*R. Bruce Hoadley*

Events

This column is for gallery shows, major craft fairs, lectures and exhibitions of general interest to woodworkers. To list your event, let us know at least three months in advance.

The Desk 1900-1915—Oct. 17 to Nov. 30, Jordan Volpe Gallery, 457 W. Broadway, New York, N.Y. 10012.

R. Bruce Hoadley—workshop on water and wood, Nov. 17, Worcester Craft Center, 25 Sagamore Rd., Worcester, Mass. 01605.

Omaha Craftsmen's Gallery—invitational show of contemporary woodworking, Mar. 28 to Apr. 30, 1980. Deadline Jan. 1. Contact Nancy Gruver, 511 S. 11th, Omaha, Neb. 68102.

The Shakers in New York State, to Nov. 21, Museum of American Folk Art, 49 W. 53rd St., New York, N.Y. 10019.

Containers—juried competition, Nov. 11 to Dec. 31. All media. Danforth Museum, 123 Union Ave., Framingham, Mass. 01701.

Workshop with Robert March—curvilinear forms, Nov. 17-18; **Sacred and Ceremonial**—multi-media exhibit, Nov. 17 to Dec. 24. Peters Valley, Layton, N.J. 07851.

1980 Houston Festival—9th Annual Crafts Exposition, Mar. 22-30, 1980. Deadline Jan. 4. Craft & Folk Arts Advisory Committee, 3815 Montrose, Houston, Tex. 77006.

Exhibits—reproduction & contemporary furniture by John Gordon, Rod Driscoll's dulcimers, Nov. 2-30; contemporary furniture & accessories in wood, Joe Rizzi, Dec. 1-31. Sterling Pond Hardwoods, Ltd., 6 N. Winooski Ave., Burlington, Vt. 05401.

Black Americans' Decorative Arts Exhibit—Oct. 18 to Dec. 30. Museum of History and Technology, Washington, D.C. 20560.

Group show including Wendell Castle, Ralph Evans, Robert Worth, Barbara Novello, Silas Kopf, Tim Philbrick and more, Nov. 2 to Dec. 3, Richard Kagan Gallery, 326 South St., Philadelphia, Pa.

I REMEMBER GRANDPA

My grandfather, Gus Vomberg, was one of those remarkable Swedish immigrants who knew and loved wood. As a young boy I could go to him time and again to learn the right way to use any tool, be it a saw, plane or file. His knowledge of ways around the problems created by the ineptitude of others, including mine, was phenomenal. One story in particular sticks in my mind.

Grandad had laid an oak floor in a new house across town. He was known for floors that others could only envy, never completely duplicate. On this particular job, he did not do the final varnishing of the floor because of another pressing commitment. A few days after he had completed the job, the contractor, highly agitated, showed up at our door. It seemed his painters had used some old varnish that would not set—the contractor made smacking sounds with his lips to indicate how the varnish felt. The owners were due to move in two days later, and the contractor was hardly able to afford removing all the varnish, let alone face the humility of not meeting a deadline.

Grandad said he would see what he could do. He went to the kitchen and picked up a bottle out of mom's cupboard. He walked across town to the job. Grandad, until he was in his 80s, always walked because he did not believe in paying to ride on streetcars or buses. When he got to the job, he dissolved a cup of liquid from the bottle in a gallon of cold water and proceeded to wipe the sticky floors. By the next morning the floors were hard and all was well with the contractor and the new homeowners. Wise old Grandad had simply used household vinegar to bring about the much-needed miracle.

—William Farquhar, Augusta, Mich.

• • •

At the time of the following incident my good friend John and I were engaged in our first major woodworking project. We were in our last year of high school, building a 14-ft. cat-rigged sailboat, working at it in our spare time after school.

It was the winter of 1925 and my grandfather, the principal character of this tale, was then in his 82nd year. He was a master craftsman of the old school, still very much alive and alert, and usually had a project or two of his own underway.

When John and I decided to build the boat my grandfather, whose property was next door to ours, let us use the shop he had at one end of his barn and gave us carte blanche to use any of his large selection of hand tools, some of which I still use in my own shop today. During the progress of our work my grandfather was often in the shop, working at his bench. He apparently had no interest in what was going on behind his back. He never walked over, unless invited, to see what was being done, and never offered unsolicited advice or comments, although he was always willing to answer our questions.

We had erected a number of forms so that we could build the hull upside down. The planking was completed and we were about ready to turn the hull over to start on the deck and interior. In the middle of the afternoon on the day in question, one of the city fire engines shrieked down the street. John and I dropped everything, dashed out and chased it down the hill for a couple of blocks, until it became evident that the fire was well beyond the park that began there, so we gave up the chase and slowly walked back up the hill.

Upon re-entering the barn we came upon an unexpected sight. There was my grandfather on his hands and knees under the hull, in the chips and sawdust, peering about overhead and feeling here and there with his hands. Being somewhat deaf, he had not heard us return. We watched in silence until he crawled out and stood up; when he saw us a sheepish grin spread over his face. He remarked: "Well, I guess you caught me this time. I just wanted to see how a couple of those joints under there are made. You know it's a day wasted when I don't learn at least one new thing." And with the grin turning into a gentle smile he went back to his own workbench.

John and I said nothing but smiled at each other. My grandfather hadn't fooled us for an instant. He knew how the joints went together. He was just making sure we weren't skimping in places where it wouldn't be noticed. I guess we passed the test. We never mentioned the incident to him again, but my father let out a hearty chuckle when I related it at supper that night. Thereafter, until the boat was successfully finished, my grandfather was much more open in showing his interest. He often left his bench to see what was going on, sometimes asking a question or two about what we were doing or how we proposed to go about something, but still never offering unsolicited advice.

And so, after more than half a century, the sharpest and brightest memory of my first major woodworking project is the sight of a wonderful old gentleman on his hands and knees, trying surreptitiously to assure himself that his grandson and namesake was, to the best of his ability, living up to his own high standards. This little incident, I think, taught John and me more than my grandfather ever realized.

—Samuel Hathaway, Sudbury, Mass.

CLASSIFIED

EXPERIENCED CABINETMAKER—5 years minimum—to relocate to Aspen, Colorado. Send resume to Willy's Wonder Shop, Box 608, Basalt, CO 81621.

POSITION AVAILABLE: Experienced woodworker wanted, must have fabricating and production skills in hardwoods. Our specialties are dining tables and architectural woodwork such as mantels, bars, wainscotting, etc. Alan Amerian, 282 San Jose Ave., San Jose, CA 95125. (408) 294-2968.

WOODWORKING JOURNALIST to join Fine Woodworking magazine as assistant editor. This opportunity results from staff transfers within our expanding organization. Successful applicant must have job experience in cabinet or general woodworking shop, plus job experience as writer or editor, or proven deftness with the English language. Drawing and photographic aptitude an asset. Must be willing to relocate to western Connecticut, and to travel on the job. We offer liberal benefits, good working conditions. Send resume and letter stating salary requirements, with photographs or slides of recent work in wood, to: Editor, Fine Woodworking, Box 355, Newtown, Conn. 06470.

WOODWORKER: Experienced with hand and power tools, to use his skills in crafting quality custom wall units and furniture. Small pleasant shop in Northern Virginia. Ebenezer Bros., Inc., Rt. 1, Box 42AA, Aldie, VA 22001.

Woodworker needed: Experienced with one-of-a-kind and/or limited production of furniture. Must have design experience. Full benefits, including profit-sharing, for a leading south Texas shop. Send resume to DISTINCTIVE CREATIONS, 3610 Saturn Rd., Corpus Christi, TX 78415. (512) 855-6232.

CARPENTER-Manager-Handyman to work full time in unique historic Westchester house. Salary based upon ability. Living accommodations available. References required. (212) 349-0700.

FACILITY for custom furniture shop available in western Maine with or without machinery. For further details, contact James Wysong, RFD 2, Harrison, ME 04040. (207) 647-5713.

FOR SALE—share in downtown Boston custom furniture shop. Must be experienced craftsman. (617) 338-8356.

FINE WOODWORKERS AND TRAINEES: We are the oldest and one of the most respected firms in our industry. Because of continuing success, our expansion and future growth plans require additional staffing. We produce high-quality musical instruments requiring the skills and abilities of experienced fine woodworkers. Our salaries range from $4 to $9 per hour plus an excellent benefits package. Lyon & Healy, 1423 W. Lake St., Chicago, IL 60604.

APPRENTICE VIOLINMAKERS AND RESTORERS: Positions available. Good salary and benefits. Background in woodworking and/or music helpful. Must be willing and able to learn. Bein & Fushi, Inc., 410 S. Michigan Ave., Chicago, IL 60605.

Canoe and kayak PADDLES WANTED. We need someone to build about 2500 for us. Bill Masters, Perception Inc., Box 64, Liberty, SC 29657. (803) 859-7518.

Kiln-dried and air-dried NATIVE AND IMPORTED HARDWOODS. Specializing in bird's-eye maple. Send stamped envelope or call (802) 863-5820. Sterling Pond Hardwoods, Ltd., 412 Pine St., Burlington, VT 05401.

LOCAL LUMBER CO. Fancy hardwoods, custom milling and kiln drying. 161 Bowers Hill Rd., Oxford, CT 06483. (203) 888-6509.

REDWOOD BURL, OLIVE SLABS. Clock kits. Free brochure. Redwood Burl Esque, Dept. F-11, POB 207, Lompoc, CA 93438.

HARDWOOD LUMBER: Oak, cherry, maple, walnut, butternut, mahogany, ash, basswood, cedar, hardwood plywood, milling, Watco oil. Amherst Woodworking, Northampton, MA 01060. (413) 549-2806.

WIDE BOOKMATCHED FLITCHES, root slabs and burls. Walnut, cherry, white oak, etc. Quartersawn flitches up to 24 in. wide. White oak, red oak, sycamore. Send self-addressed envelope for price list. Bartering considered. Sam Talarico, RD 3 303, Mohnton, PA 19540. (215) 775-0400.

Clear heart, vertical grain redwood and cypress. Various lengths up to 18 ft., widths up to 20 in., and thicknesses up to 3¾ in. MANY BOARD FEET, Inc., Box 206, Ipswich, MA 01938. (617) 356-5323.

CABINET WOOD. Pennsylvania hardwoods: black walnut, black cherry, white oak, red oak, white ash, yellow poplar, etc. SASE Dick Archer, 826 Trooper Rd., Betzwood, PA 19493. (215) 666-0357.

FINE LUMBER: Teak, mahogany, oak, maple, cherry, Ga. pine. KD, FAS. For your home, office or boat. Call (301) 544-1122 or send for our brochure/price list (50¢). F. SCOTT JAY & Co., Box 146, Pasadena, MD 21122.

Table, clock slabs. CALIFORNIA REDWOOD, BUCKEYE, others. Col. Buckeye Savage, 760 Illinois, San Francisco, CA 94107. (415) 863-2115.

1/16 VENEER top quality KD flat-sliced red oak and walnut. 85¢ per sq.ft. plus shipping. David Flatt, Box 3130, Madison, WI 53704.

HARDWOODS, chemical supplies for woodworkers. The Woods End, Box 310, Winsted, CT 06098.

DYES, chemicals, spinning-wheel books. Unique catalog, $1. Straw Into Gold, 5533G College, Oakland, CA 94618.

WALNUT and OAK DOWELS. Furniture parts. Toy parts. Catalog 25¢. Woodworks, Box 79238, Saginaw, TX 76179.

WOOD TABLE SLIDES—first quality. When you build your own table, need replacement, or want more leaves in your existing table. Send 50¢ for full information. Bogert Built Furniture, Dept. F.W., Box 59, Westwood, NJ 07675.

Special DOWELS with tenons or without, 6 diameters, 6 different woods. Odd Ball Supply, Box 133, N. Attleboro, MA 02761.

WOODEN PLANES, hand-crafted in our shop to cut hardwoods perfectly. Three sizes, reasonably priced. Data sheets $1. Stevens Cabinet Co., 18305 Queen Elizabeth Dr., Olney, MD 20832.

CANADIANS. Quality tool price list, 25¢. Albatross Tool Co., 1213 Walnut St., Victoria, B.C. V8T 1N3. (604) 385-0881.

Inca Stationary Power Tools. Professional woodworker offers demonstration, advice, sales. Based on four years Inca shop experience. Contact ARTHUR REED—WOOD ARTISANS, 454 W. 3rd St., Elmira, NY 14901. (607) 732-5510.

STANLEY #55—complete with all parts and blades. $275. Call John Moody (812) 422-4504.

Western Canada Inca Tool Sales for B.C. and Alberta. Catalog, $1. ACORN WOODWORKS, 720 E. 27th Ave., Vancouver, B.C. (604) 873-2781.

Woodworkers Swiss ZYLISS VISE, regular $138.50, special $84 postpaid. Bargain catalog, $1. Rego, Downing, Fall River, MA 02723.

Radial arm saw operators: At Last! You can now easily make those impossible thin and narrow ripping cuts, with our new Easy Rip fence. You won't believe it until you try it. IOWA ROYAL PRODUCTS, 2221 Otley, Perry, IA 50220.

IRONS AND CUTTERS. Offering the country's largest selection of plane irons and cutters at unbeatable prices. Send 25¢ for lists to The Tool Works, 76 Ninth Ave., New York, NY 10011.

CANADIANS. Demonstrations and immediate delivery. Inca Swiss-precision woodworking machines, Myford ML8 woodturning lathes, W&H molder-planers. Shopsmith multipurpose machines. $1 for literature (will refund $5 with purchase). J. Philip Humfrey Ltd., Box 173, 33 Red Lea Ave., Milliken (Toronto), Ontario L0H 1K0. (416) 293-8624.

OLD TOOLS for the woodworker and collector. Large variety and supply of quality old tools on hand. Send your wants or $1.50 for latest pictured catalog to Bud Steere, 110F Glenwood Dr., N. Kingstown, RI 02852. (401) 884-5049.

ANTIQUE WOODWORKING TOOLS. Illustrated quarterly catalog $4/year. The Tool Box, c/o John Moody, 405 Carpenter St., Evansville, IN 47708.

SANDERS—U-BUILD PLANS. Sidestroke $4, string $5, flat bed table $7, all three $15. Free brochure. McCall House, 1950-F, Lenoir, NC 28645.

200 MAIL ORDER SOURCES for woodworking supplies, tools, patterns. Many hard-to-find specialty sources. Only $3. Love-Built Toys-A11s, Tahoe City, CA 95730.

BRANDING IRONS made to order. Brand your name, initials, monogram on wood or leather. Logos and signatures faithfully duplicated. Write for information and sample brandings, giving size and inscription wanted, and intended use. A quality hallmark worthy of your labor. Norcraft Custom Brands, Box 277F, S. Easton, MA 02375.

GOLD LEAF & related imports. Write for products list, stating needs, for latest prices. Art Essentials of New York, 180 E. 73 St., New York, NY 10021. (212) 472-2770.

Are you interested in WOODTURNING as a hobby? Take a two-day intensive course for beginners from a qualified instructor. For further information write: PRACTICAL WOODTURNING, PO Box 102, Orangeville, Ontario, Canada L9W 2Z5.

FIX BANDSAW BLADES for 5¢ each. Precision fixture and joining kit. Albright Corp., Jeffersonville, VT 05464.

Stainless steel and brass, SCREWS AND BOLTS. Small quantities, free catalog. Elwick, Dept. 355, 230 Woods La., Somerdale, NJ 08083.

NUTTY ASSORTMENT. #6 and #8 Phillips, oval head sheet metal and wood screws. Brass plated, zinc plated and bronze plated. Ten-pound assortment $9.99. Nutty Co., 135 Main, Derby, CT 06418.

Solid brass engraved NAME OR TITLE PLATES. Two-line sample, $1. V-B, Dept. FW, 807 E. Dana, Mountain View, CA 94040.

CONTEMPORARY FURNITURE PLANS—Catalog contains over 200 exclusive plans: beds, tables, chairs, rockers, sofas, desks, shelving and more! $2 refunded with first order. The Designery, Dept. BL-1, 521 W. Kirkwood, Bloomington, IN 47401.

TIMBER FRAME BLUEPRINTS. Traditional designs. Ten houses, three barns. Send for information to Dovetail Press, Box 1496, Boulder, CO 80306.

NEW AND USED BOOKS on wood, woodworking, carving, turning. We deal only in woodworking. Frequent catalogs. $1. R. Sorsky Bookseller, 3845 N. Blackstone, Fresno, CA 93726.

WOOD & TOOL EXCHANGE

For Sale

Antique, 4th-generation woodworking lathe from Netherlands, treadle-driven flywheel, wooden frame, one meter between centers. Scott Rodibaugh, 1915 Bel Aire, Peoria, IL 61614.

Inca 10-in. saw with mortising table, stand, 1½ HP, blades, tenon jig, shaping jig and head, etc. Perfect condition, $800 firm. L. Kraut, 180 N. LaSalle St., Chicago, IL 60601. (312) 855-5817.

Two veneer presses, capacity 43 in. wide x 36 in. high. Five screws per press, $100. George Denninger, Sugar Loaf, NY 10981. (914) 469-2391.

22-in. dia. blade table saw, 10 HP motor, 15 assorted blades, $750. Lignum vitae log available. Douglas R. Spagnola, 24½ Van Houten St., Paterson, NJ 07505. (201) 881-0986.

Approx. 4,000 bd. ft. butternut, cut and stacked spring '79. 1 in., 2 in., 4½ in. thick, 6 in. to 16 in. wide, 6 ft. to 16 ft. long. $700 per 1,000. Ernest Anderson, Box 21, Ellison Bay, WI 54210.

Stanley #55 with cutters, $225. #45 with cutters, $125. C. Spooner, 170 Palmer Ave., Falmouth, MA 02540. (617) 548-5393.

Powermatic 10-in. table saw, Rockwell/Delta 14-in. wood and metal band saw, 15-in. drill press, 6-in. x 48-in. belt sander, 6-in. jointer, $2,500. P. Nehring, Box 368, Franconia, NH 03580.

Hammond Machinery Co. of Kalamazoo, router/planer/mortiser, Model RPM 12, new, never used. Cost $2,200, will sell for $1,100 (firm). G.E. Mueller, Box 3356, Santa Monica, CA 90403.

Crescent band saw. 32 in., 3 HP, 3 PH tilt table, miter gauge, rip fence. Weight 1,800 lb. $750 or trade for quality wood lathe. J.P. Morton, 504 Glen Dr., Keller, TX 76248. (817) 431-2166.

Stanley #45 used, excellent condition, original box and complete, $100. Mike Townsend, 43774 Yorktown, Canton, MI 48188.

Rockwell heavy-duty shaper with accessories, $1,150. Rockwell overarm router-shaper, $950. Both almost new, excellent condition, both 2 HP, 1 PH. C. Fox, S. Strafford, VT 05070. (802) 765-6211.

To be sawn to customer's spec.: sugar maple, yellow birch, beech, $650/Mbf. Hemlock suitable for heavy timber frame, $350/Mbf. A. Krueger, Box 42, Weston, VT 05161. (802) 824-3900.

Stanley iron planes #3, 4, 7. Also #112 scraper. R.H. Coleman, 404 Glendale Ave., Decatur, GA 30030.

Fancy gunstock blanks and patterns of all standard and many special target models. Entire stock must be sold. N. Kaatz, 3733 Clover La., Madison, WI 53714. (608) 221-2506.

Sanded furniture parts—Nice for school shop, boys club, craft show, or start a new business. Barry McNew, 304 N. Grant St., Waynesboro, PA 17268. (717) 762-2962. Must sell.

Reichenbacher six-spindle carving machine. From Germany, for copies to .005 in. Flat, round, any shape to 60-in. length. Cost $25,000 new. (608) 249-6769. D. Mather, 2306 Center Ave., Madison, WI 53704.

Inca 10-in. table saw. 1½ HP motor, mortise table, tenon jig, carbide dado, carbide blades, ext. rails, many extras. Mark Platas, Rt. 9W, Sparkill, NY 10976. (914) 359-4987.

Wanted to Buy

Patternmaker's tools, particularly cranked neck chisels and gouges. D. Ferry, 7235 Trenholm, Youngstown, OH 44512. (216) 758-6109.

Manual and any information on 4-in. x 12-in. planer Red Fox by Partington, Inc., Cincinnati, Ohio (A.V. Carroll Machine Tool Company, Station H). M.J. Haley, 2970 N. Main St., Danville, VA 24541.

Good-quality handcrafted Spanish and Santa Fe style furniture for my home. C. Sefelt, Box 6172, Scottsdale, AZ 85255.

Miller-Wellman core box machine, patternmaker's feather-tooth saw, Maydole patternmaker's long-head hammer, clock turn. Robert Casperson, 1520½ W. Temple St., Los Angeles, CA 90026.

S.C.M. (L'invincibile) Universal Woodworker (C-30, C-35, 2000d), used, good condition. Please contact T. Spach, 51 Bedford Ct., Concord, MA 01742.

Stanley #55, 39 cutters, $160. Desperate to find cutters #33, 96, 101, 223, 225 for Stanley #55. M. Wehmeyer, 2175 Valley Dr., Idaho Falls, ID 83401. (208) 529-1982.

Cast-iron table for Shopsmith Mark V. Also need cast disc sander for same. Contact Robert Pheigh, 2039 Crawford, Apt. C, N. Las Vegas, NV 89030. (702) 642-0035.

SITUATIONS WANTED

Experienced woodcraftsman seeks association with small, established shop in Maine, Vt., N.H., Mass. Offers unique abilities in design and craftsmanship. References on request. John Hines, 924 N. Grove St., Bowling Green, OH 43402. (419) 352-0801.

Mature, experienced, natural talent. Desire employment with established craftsman in restoration and woodworking. Would invest. J.L. Tweddell, 317 W. 9th St., Beardstown, IL 62618.

Carpenter with post-and-beam experience and tools wishes work with owner/builders. R. Foulkes, 401 N. 7th, Ann Arbor, MI 48103. (313) 663-8149.

Apprenticeship desired with cabinet/furniture maker. Have basic skills and tools. Hard worker and fast learner. Will relocate. Contact Ed Peterson, 311½ W. Broadway, Maumee, OH 43537. (419) 893-5140.

Australian resident seeks year's work from Feb. '80 in any aspect of fine woodwork. Have skills/design diploma. Interests: children's furn., bent lamination. Prefer Portland or NW. Delton Hedges, 28 Wilson Ave., Armidale, NSW 2350, Australia.

The CLASSIFIED RATE is $3.00 per word, minimum ad 15 words. Payment must accompany order. The WOOD & TOOL EXCHANGE and SITUATIONS WANTED rate is $2 per line, minimum three lines, maximum six lines, limit two insertions per year. Allow 30 letters or spaces per line, including name and address. The Wood & Tool Exchange and Situations are for private use by individuals only. Commercial accounts must use Classified. Please inquire for DISPLAY CLASSIFIED RATE. Send to: The Taunton Press, Advertising Dept., Box 355, Newtown, CT 06470.

Wharton Esherick

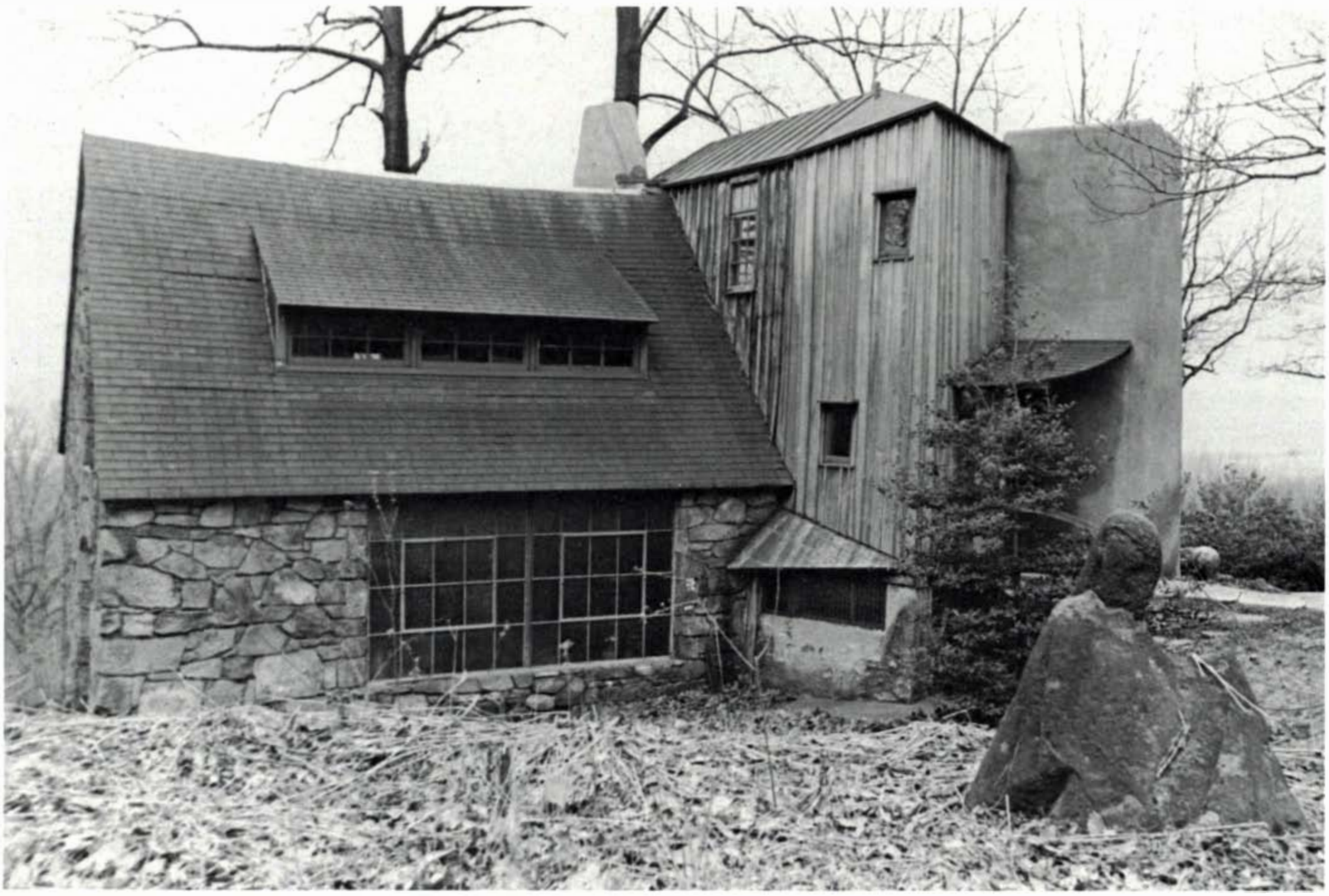
Work of the hand, the heart and the head

by Michael Stone

On a wooded Pennsylvania hillside during the 1920s, Wharton Esherick began creating furniture that challenged the symmetry and straight lines dominating the traditional woodworking of the times. Many of his designs were inspired by the forms he saw in living things, especially in the trees surrounding his studio. His friend, the late Philadelphia architect Louis Kahn, once said, "Trees were the very life of Wharton. I never knew a man so involved with trees. He had a love affair with them; a sense of oneness with the wood itself. . . ."

Esherick's application of organic design to furniture making has since become the trend in contemporary woodworking, but few of today's craftsmen realize that Esherick was creating "modern" furniture over a generation ago, or that his work helped to free them from the restrictions of previous styles. Most of Esherick's influence is hidden, subconsciously passed from teachers who knew him and visited his studio to their students. Today, pieces that are reminiscent of Esherick's style frequently appear, though their designers may not even know about Esherick's work.

Many teachers and craftsmen working today do, however, acknowledge Esherick's influence. Arthur (Espenet) Carpenter of Bolinas, Calif., a craftsman noted for his graceful organic style, has said, "Esherick's sculptural treatment of wood, independence of working and the timing of his life make him the 20th-century progenitor of the present furni-


Hugh Levins

Esherick began work on his studio in 1926. It later became his home, and he continued to modify and add to it throughout his lifetime. The lower windows look into the main workshop (now a sculpture showroom), the upper windows into Esherick's bedroom and library. The tall wooden section contains a dining area on the first floor (with a deck attached) and a bedroom above. Esherick had always wanted a silo and in 1966 added the concrete one at right to house a kitchen and a dressing room. He directed two masons with buckets of pigmented cement to fresco the exterior in an abstract pattern inspired by the autumn colors of the landscape.

Photos, except where noted: Courtesy Wharton Esherick Museum

Philadelphia Museum of Art

An Esherick woodcut, 'Diamond Rock Hill' (c. 1923), top; woodcuts led to wood sculpture. 'Reverence,' right, was carved in 1942. Above, Esherick in 1967, at age 80.

Donald Lloyd McKinley

The south face of the Esherick studio and home includes the door that opens onto the coat room (shown behind the staircase, p. 54). Above is the dining area, and above that a bedroom. The foundation is limestone, the siding roughsawn oak, and the deck cedar and fir, supported by stone and plastered pillars.

ture craft." But Esherick's influence was not merely stylistic—it was also an invitation to younger craftsmen to join him in creating pieces of furniture that were also works of art. The versatile craftsman and teacher Wendell Castle of Scottsville, N.Y., revealed what he had learned from Esherick's work: "Esherick taught me that the making of furniture could be a form of sculpture; Esherick caused me to come to appreciate inherent tree characteristics in the utilization of wood; and finally he demonstrated the importance of the entire sculptural environment."

Esherick himself believed teachers inhibit the growth of developing artists and he urged students to develop their own style. He dismissed offers to teach by saying, "I make, I don't teach." However, he did open his studio to students and loved to discuss his work with them. Today, his pieces are now in the permanent collections of several major museums, including the Metropolitan Museum of Art in New York, the Philadelphia Museum of Art, the Whitney Museum of American Art in New York, and the Addison Gallery of American Art in Andover, Mass.

* * *

Wharton Esherick was born into an upper-middle-class Philadelphia family in 1887. His parents urged him to enter a profession, but instead he convinced them to allow him to enroll in a manual-training school. He later studied painting at the Philadelphia School of Industrial Art (now the Philadelphia College of Art) and at the Pennsylvania Academy of the Fine Arts, and came away with an intense desire to draw and paint.

Esherick began to work with wood in 1919, carving frames for his Impressionistic paintings to make them more salable. His friend, the writer Sherwood Anderson, once told him that his frames were better than his paintings. During the twenties and thirties, Esherick combined his love of drawing and wood by carving woodcuts. These appeared in magazines such as *Vanity Fair* and in nine books, including two volumes of Walt Whitman's poems.

Woodcuts seem to have engendered Esherick's interest in sculpture of wood. Although furniture and interiors dominated his career, Esherick grew to love and depend on sculpture for giving him the greatest freedom of expression. "Reverence," above, is one of his most memorable works. Originally created to mark the grave of Sherwood Anderson, this haunting figure of an aged traveler leaning on his staff is carved from a single black walnut log and stands 12 ft. tall. Though Esherick appreciated the effects of weathering (in some cases having exterior pieces painted as needed, often in a different color), Anderson's widow felt the sculpture would not survive the elements. Esherick replaced it with an abstract in black granite, and "Reverence" was acquired by the Philadelphia Museum of Art.

Esherick first made furniture for himself; his skills were largely self-taught. At the urging of friends he made some pieces to sell and found them more marketable than paintings and woodcuts, which by the late 1930s he had given up in favor of furniture, interiors, utensils and sculpture.

Esherick's style evolved through several phases; his earliest furniture is decorated with low-relief, woodcut-like carvings. The red oak drop-leaf desk he made for himself in 1927 (next page, bottom left) illustrates this attention to surface design, soon to disappear entirely from his work. The carvings on the lower doors are abstractions of various trees native to the area around Esherick's studio—black cherry, maple, hickory. On the drop leaf of the desk is meant to be a view of the branches of trees when seen from below. The two top doors, behind which Esherick kept books, are carved in images of the hawks that soared overhead. The desk measures 6½ ft. tall, and its bulky symmetry has little resemblance to his later, more sculptural work, though the carved handholds are characteristic. Esherick's consummate use of space, however, is typical: The desk has a deep, wide, short drawer in its base, making functional that space which is usually wasted. The drop leaf and cabinet doors swing on rounded wooden hinges cut from the door itself.

During the 1930s, Esherick's work is characterized by bold angles and precise, cubist shapes, A good example is the intricate corner writing desk he made in 1931 (facing page, top left). The desk rises into a peak like a fractured prism, its outside of black walnut with ebony bead, hinges and drawer pulls; the interior is red padauk and leather. The desk opens in three hinged sections, and there are no knobs—Esherick disapproved of handholds that were attached after the fact. The desk, though strongly geometric, is comfortable and useful to work at—practicality is integral to Esherick's furniture, whatever the style.

Gradually, the sensuous, flowing style that he was to practice the rest of his life unfolded: "Some of my sculpture went into the making of furniture. I was impatient with the contemporary furniture being made—straight lines, sharp edges and right angles—and I conceived free angles and free forms; making the edges of my tables flow so that they would be attractive to feel or caress." Esherick believed that furniture should be friendly, with no sharp edges or corners. His pieces have strong, well-defined lines; they are never mushy, yet they are kindly to the touch. The spiral library ladder (facing page, top right), made of cherry with hickory legs, is a good example. The steps grow out of the vertical post like branches, softening the angularity of the joints. They are dovetailed to the legs, and here too the joint is curved over.

Esherick's fascination with using space wisely led to pieces that serve several needs. One example is a cherry piano bench that doubles as a cocktail table, made in 1950. Esherick also made for several different clients a pair of dinner tables, one with three legs and one with four. The tables usually stand in different rooms but fit together to form an extra-long table for large dinner parties. Esherick's beds, sofas and end tables usually contain drawers for storage. He shaped many of his sofas to fit odd wall spaces—some roll into the center of the room, doubling as room dividers. He often designed dining tables to match wall areas so they could be pushed back when not in use.

"My design follows function," he once said. Frequently, his ideas were a response to an unusual need. When a patron who was a composer needed a piano chair, Esherick made the chair just high enough for him to lean over the top of the piano to write music but still low enough to reach the keys. For another commission he created a portable radio-phonograph cabinet that could be tucked away into a curved corner unit holding records and sheet music (p. 56). Where the curve of the cabinet is too shallow to hold records perpendicular to the wall, Esherick angled the dividers, so that all the records are more visible than if they were stacked parallel to one another. The cabinet is cherry; shelves and drawers, which swing out on hinges along the outer edge, are oak.

The curves Esherick used in his work were dictated by the natural flow of the wood's grain; often he used root and limb wood or trees twisted or bent by the weather, as in the uprights of his dictionary stand, facing page, middle. Following the grain, rather than bending the wood, gives the piece an innate strength—the grain structure is not adulterated. Esherick objected to forcing wood into artificial shapes. When furniture maker Sam Maloof of Alta Loma, Calif., praised Castle's ability to bend wood to its limit, Esherick replied, "What did he make it out of wood for, then, if he's only after form? There's no beauty of wood there."

Esherick worked almost exclusively in local hardwoods—walnut, cherry, oak, cottonwood, hickory and dogwood—because he knew their reaction to his tools and their limits of expansion and contraction. Occasionally, the trees came from his own land. "If I can't make something beautiful out of what I find in my backyard, I had better not make anything," he once said. Esherick often combined cherry and walnut, and was particularly attracted to the much-neglected cottonwood—he found that if he took the time, he would almost always uncover a firey figure hidden within the wood.

Esherick sketched directly on the rough boards, and would readily alter his design if he uncovered interesting figure that suggested some new possibility. He once rescued a burning log from his fireplace because he saw in its shape a sculpture he later titled "Head of Mary." His relationship with his wood supplier, Ed Ray, who at 79 still runs his lumber company in Valley Forge, Pa., was a craftsman's dream. If Ray cut a log and uncovered an intriguing grain pattern, he would call Esherick and rough-cut it to his specifications. The wood was then air-dried in Esherick's shed at least one to two years per inch. Ray also stockpiled odd-shaped pieces of wood, which often became curved parts in Esherick's furniture.

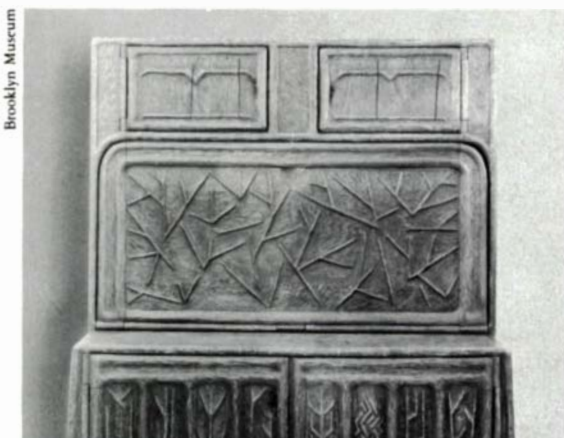
Esherick's construction techniques were simple and direct. He found joinery and finishing tedious and generally assigned this work to his shop assistants, Bill McIntyre and Horace Hartshaw, so he could concentrate on the shaping. McIntyre was with Esherick for 42 years, and Hartshaw, who still produces some pieces of Esherick's design, joined them in 1959 for the final 10 years. Hartshaw introduced several machines to Esherick's work where previously all the joinery had been done by hand—Hartshaw began cutting dovetails with a router while trying to maintain a handcut look. Esherick, nevertheless, personally involved himself with every piece and generally signed and dated all his work.

Wherever possible, Esherick used round tenons because

The cherry uprights of this dictionary stand (1962), below left, were shaped by nature, not steam-bent. The top is cottonwood, the shelves walnut. However, Esherick did steam-bend a few pieces, such as the hickory library ladder (1935), left, topped by caricatures of an elephant and a donkey. The library ladder (1969), below, of cherry and hickory, is one of Esherick's last pieces.

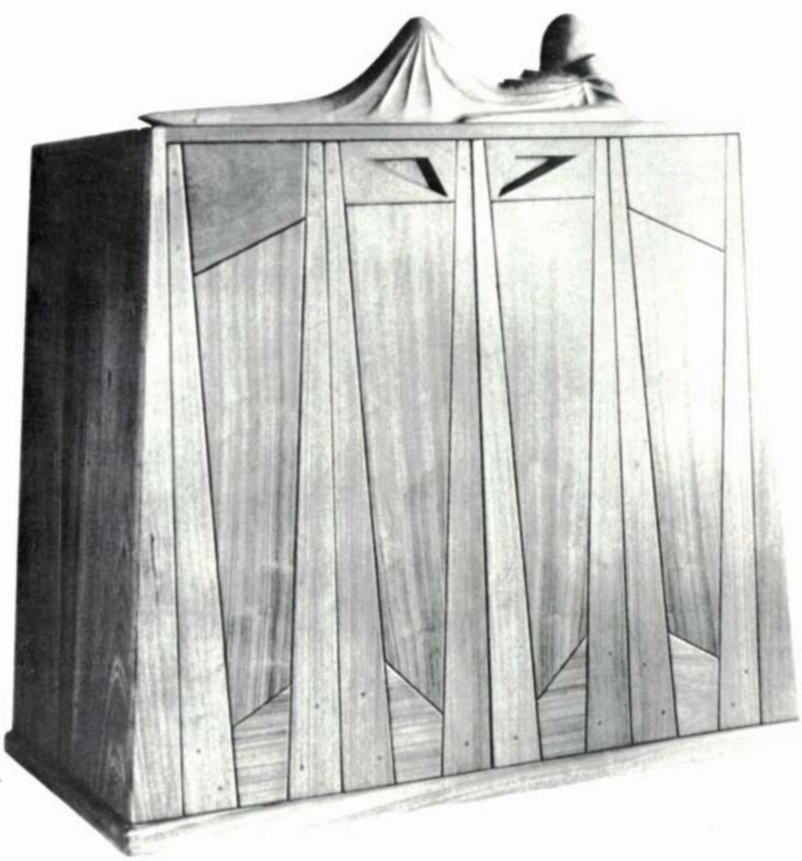
Richard D. Liberto, Lee Nordness Galleries

Brooklyn Museum



Bulky forms and woodcut-like relief carvings are typical of Esherick's early work—this red oak drop-leaf desk (1927), above, which stands 6½ ft. tall, holds his drawings and woodcuts. Next in Esherick's evolution were strong, geometric forms. His pyramid corner desk (1931), top, of walnut, ebony, padauk and leather, adapted cubist ideas to furniture design. When it's open, a person seated at it will find the cover leaves folded out of the way, leg-room ample, and the drawers and dividers angled conveniently around.

Below, victrola cabinet of padauk (1938) built seven years after the pyramid desk, is another variation of cubist ideas. The cabinet front is frame and panel, though Esherick altered the basic configuration by tapering rails, stiles and panels. The figure atop the cabinet, 'Finale,' was made in 1928, of walnut.

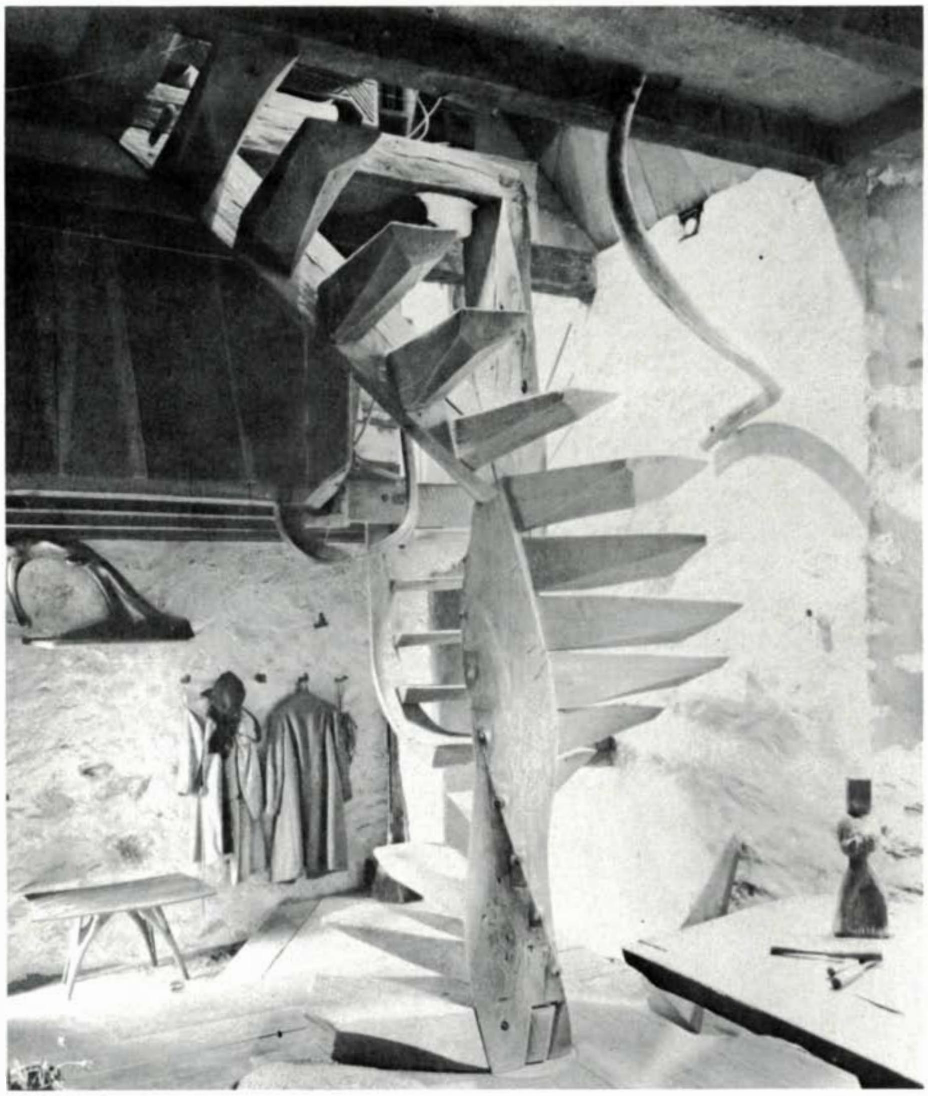


Donald Lloyd McKinley

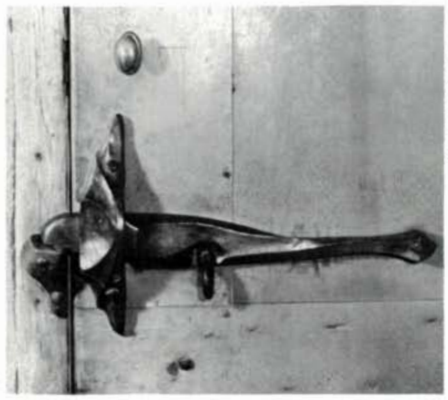
Hammer-handle chair (1930), an example of Esherick's imaginative use of found objects, is comfortable and made extremely strong by careful triangulation of the legs.

Smithsonian Institution

Esherick's three-legged stools all stand on hickory legs, but no two seats are alike—he shaped each individually, according to the wood at hand. These stools were made between 1948 and 1968; the seats of the outer stools are walnut, and the center seat is coffeewood.



Red oak spiral staircase, made in 1930, connects the main floor, the dining area and Esherick's bedroom in the loft (right). Despite its unorthodox shape and lack of a continuous handrail, feet and hands travel effortlessly upon it—a tribute to its cunning construction. The steps are tenoned into the massive post and drawn up with 8-in. bolts through nuts set into the tenon.



Donald Lloyd McKinley

Carved rosewood latch (1926) inside the front door is typical of the detail work in Esherick's studio. He designed and made everything from lamps and switchplates to radiator covers, all to this standard.

they could be twisted into a mortise for a tight fit. In Esherick's three-legged stools, where cross members and legs had to be brought together all at once, this proved especially helpful. A disadvantage of using round tenons is the resulting poor glue bond, since long grain is only partially glued to long grain. He would strengthen his joints with wedges in kerfs in the tenons or with wooden nails driven into holes bored through the side of the joint. Wooden nails are stronger than dowels because they are split along natural lines of cleavage and the grain is continuous. They are diamond-shaped in cross section, and the sharp edges slice into the grain as the nail is pounded home.

Esherick was not sentimental about crafting by hand, saying, "I use any damn machinery I can get hold of. . .I'll use my teeth if I have to. There's a little of the hand, but the main thing is the heart and the head." The tool Esherick relied on most was the band saw. He had two of them: One, made from two bicycle wheels by his first cabinetmaker, Jon Schmidt, had its column on the right; the other had the standard left-hand column. Esherick was therefore free to run the work through from whichever side was handier. After the form was rough-cut, Esherick would shape it by hand with gouges and rasps or with a stationary belt sander if the contours were broad. The shop also contained a thickness planer, jointer, drill press, table saw and radial arm saw.

Because Esherick valued the beauty inherent in wood and respected its temperament, he often called attention to checks in his furniture, rather than trying to hide them. Likewise, he appreciated knots for the texture they contribute. Esherick believed furniture should be used freely and not pampered, as illustrated by his facetious formula for finishing: "Take a tabletop. Throw oil all over it, add salt and pepper. Rub them in carefully, then scrub them off with an abrasive cleaner." Tables, he said, are like shoes, and improve with use.

For more serious finishing, Esherick preferred boiled linseed oil, except for a few cocktail tables and countertops, which he treated with epoxy. Esherick rubbed the oil into the wood with sandpaper, then wiped it dry. One application was administered daily, using progressively finer grits of sandpaper. The final oiling was applied with rottenstone and worked into the wood with bare hand.

Esherick worked until his death at age 83 in 1970. His family and close friends preserved his home, and in October 1972 it opened as a museum. In the museum's collection are several models, prototypes and examples of designs Esherick used repeatedly, including his three-legged stools and hammer-handle chairs (p. 54, top). The stools are probably Esherick's most familiar and most widely imitated work. They were easy to make and sell, and he referred to them as his "bread and butter." The legs of the stools were always hickory, but the seats could be anything from coffeewood to dogwood. Whenever Esherick or his assistants found a piece of crotchwood lying by the roadside, they saved it for stool seats. Esherick fashioned each seat according to the shape suggested by the wood's figure, and no two are alike.

Two barrels of hammer handles purchased at auction were the genesis of Esherick's hammer-handle chairs. They were set aside, and when some time later the actors of Hedgerow Theatre, an impoverished repertory company, approached him for seating, Esherick constructed 48 chairs with the back legs angled out so the sitter could easily lean back. Under his direction, the actors finished the chairs themselves and laced the seats with painted canvas belting used to drive factory machinery. As with most chair designs, Esherick kept the prototype for his own use.

Esherick was fond of recycling materials in unusual ways. Besides hammer handles, machinery drive belts and bicycle wheels, Esherick also found a use for a couple of oxtail vertebrae from a favorite soup prepared by his neighbor. The intriguing shapes still serve as a lamp-pull weight in Esherick's dining area.

Esherick is as well known for his interiors as he is for his furniture. He received the gold medal of honor from the Architectural League of New York in 1958, and the American Institute of Architects posthumously awarded him their gold medal for craftsmanship in 1971. Perhaps the quintessence of Esherick's ideals of a totally sculptured living space is his studio, begun in 1926 on a wooded hill just above his farmhouse, 20 miles west of Philadelphia (p. 50). As with many of his other works, nature supplied his raw materials—sandstone and oak. Inside and out, every aspect of the studio was shaped by Esherick's hand. The stone walls rise from the foundation and slope inward like an old tree trunk, and the roof gently sags across its ridge. Eventually Esherick made the studio his home. Doors, walls, ceilings, furniture, lamps, light switches, mirrors, bowls and plates were all crafted by Esherick into a unified work of art. He even shaped the oak toilet seat, forged the door hinges, and had a coppersmith line the wooden sink in the kitchen. (The shape of the sink is free-form, and it receives a free-form cutting board, plucked from an overhead beam, to enlarge the kitchen's counter area.) The floorboards are a mosaic of apple and walnut cutoffs discarded by his woodman, Ed Ray. They are not nailed, but splined. Each room is comfortable and unique. Doorpulls, spoons, pot handles and the twining railings fit perfectly into both hand and spirit.

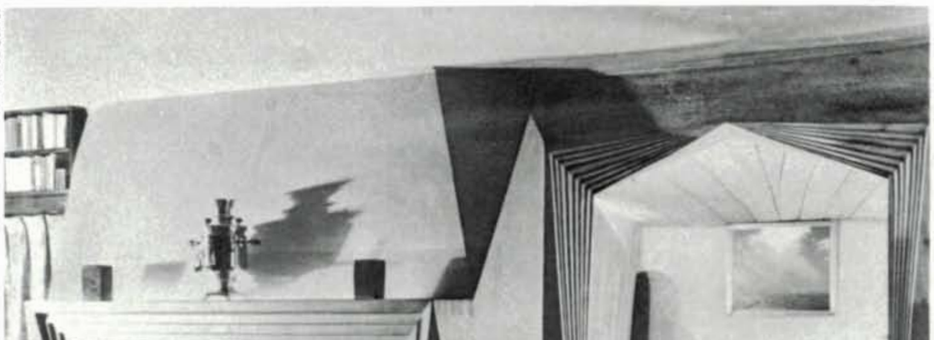
The careful use of space and characteristic irregular walls give some Esherick interiors a ship-like appearance. Esherick's own kitchen occupies one level of a cylindrical addition to his studio, called "the silo." Utensils and pots hang from the crowded ceiling, and curved shelving fits against the round walls, strongly suggestive of a ship's galley. The view from the kitchen is one of the best in the house—"A kitchen should have a good view; people spend a lot of time there. . ." said Esherick, although Miriam Phillips, his long-time companion, adds, "Esherick didn't."

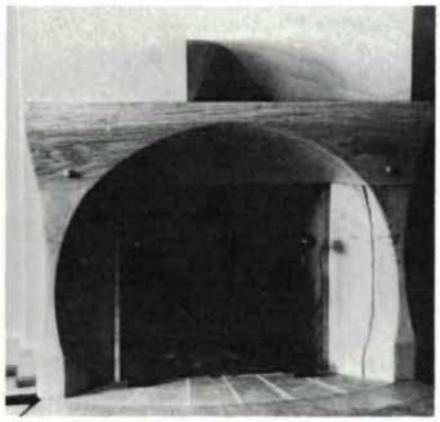
The studio centers around a spiral staircase made of red oak, which sprouts from the main floor and ascends to Esherick's bedroom in the loft (p. 54, bottom left). The stairs divide at the fourth step, the spiral continuing for six more steps, then straightening out up to the bedroom. The other section scoops down from the dining area to meet the center column. The steps are tenoned into the twisting 9¾-ft. center post and secured with metal bolts. Like most of Esherick's larger works, the stairs can be disassembled, and twice they have been removed for exhibition in New York.

The home of Judge Curtis and Nellie Lee Bok of Radnor, Pa., was one of Esherick's earliest interiors, and the work commissioned by Judge Bok helped keep Esherick employed during the lean years of the Depression. The spiral staircase at the Bok's (p. 56, top) rises in the front hall, welcoming guests to an exceptional home. The steps are solid white pine beams, once part of a bridge (believed to date back to the

Stairs, left and above (seen from below), designed and built for the front hall of the Bok house (1935) from solid white pine beams.

Lawrence Seiver





Library fireplace and music-room doorway of the Bok house, above. The arches over fireplace and door were built in 1936 of white oak. The music-room fireplace in the background is plaster and the ceiling is white pine boards joined with full-length tongue and grooves. The curved storage unit for phonograph records and sheet music, right, made of cherry, is built into a corner. The angle of the partitions is varied to utilize the depth of the corner and to provide easy access to all the albums. The separate unit is a radio-phonograph cabinet. The window, sculpted to resemble a curtain blowing open, reflects the spirit of playfulness Esherick brought to much of his work. In the Bok's dining room, the fireplace mantel (1935), above right, is solid chestnut oak with a stone hearth, surrounded by a copper arch.

Revolution) that spanned the Delaware River. The first ten steps are free-standing, held in alignment with a 2-in. wide iron band that runs through the outer edge of each step. The eleventh step is anchored to the rear wall, and adjacent steps are joined with wedged dowels. After several years, at the request of Mrs. Bok, Esherick added polished iron railings for safety and to accentuate the curves.

The current owners of the Bok house carpeted the steps to protect them from spike-heeled shoes; the pine scratched easily, and repeated sanding wore the steps down to the iron band. Years later Esherick admitted the staircase should have been made of oak, although that would have sacrificed the knotty texture and golden color of the pine.

For Judge Bok, Esherick also designed a padauk and walnut library, which holds 8,000 volumes. A hidden shelf pulls out from among the books to hold large reference works. The arching library ladder (p. 53), topped with caricatures of a donkey and an elephant, playfully symbolizes Bok's bid for public office and marks Esherick's transition from the cubism prevalent through the Bok house to the more sculptural, organic style he worked in for the rest of his life.

The commissions of Lawrence and Alice Seiver of Villanova, Pa., represent Esherick's work during the 1960s. Esherick replaced the usual draperies in the living room with an abstract window screen of wooden slats and paneled the wall over the fireplace in a bold configuration of splined boards suggestive of brushstrokes (right). Esherick constructed the paneling like a huge jigsaw puzzle. He routed grooves $\frac{5}{8}$ in. deep along the edges of the 1-in. panels, and cut $\frac{1}{4}$-in. plywood splines to fit the grooves and join the panels. The splines are about $1\frac{3}{16}$ in. wide and nailed to furring strips which, in turn, are anchored to the wall beneath. Esherick didn't glue the splines into the panels but rather secured them at a precise distance to allow the panels to expand and contract freely without buckling or showing too much spline. Esherick painted the splines in bright colors, which can be appreciated in the winter. In the summer, when the boards expand, the colorful splines disappear.

Esherick also splined his curved paneled sofas and cabinets, but since these are not framed with a lower rail, he glued one side of each spline to keep it from slipping out of the bottom of the slot. He formed the curve of these pieces by mounting the boards on a bandsawn batten screwed on from behind. For wall paneling around a fireplace, he would insert a metal strip between the top of the fireplace and the bottom of the paneling in order to secure the panels and to prevent flames from leaping behind the wood.

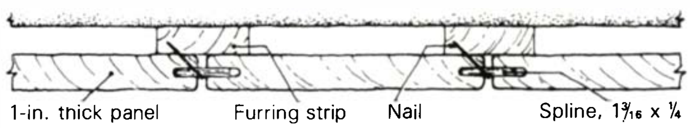
Wharton Esherick was a quiet man—shy, some would say. He rarely left his studio, preferring to communicate through his work. Craftsmen who knew him remember him as being highly opinionated on questions of design, although he never criticized a fellow artist. He rarely socialized and would not attend any function where the invitation suggested "formal attire." He worked incessantly, never taking a vacation because he could not imagine an activity more enjoyable than being in his shop. His son remembers hearing Esherick arise in the middle of the night to run the band saw. "If you take the fun away," Esherick often said, "I don't want anything to do with it." □

Michael Stone, 24, is a freelance writer and amateur woodworker who lives in New Britain, Conn.

Michael Stone

During the 1960s Esherick did extensive work for Lawrence and Alice Seiver of Villanova, Pa. Window and fireplace paneling in their living room is tulip poplar; construction is shown below. Esherick also made the shelving and curved paneled sofa.

Wall paneling construction



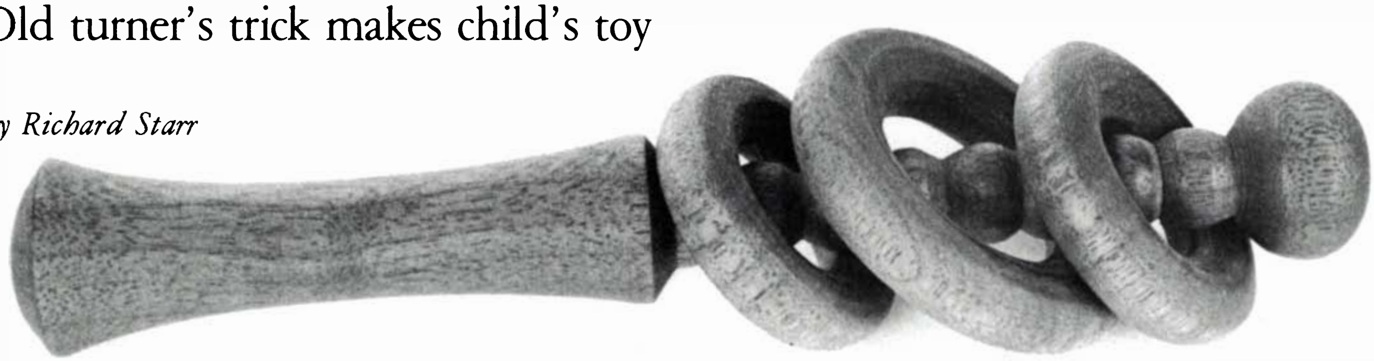
Walnut and leather chair. Slats in the walnut grill coverning an air-conditioning unit go from flat tenons at the bottom to round tenons at the top. (Commissioned by the Schuette-Koerting factory, 1942.)

The Wharton Esherick Museum (Esherick's studio and more than 200 pieces of his work) is open by appointment on weekends to groups of six people or less, and on weekdays to larger groups or school tours. The museum is staffed by volunteers: Bob Bascom, the director; his wife, Ruth (Esherick's daughter); and Miriam Phillips, Esherick's long-time companion. Reservations, which include a one-hour guided tour of the museum, are required, and an admission fee of $2 per person should accompany the request. The address of the museum is Box 595, Paoli, Pa. 19301, and the telephone number is (215) 644-5822. A map giving directions from the Pennsylvania Turnpike is sent with the reservation confirmation.

Ringed Rattle

Old turner's trick makes child's toy

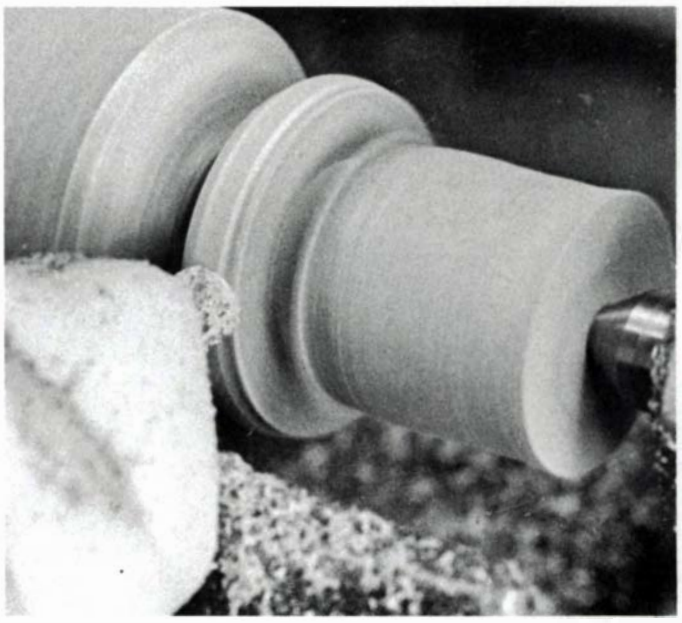
by Richard Starr



This neat little toy interests adults almost as much as it pleases kids. It's pretty to look at and fun to handle—the loose rings bump along the beaded shaft with a gentle clatter. Grownups wonder how the rings got onto the one-piece handle and shaft. Some even try to undo the puzzle, but the rings won't come off because they were turned in place. It's an old trick: A beautiful 6th-century B.C. wooden chalice unearthed in a Celtic burial site in Germany had free rings turned around its base.

The rattle in the photographs is about 6 in. long; I made it from stock about 8 in. long and 2 in. in diameter. Make yours any size with any number of rings, but avoid toxic or irritating woods such as African blackwood, wenge or cocobolo, and finish it with mineral oil; this toy is likely to be put in baby's mouth.

EDITOR'S NOTE: Another good old trick is to break one ring, interlock it with another, and glue the break. They'll never figure it out.



1. To begin, cut two grooves near the end of the stock with a parting tool, leaving the wood between them a bit wider than the first ring will be. Turn down the end of the stock to about 1 in. in diameter, then widen the space to the left of the ring with a gouge. I like to graduate the ring diameters so the middle ring looks as if it would fall off the rattle, were it not retained by the smaller rings. To do this, reduce the diameter of the first ring, then round its crest with a gouge or beading tool.

Photos: Richard Starr

2. Undercut the ring from both sides using the toe of a sharp ¼-in. skew. A paring cut leaves a smooth surface, but be careful not to free the ring yet.

3. Sand the accessible surfaces of the ring; I use 220 and 400-grit wet/dry paper, kept wet with mineral oil.

4. Free the ring by undercutting from both sides with the toe of the ¼-in. skew, keeping the edge horizontal and the handle down. Try to cut the inside diameter of the ring as large as possible.

5. Use the same procedure to cut and free the rest of the rings; be sure to sand the surfaces before freeing each ring.

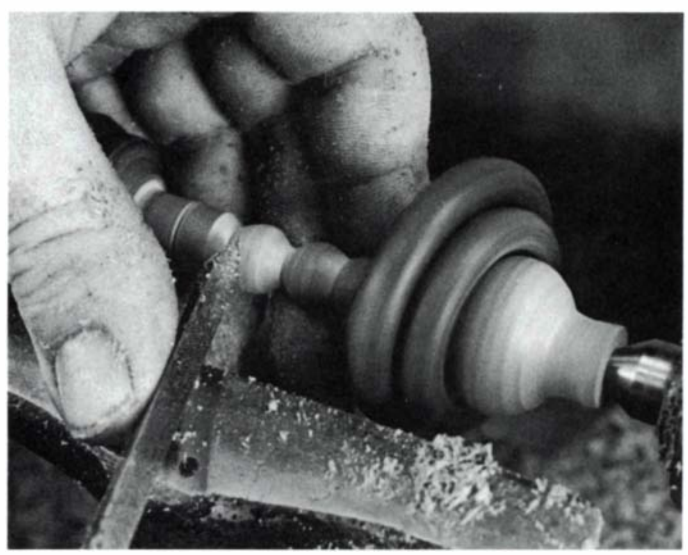
6. Shape the ball on the end of the rattle, leaving it just a little larger than the inside diameter of the first ring.

7. Use a ½-in. skew to trim the shaft to a smooth cylinder, but leave the diameter of the shaft as large as possible at this stage. Hold the rings away from the tool with your finger.

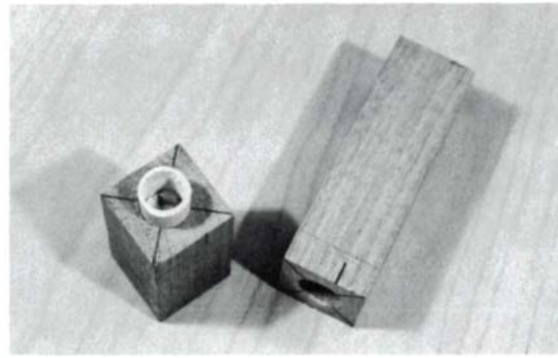
8. Wrap a strip of sandpaper around the shaft clockwise (so it doesn't unwind in use) and hold it in place with a rubber band. If the inner surfaces of the ring are ragged, start with 100-grit paper.

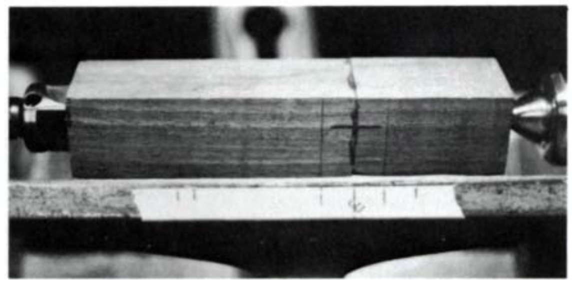
9. With the lathe running, hold each ring against the sandpaper. Move the ring to sand every section of the inside surface evenly, and tilt it to round the edges. I work up to 400-grit wet/dry paper wetted with mineral oil.

10. This is a good time to rough out the shape of the handle. Then trim the shaft to its finished diameter and lay out the beads with deep marks cut with the point of the ¼-in. skew.



11. Use the toe of the skew or a beading tool to cut the beads. Shape the handle, then sand everything with wet/dry paper and mineral oil. Saw the waste off the ends, whittle them smooth, sand and oil. Warning: This rattle may be habit-forming. Don't leave it around unsupervised adults. □





Rattles are assembled from a crosscut block and a wooden sleeve made by drilling a dowel. Kernels of corn rattle inside the cavity, and the dowel walls provide long-grain surface for gluing. Marks on reglued block, right, show where to avoid turning into the dowel.

Another Rattle

by John C. Townsend

Turning a child's rattle can be a challenging project for both the intermediate and advanced woodturner. The rattle's design is limited only by the age, size and weight of the child for whom it is intended, though certain safety precautions must be taken. The rattle must not be too narrow in diameter, certainly no less than 1 in. at its widest point, so that there will be little danger of the child choking. The finish should be a safe one: Mineral oil, available at most supermarkets, is a good choice.

To make a rattle, first select a 7-in. piece of 1¼-in. square stock with a pleasing grain. Scribe a line 2½ in. from one end, where the block will be cut apart. Also draw a second line crossing over the cutting line, to help line up the grain at assembly.

Cut at the 2½-in. mark. The smaller the sawblade gauge, the thinner the kerf, and the greater the chance of a one-piece body illusion. The cut must be straight.

Mark diagonals on the sawn surfaces to locate the exact center. With one piece firmly clamped to the drill-press table, use a ¾-in. spade bit to bore a starting hole no more than ⅛ in. deep, for the ¾-in. Forstner bit that will bore to the final depth of ½ in. Do the second piece the same way.

To prepare the noisemaker, center a length of ¾-in. dowel in a three-jaw chuck in the lathe. Secure a ⅝-in. Forstner bit in the tailstock, and bore the dowel to a depth slightly over an inch. Cut the piece to its finished length of exactly 1 in. with either a parting tool or a handsaw. You could eliminate the dowel altogether by turning a shoulder in the handle section to fit a hollow (which accepts the noisemaking corn) in the top. (See "Small Turned Boxes," *Fine Woodworking,* Winter '77).

The parts of the rattle are now ready for dry assembly. Trial-fit the dowel inside the two body pieces, making sure the pieces meet squarely and the grain is aligned. If the body sections do not meet, pare the dowel. Seal the mating surfaces with plastic-resin glue and let dry, an important step because when the rattle is completed, very little surface area will remain to hold both pieces together. Insert the dowel and six or seven kernels of popcorn in one piece and recoat both surfaces with glue. Align the grain and clamp overnight between centers on the lathe.

Mount a spur center in the end of the longer of the two pieces and make a small starting hole in the other end for the tailstock's cup or ball-bearing center. Put a strip of masking tape on the tool rest and locate on it the glueline and the ends of the hidden dowel, to avoid turning into the dowel and ruining the rattle. Rough-turn to a cylinder about 1⅛ in. in diameter, then shape it. This shaping is of personal preference, limited only by the length and diameter of the hidden dowel. Avoid turning the body so that only a thin wall remains—splitting will inevitably result.

When you have your finished shape, use a sharpened nail to cut a slight groove at the glueline. Be careful not to sever it. Cut several other grooves along the body at regular intervals for further decoration. Shallow cuts with the parting tool are also effective. The grooves make a pleasing pattern on the rattle body and also hide the glue line. If they are cut carefully, only a trained eye will be able to detect the joint.

You can create a nice effect by burning in the small grooves with a piece of thin-gauge wire applied under slight tension while the rattle turns. Finish-sand the rattle, making sure no sharp edges remain, and cut free. Use a thin-bladed handsaw or a parting tool. Sand the ends of the rattle with very fine abrasive on a flat surface. To avoid sharp edges, back the abrasive with a small piece of rag. Apply a mineral-oil finish either by hand-rubbing or by dipping the rattle into the oil and wiping off the excess. A final coat of pure beeswax may be applied, but the mineral oil itself is suitable.

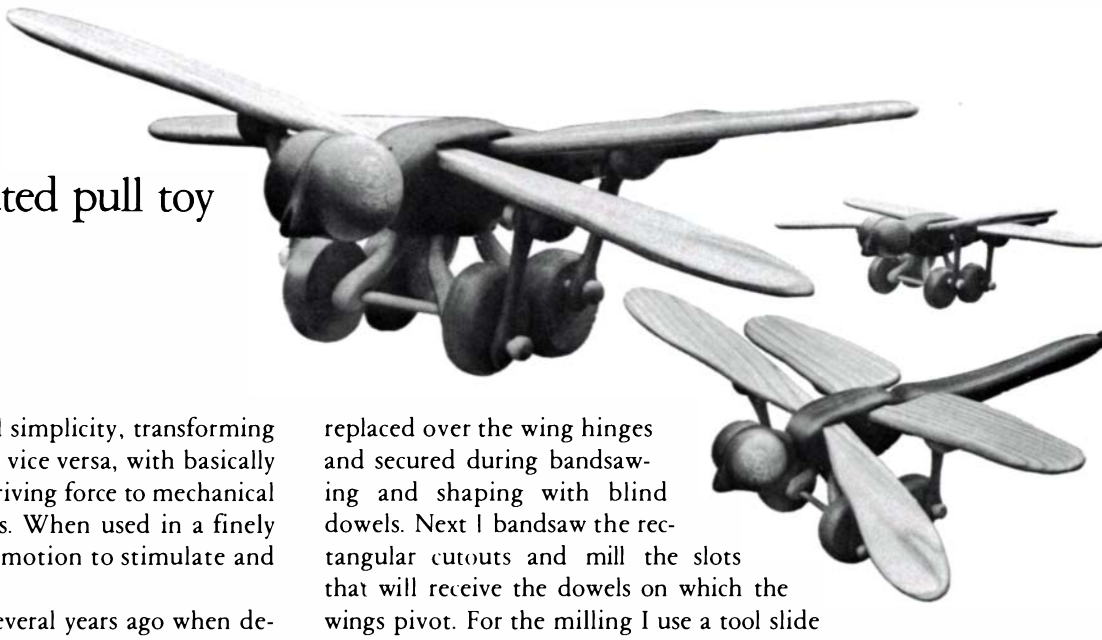
I've turned rattles with one rattle as described here, with two rattle sections in the traditional barbell shape and with rings cut free between the rattle section and the end of the rattle. I have used numerous hardwoods, and among the best are cherry, walnut and apple. □

John Townsend lives in Hamilton Square, N.J.

Dragonfly

Plans for a cam-operated pull toy

by William Huntley



The cam is a marvel of mechanical simplicity, transforming circular motion into linear, and vice versa, with basically two moving parts. It transmits the driving force to mechanical devices from bicycles to locomotives. When used in a finely finished wooden toy it can provide motion to stimulate and enchant the imagination.

I stumbled onto the cam wheel several years ago when designing my first pull toy, a wooden rabbit that hopped on two eccentrically mounted wheels. From hopping rabbits and frogs through wiggling fish, I came to the push rod—to flap wings and agitate jointed legs. The inspiration for designing a toy dragonfly came from the river behind my workshop. Darting and hovering, with bodies straight and rigid, their rapidly beating wings create that same slow-motion effect seen in a whirlybird propeller. The dragonfly seemed perfect for mechanical rendering, and the model in the plans on the next page has been in production more than a year.

The first problem was how to add an assortment of mechanical apparatus to a six-legged, four-winged creature. To avoid visual clutter, I gave the animal only four legs, using them to support two sets of axles and wheels. The wings are hinged inside the block of wood that is the abdomen, with smooth curves taking the sharpness from external mechanical parts. After several experiments with wheel diameter and push-rod length, a working model emerged. In production I make dragonflies in batches of 10, but I'll describe the procedure as if I were making only one.

The three main sections of the dragonfly are made separately and doweled together, carefully matching the shapes of abutting pieces at each joint. I cut the blanks for the head, abdomen and thorax from the same piece of 2-in. by 3⅛-in. walnut or mahogany. This allows a continuous matching of grain and color through the body. I drill the dowel holes centered in the ends of the rectangular blanks, then rough-shape each part by bandsawing in two steps. I start with the side-view profile and save the cutaway pieces for support in making the second cut to obtain the outline of the overview. It's important that the layout of all shapes be centered on the dowel holes, because inaccuracies are exaggerated by the long, slender body.

The angled sides of the head, to which the eyes are glued, are a little tricky to cut. First, I lay out the tapered shape on the bottom side of the head with two straight lines from points 2 in. apart at the rear edge of the stock to a thickness of ¾ in. at the tip. I cut along these straight lines, cradling the head in the top cutaway produced in the profile cut.

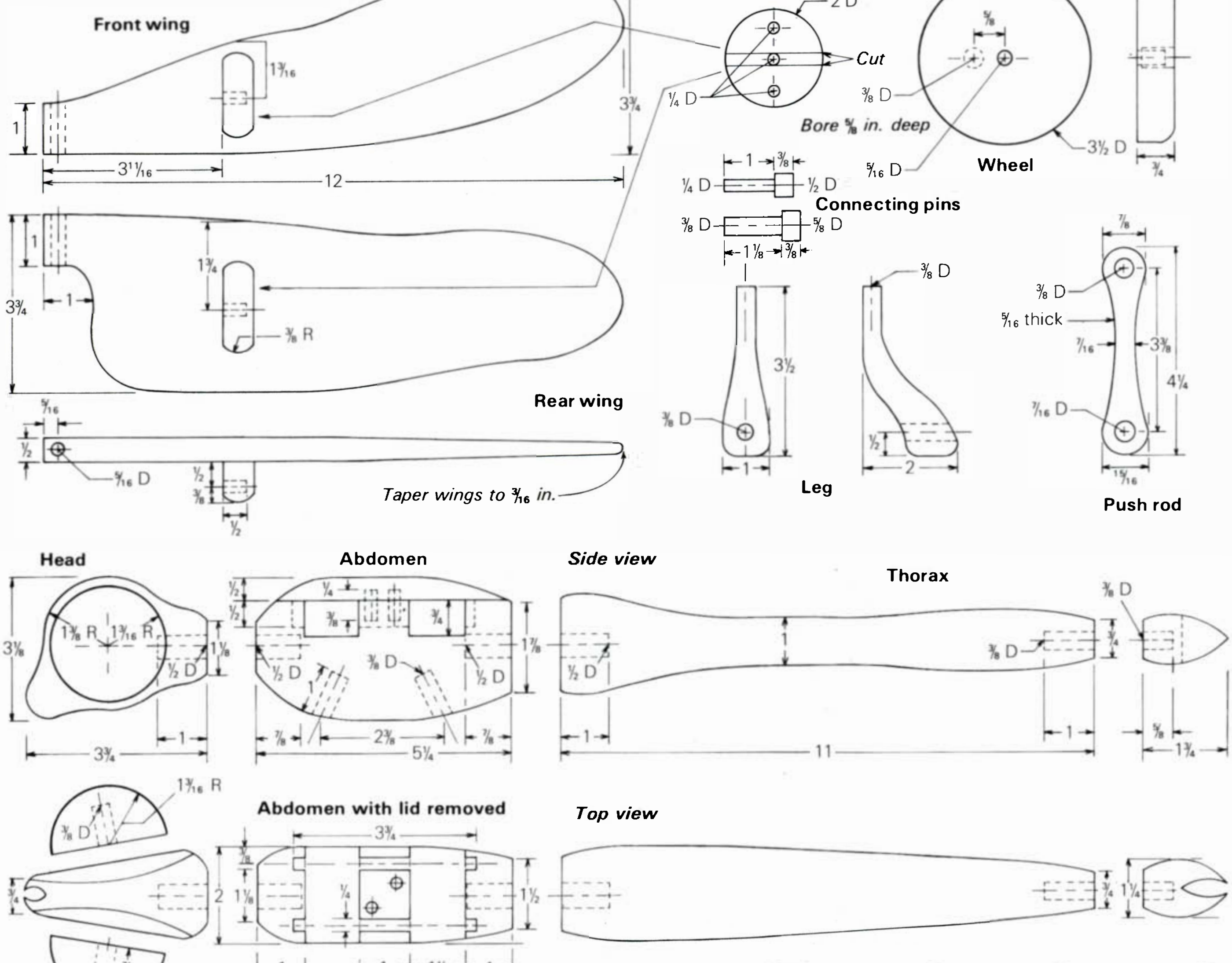
The layout and machining of the abdomen are the most critical part of the procedure. This piece contains all the moving parts, which must be accurately aligned to ensure smooth operation. All machining for the legs and wing assembly is done before shaping this piece. First, I rip a ½-in. thickness off the top side of the dimensioned blank. This piece will be replaced over the wing hinges and secured during bandsawing and shaping with blind dowels. Next I bandsaw the rectangular cutouts and mill the slots that will receive the dowels on which the wings pivot. For the milling I use a tool slide salvaged from a metal lathe. It consists of a small sliding table with two stop adjustments similar to the one on a drill press. The slide is controlled by a geared lever and contains several *T*-slots to which a vise may be bolted. The slide and vise assembly is then clamped to a drill-press table. With a straight, ¼-in. router bit chucked in the spindle, and with the spindle turning at its highest speed, this setup can produce straight and accurate slots. The spindle is lowered to a fixed height, and the lever moves the work horizontally into the bit. This rig is useful for accurate mortising and for drilling a series of holes along a centerline, especially in round stock.

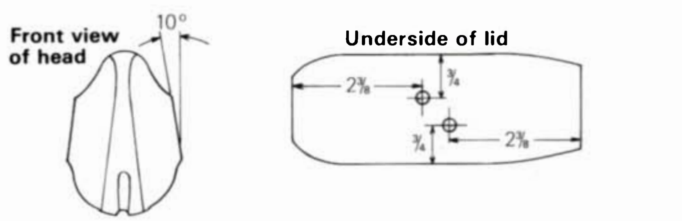
I shape the roughed-out parts with a stationary belt sander, rasps and a flap sander. The belt sander takes out band-saw marks and roughs out the curves and contours on the sharp edges. Several rasps and a flap sander with 100-grit abrasive produce the finished shape. A table-mounted router with a self-piloting, quarter-round bit gives the thorax a ½-in. radius. Positioning the piece with the convex side toward the table, I make several shallow cuts until I reach the desired radius. The outside edges of the wheels are similarly shaped with the router, using a ⅜-in. radius cutter.

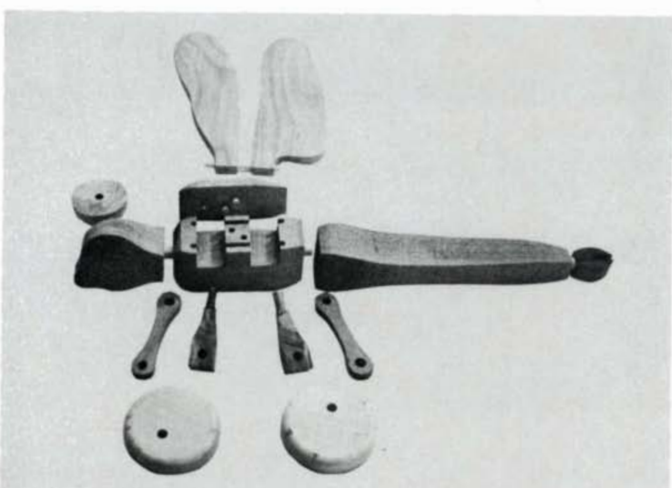
I have found that a circle-cutting jig and band saw make good wheels and other round parts. My jig uses a sharp, hard-steel point as a pivot pin. Rounds are cut quickly and accurately and emerge with the center marked. I edge-sand wheels on the lathe, using a tapered arbor held in a chuck. With a

Huntley's menagerie: Turtle of laminated maple shell and mahogany head/tail and legs is the only one not cam-operated. It is a bank, and a coin dropped through the slot in its shell causes the head and tail to bob. The rabbit hops; the stack-laminated, mahogany beaver with the ivory teeth flaps its tail; the butterfly of six different woods flutters its wings; the fish wiggles its jointed tail and waves its fins.

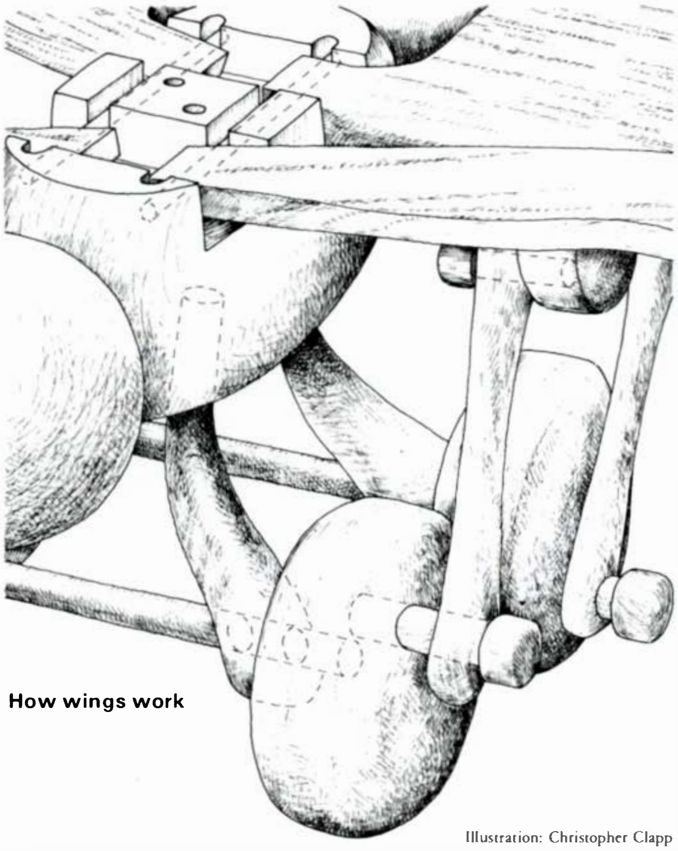
Dragonfly







Partially shaped blanks: mahogany body, oak wings, maple wheels and eye, walnut connectors and goncalo alves legs.



How wings work

Illustration: Christopher Clapp

Design: William Huntley

center hole drilled, round pieces can be popped on and off the headstock without stopping the lathe. A tapered arbor holds work more securely than one of uniform diameter. The end of a piece of metal shafting can easily be tapered by filing while it's spinning in a chuck.

This method of chucking work in the lathe also has advantages for turning the semispherical eyes. The bandsawn blanks can be chucked quickly, and the chisel and tool rest can move freely to shape the rounded surface of the eye. I like to use crotch or burl wood for dragonfly eyes. The iridescence and depth obtained from such pieces when polished reminds one of the multifaceted structure of the real thing.

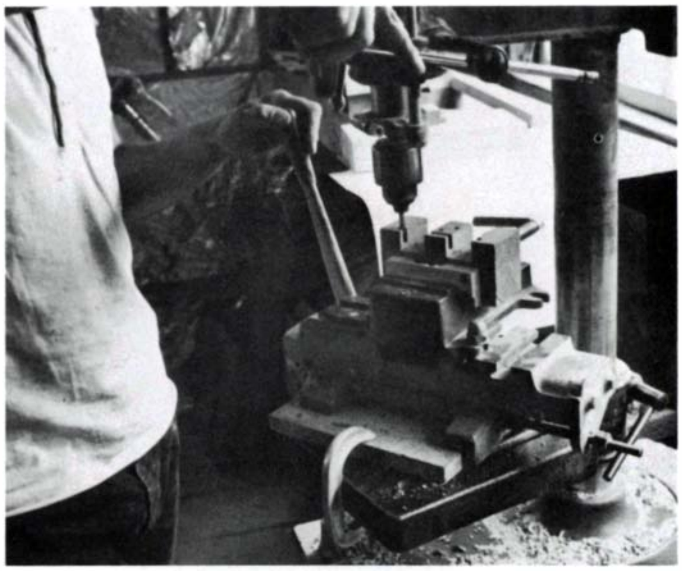
I use headed dowel pins to connect the push rods to the wheels and wings. I make these pins in two sizes and have found them versatile in joining pivotal parts in several mechanical devices. They are made with appropriate plug cutters and a drill-press vise fitted with wooden jaws. The vise is outfitted for holding dowel pieces by drilling a hole the diameter of the head of the pin into the wooden jaws with the jaws cracked open slightly (1/16 in.). When tightened, this vise will secure dowel lengths vertically and enable them to be centered accurately under a plug cutter on a drill press. From a 5/8-in. dowel, a 3/8-in. plug cutter can produce a smooth and accurate tenon with a 5/8-in. diameter head. I had difficulty, however, locating a 1/4-in. plug cutter that could cut a tenon longer than 1/2 in. Finally I found a metal-cutting tool, similar in design and function to a plug cutter. With a little regrinding of the cutter angle, I had a dowel cutter that could cut a 1/4-in. diameter tenon up to 2 in. long.

The dragonfly's abdomen, with all its mechanical parts, is assembled first—I put it together dry to ensure that everything fits well and is aligned. I install the wings first, using two lengths of 1/4-in. dowel as the hinge pin. Then I glue and clamp the top piece of the abdomen in place. When dry, scraping and sanding blend this joint into the finished shape.

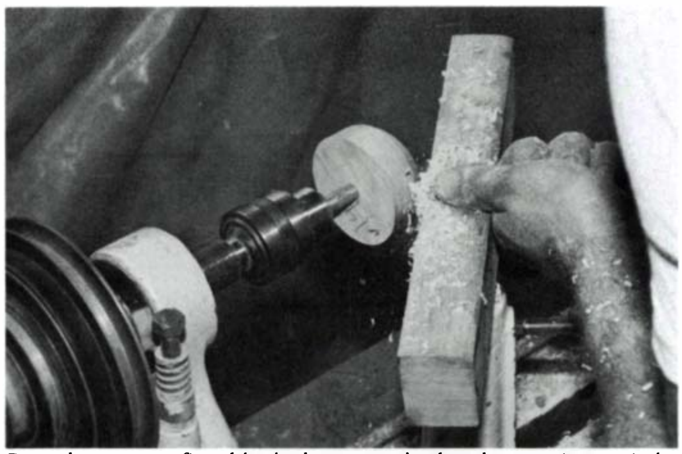
I use three parallel string lines laid out on a tabletop to locate the semicircular wing connectors. Center the body segment on the middle line, with the other two lines passing over the wings and marking off the distance to the edge of the connecting pieces. After fastening these pieces to the wing, dry-assemble the legs, axles, wheels, dowel pins and connecting rods. Test fly. For glue-up, I use two long dowels (about 24 in.) as guides to align the legs. Twist the legs until the dowels are parallel and square to the string centerline. When the legs are set, replace the long guide dowels with axle dowels of the proper length and glue on the wheels. I make sure the dowel-pin holes in the wheels on opposite ends of the same axle are 180° from one another so that the wheels will roll evenly: The upward force necessary to raise a wing on one side will be compensated by the downward movement of the wing on the other side. Because each of the two sets of wings is moved by an independent cam assembly, the flapping of front and back wings can be staggered.

The final assembly involves more dowels into dead-end holes. I find better glue contact from dowels slightly tapered and rotated into their holes. Hide glue has good holding power in this type of construction because it is elastic when dry. Thus the eyes are glued to the head and the head and thorax to the abdomen. Attach a pull string, and the mechanical dragonfly is ready to fly. □

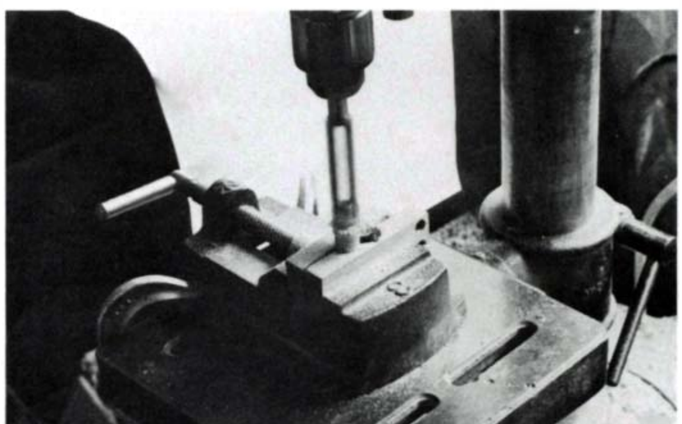
Bill Huntley, 30, lives in Center Ossipee, N.H.



Huntley uses a machinist's tool slide to move the abdomen blank horizontally past a straight, 1/4-in. router bit chucked in the drill press. The slot thus cut receives the dowel hinge-pins on which the wings pivot.



Round parts are first blanked out on the band saw using a circle-cutting jig, then drilled with a center hole. For final shaping and/or sanding, they are pressed onto a tapered, steel shank chucked on the lathe. Here Huntley shapes curly maple for a dragonfly's eye.



The author uses dowel pins with heads to assemble the push rods to wheels and wings. He makes the headed pins, left, by fixing the dowel upright in a wooden-jawed drill-press vise and cutting down most of the length with a long plug cutter, above.

Two Toy Trucks

Auto transport and delivery vans

by William J. Lavin

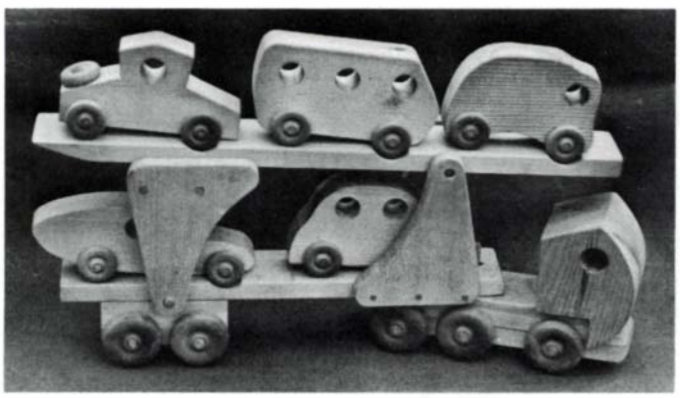
The auto transport is a favorite of both the youngster who plays with it and the grandparent or parent who builds it. The unit functions as a toy truck, and the vehicles it carries are toys, too. The truck rolls and turns, and the top carrier slants down to unload. Inlet grooves cut into the ramps allow the vehicles to remain in place over the bumpiest of roads and while the top ramp is in the unloading position.

Construction is divided into three parts: the cab, the carrier and the five vehicles. Of these, the carrier requires the most careful planning and layout.

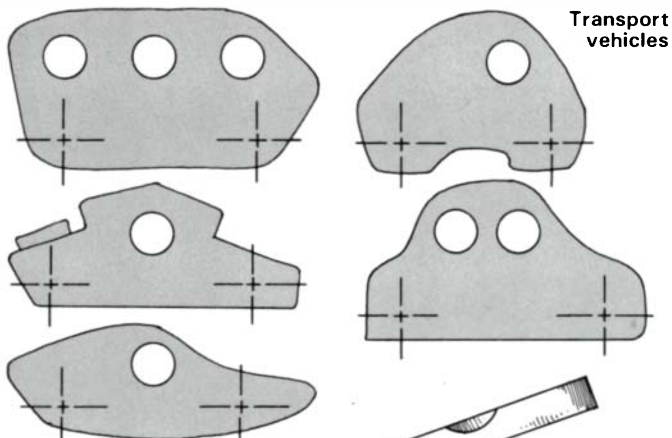
Begin by gluing up enough stock to a thickness of 3½ in. Shape the cab and bore a hole for a window. Next make the carrier. It is divided into three units: the top and bottom ramps, the pivotal supports and the wheel/axle assembly. To make the wheel/axle assembly, prepare a piece of ¾-in. stock the combined length of the front and rear axle holders (16 in.) and lay out where the dadoes for the axles should go. Dadoes along the full width of the truck minimize axle breakage, while allowing free movement. Cut the dadoes about 1/16 in. wider and deeper than the diameter of the axles. I use ⅜-in. dowel and cut my dadoes 7/16 in. wide by 7/16 in. deep. Make sure to lay out the dadoes for double wheels far enough apart so the wheels won't rub against each other. To separate this assembly from the lower ramp, glue it to a spacer made out of 5/4 stock.

The four pivotal supports of the carrier are all the same shape but the front pair (which is stationary) is drilled differently from the rear pair (which moves). The rear support braces the top ramp and also swings down to allow the top ramp to tilt and touch the bottom ramp for car removal. The front support allows the top ramp to pivot. Carefully plan the location and size of the support holes. I secure the front pair of supports to the lower ramp with dowels, either blind or showing for decoration.

I use ¾-in. stock 2¾ in. wide for the top and bottom ramps, and cut wheel grooves into them. The wheels of the cars determine the size of the grooves. My cars have 1½-in. diameter wheels and I cut the radius of the grooves ¾ in. The diagram below shows how. I usually make two trucks at a time and clamp two pieces of stock for the top ramps (cut to size and marked with the centerlines) with ¾-in. thick scrap in between. I then bore holes with a 1½-in. speed-bore bit to a depth that will allow the wheels to rest in the groove, usually about ⅝ in. on each edge. Repeat the procedure for the bottom ramp. If you're making only one truck, use a piece of scrap that is 1½ in. thick. After the grooves are drilled, cut the

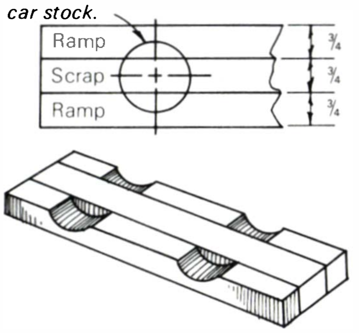


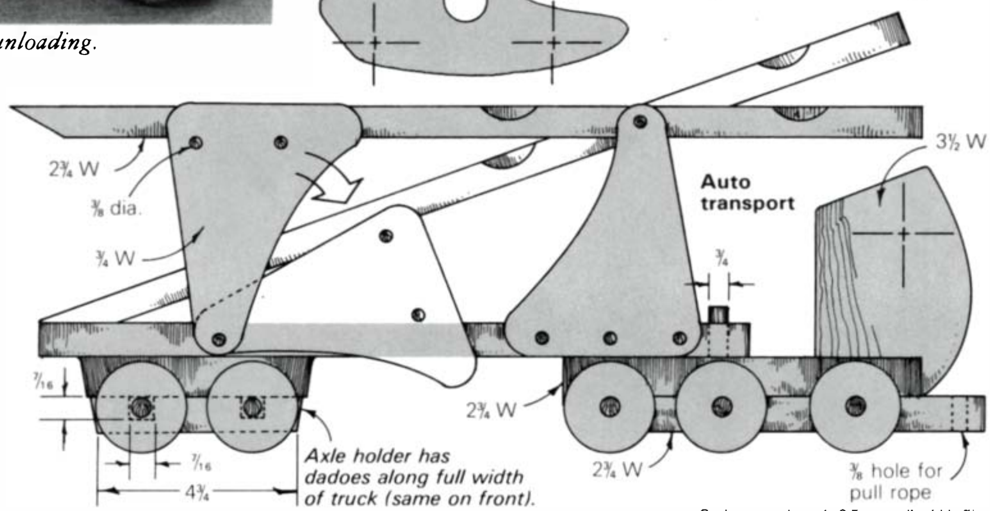
Auto transport has tilting top for easy unloading.



Wheel grooves cut on ramp hold cars

Bore 1½ in. dia. by ⅝ in. deep or to suit width of car stock.





Scale approximately 2:5, overall width 4¼

Photos: William Lavin; Illustrations: Bob Crosby taper on the bottom side of the rear of the top ramp so that it will sit flat on the bottom ramp when slanted.

The five vehicles are cut from 1½-in. stock. Because these toys are handled so much, round all sharp edges and sand smooth the insides of all large holes. I use ¼-in. diameter axles and bore the holes 9/32 in. for free movement.

Now the wheels, which is the most troublesome aspect of making toy trucks. Of all the methods I've tried, I find the best way to make the wheels is with a circle cutter on the drill press. After you cut them out, put a threaded rod the same diameter as the pilot drill on the circle cutter (usually ¼ in.) through the wheel, locking the wheel in place with a nut on either side. Chuck the assembly in the drill press and sand the rotating wheel until it's perfectly smooth. Then redrill to the axle size. Or, you can buy wheels ready-made. I get mine from Love-Built (P.O. Box 5459, Tahoe City, Calif. 95730) and use #7 wheels on the truck and #8 wheels on the vehicles. About the only time I make my own wheels is when I want them to be made out of a wood that contrasts with the body of the vehicle.

I glue the wheels onto the axles with Elmer's yellow glue. I have no problem with them falling off—in fact, in trying to remove a wheel, I've inadvertently broken the axle because the wheel wouldn't budge.

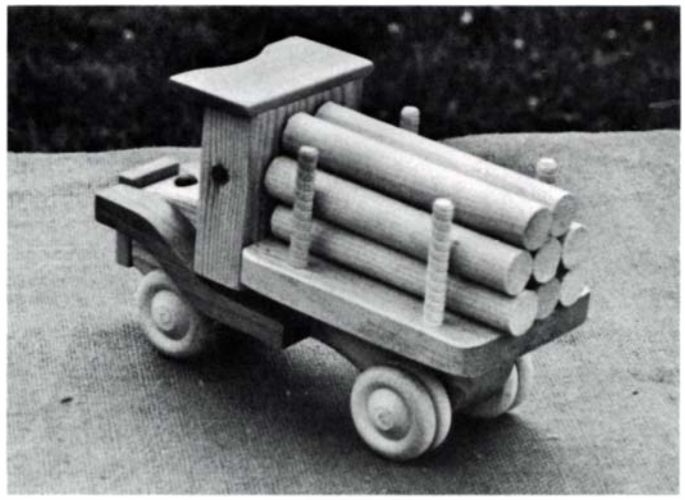
Instead of the dadoed wheel/axle assembly, you could use capped axle pegs to mount the wheels to the vehicles (also available from Love-Built, #PPLR:2). This method is not as strong, but it is much faster and easier. Simply drill a hole in the body the size of the mushroom-shaped axle peg (you want a tight press-fit), slip the peg through a wheel, and glue the peg in.

Axle pegs are also available for use on the front and rear pivotal supports (#PPLR:4). Remember that the hole at the vertex of the supports should allow free movement of the supports on the axle peg so the ramp can slant.

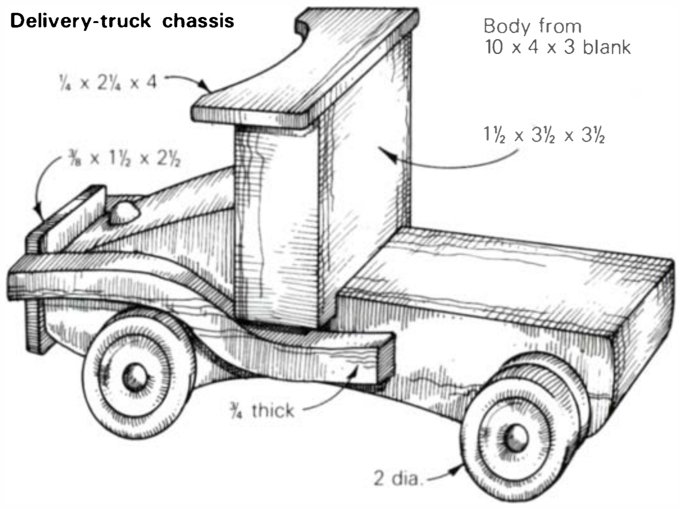
Small delivery trucks are the envy of any little boy or girl. Alphabet blocks, logs, empty boxes and almost any other imaginative cargo travel along the playland highways in these vans. It's easy to produce a fleet of them by making basic solid chassis and fitting them with shapes and styles of truck bodies not from the children's make-believe world, but from the real, everyday world of commerce. I try to use imaginative preprinted wood components—some of my truck bodies are built from the tops of 1-lb. salted codfish boxes, wooden paint-mixing sticks, wooden rules, pencils glued three or four high to form a rail, and the "does it really work?" mousetrap for the novelty approach.

To construct the chassis, I lay out several pieces of stock 1½ in. to 2 in. thick and bandsaw them to shape. I lay out the fenders on contrasting ¾-in. stock and cut them on the bandsaw, too. Then I cut the cab roof and the radiator. I always try to dress up the radiator by cutting a design into it. The cab is cut from the same stock as the chassis and has the top end slanted a few degrees forward to allow the roof to tilt down. Shallow holes can be bored in the cab for windows or you can put in plugs cut with a plug cutter from a contrasting wood. A wooden button can be used as a radiator cap on the engine. All sharp edges should be thoroughly sanded or routed with a rounding-over bit.

I use 2-in. diameter Love-Built wheels (#WP-11). These have a ¼-in. axle hole, so drill a 9/32-in. hole in the chassis. I always put dual wheels on the rear for that "official-look-of-a-truck" effect.



Truck chassis stays the same; body variations include doweled flatbed, above, and delivery van on previous page.



Unless I build a body for a specific item (such as alphabet blocks), I eyeball all measurements, mark a line and cut, using one piece as a comparison for the next. What is pleasing to the eye and fits the prepainted stock is good enough. If the stock is thin, brace it by gluing it to ¼-in. or ⅜-in. backing. I glue most of the bodies to the chassis, but for the mousetrap, I rout a rabbet in the side of the truck and let the trap in. Usually the bodies are about 6 in. to 7 in. long, 4 in. to 5 in. wide, and 2 in. to 5 in. high. Be sure to release the springs on the mousetraps and fasten all metal parts securely by soldering or epoxy.

Finishing—When I know a toy will be used with all the gusto children have, I finish it with a half-and-half mixture of boiled linseed oil and pure turpentine. I brush the mixture on and after a few hours wipe it dry. I dip the wheels into the mixture. Four days later, I repeat. I have found this the best method of finishing toys: There is no grain raising between coats, and the oil brings out the grain of the wood. I often spray the delivery trucks with several light coats of Deft instead of coating them with the mixture, but don't brush the Deft on printed wood or the ink will run. □

William Lavin, 34, of Syracuse, N.Y., builds wooden toys and hand planes, and teaches junior-high-school industrial arts.

Oyster-Shell Veneering

Experimenting with sliced branches

by Girvan P. Milligan

When a branch from a tree is cut transversely into thin slices and then applied to the surface of a box or piece of furniture, the grain and shape of the slices resemble oyster shell. Hence the name of this traditional decoration technique: oyster-shell veneering. Ernest Joyce, in his fine book, *The Encyclopedia of Furniture Making*, mentions the method, and that, along with the picture of a beautifully veneered cigarette box, led me to try my luck oyster-shelling a small plywood box. An unproductive plum tree provided wood with close grain, deep reddish heartwood and creamy sapwood—most attractive for the purpose. A locust branch, ochre in the center, helped me discover more tricks of the trade.

Cutting round sections on the band saw is easier and safer if you put a clamp on the branch or trunk to prevent rolling. You can cut smaller branches on the table saw or radial arm saw. Cutting diagonally rather than straight across yields oval shapes, which look more like oyster shell. Also, angling the cut varies the grain pattern though it also creates a problem in grain direction, which must be taken into account in the final scraping of the surface. I cut my slices freehand about ⅛ in. thick and stack them with narrow spacers between. Joyce suggests weighting down the stack, and that works fairly well until you accidentally knock one over. Binding the stack with strips of inner tube keeps the slices flat and permits easily moving the stacks from one place to another.

Being thin, the slices dry quickly. I experimented with burying the slices in dry sand, putting several thicknesses of newspaper between them in the stacks, and clamping them with cauls and no spacers or paper. The sand was the least effective because it provided no pressure and allowed the pieces to cup and check badly. Short lengths of branch, however, can be buried in sand with better results. Coating the ends of the branches with glue also helps to reduce checking. I put one of the stacks on top of the oil burner to hasten the drying time—a lesson in patience. The stickered stacks that dried more slowly in my cool shop produced more check-free slices, though even the ones that did check with the other methods gave much usable material.

When the "oysters" are dry you can cut them into squares, rectangles, polygons or fit one to another in the more natural curves of the round sections. In any case, the joints should be hairline. Obviously, straight edges are easier to fit and keep square; I use a shooting board and a block plane. Check the fit of the joint by holding the pieces up to a bright light. High spots can be cut down and checked again. In working with curved joints you can sometimes chase high spots from one end of the curve to the other since removing wood from one spot changes the relationship of other segments of the curve. Whatever the shape of the pieces, keep in mind the size and shape of the surface to be covered so the finished product will have a balanced pattern. You can bookmatch adjacent slices from the branch to start a pattern in the middle and balance it with other matching pieces toward the edges.

When you've achieved a satisfactory fit, glue the pieces together one, or perhaps two, at a time. If the pieces are square you can glue a whole row at once. One could lay out a whole panel in jigsaw-puzzle fashion and glue it all at once, but probably the joints will be tighter and assembly less nerve-wracking doing it more gradually. Trials with adhesives including white glue, Weldwood, yellow glue and epoxy came out in favor of "five-minute" epoxy. You can mix it in quantities small enough for each joint and its strength and speed of setting enable the work to move along quickly. A board covered with a piece of polyethylene and held in the vise is a good assembly surface. Polyethylene releases any glue and obviates the necessity of scraping off paper. Small clamps hold the pieces in place while the glue sets and thus prevent warping. Clamp down all the edges and not just the joint: The oysters tend to curl if not held flat. When you've assembled an area large enough to cover the surface to be veneered, trim the assembly a bit oversize and clamp or weight it between cauls until you apply it to the surface. Some pieces of the semifinished panels will be thicker than others. The radial arm saw can cut down high spots and eliminate a lot of laborious scraping. Just raise the sawblade up off the table a distance equal to the thickness of the thinnest piece and pull the saw over the piece repeatedly, shifting the panel between pulls, until the panel is level.

Now construct a box to receive the assembled oyster-shell veneers. Plywood offers a more stable base than solid wood, multi-ply birch being the easiest to work. A box of ⅜-in. ply, with the panels adding another ³⁄₃₂ in. or a little less, does not look clumsy and has adequate area for fastening hinges. My joinery is simple. I rabbet the front and back of the box and dado the sides, all of which I glue and nail together. The top and bottom I butt-join, glue and nail. Because the veneer will cover the entire outside, the joinery is concealed—any strong, simple joint will do. The box has no opening yet; cutting off the top is a later step.

Before gluing, coat the back of the panels with a thin layer of glue and let it dry to increase the strength of the end-grain glue bond. Trim each panel flush with the edges of the box. When all the panels are glued and clamped in place and the glue has set, scrape the surface level, taking care to scrape toward the center to avoid chipping the edges. When two obliquely cut pieces have been bookmatched, you can best handle the abrupt change of grain at mid-panel by scraping across both. A heavy power-hacksaw blade with the teeth ground off and all edges ground square makes an excellent scraper. It is 12 in. long, flexible and made of superior steel. Square grinding on a fine wheel gives an edge that holds, and its length provides the equivalent of half-a-dozen ordinary scrapers. When the section being used becomes dull, it is only a matter of moving down the blade a few inches to have a brand-new edge. And there are four edges. The edge that had the teeth remains a little wavy after they have been ground off, and this edge gives a rougher but faster cut. An old Victrola spring has also given me yards of excellent scrapers. A belt sander with an 80-grit belt will cut down the excess quickly, but take care to avoid burning the wood. In one trial with yellow glue, the heat of the sander softened the glue. Excessive heat can also cause checking and warping.

When you've completed scraping, cut a rabbet all around the top and on all four corners to accommodate a strip of edging the thickness of the panel. Cut the edging oversize, and scrape it down level with the surface. A contrasting color, either lighter or darker than the ground color, looks attractive. Narrow strips of inner tube wrapped about the box make satisfactory clamps for gluing the edging in place.

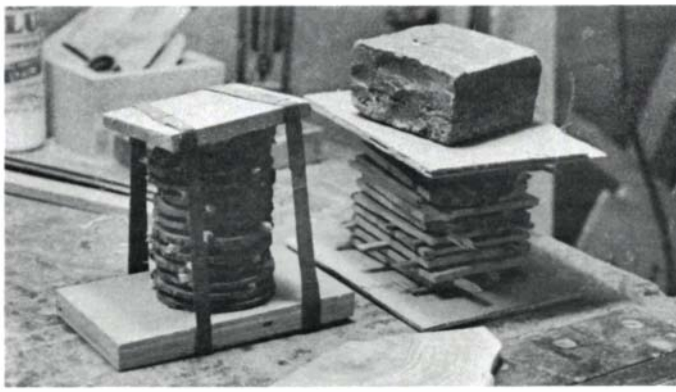
Now the whole box can be sanded to almost its finished state. There is more handling involved before completion, which may well result in scratches, so it is best to leave the final sanding till last. Cut the box open on the radial arm saw in its horizontal position, using a fine-tooth blade, or on the table saw. Take care to back up the corners with a piece of scrap to reduce the chance of splintering the edging. If you've used plywood for the box, line the box with either veneer or Formica. White matte Formica gives a nice light interior and can easily be kept clean. Veneer the exposed edges of the plywood along with the bottom of the box. I usually set four plugs made with a plug cutter into the bottom for short feet, which keep the bottom from becoming scratched.

Finish the sanding in good light, checking for the scratches you don't believe are there. They probably are. The final finish is to a large extent a matter of preference, but it's important that the surface be thoroughly sealed. Polyurethane is durable and with a number of coats and careful rubbing gives a beautiful result. Watco oil gives a nice finish, too, and allows for touching up mars more readily than polyurethane. Watco is not moisture-proof, however, and in one box finished with it there seems to be more expansion and contraction of the individual pieces.

Be prepared for wood movement. Cross-sectional pieces are highly sensitive to changes in moisture. Keep your finished boxes away from direct sunlight and radiators. To keep peeling and cracking to a minimum, cut the sections as thin as possible, size them before applying, and use a moisture-proof finish. Even so, you may have to accept small cracks and gluelines that vary in size as part of the design. PEG (see p. 68) is an alternative I have not tried.

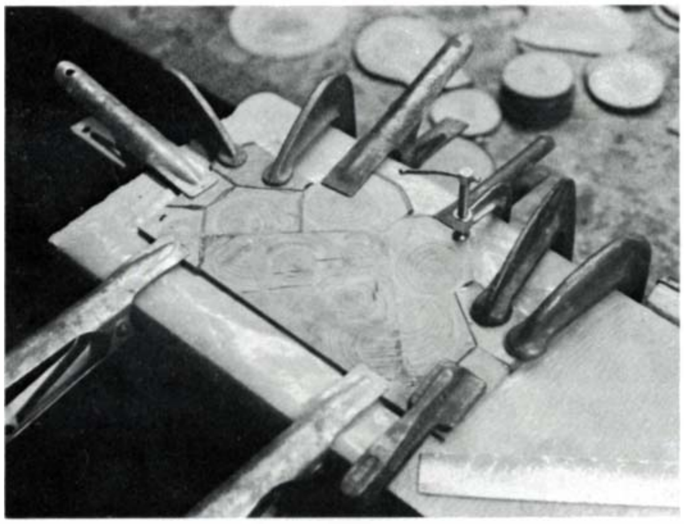
A variation that is not truly oyster work (since the wood does not contain the heart) can be made from all those small scraps you have hesitated to throw away. Many woods have beautiful and interesting end grain, and careful matching and mixing can result in a handsome piece of work. □

Girvan Milligan, a retired teacher, lives in Carmel, N.Y.

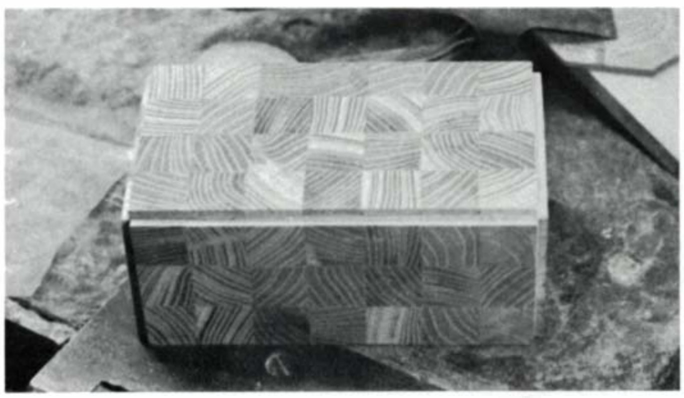


Photos: Girvan Milligan

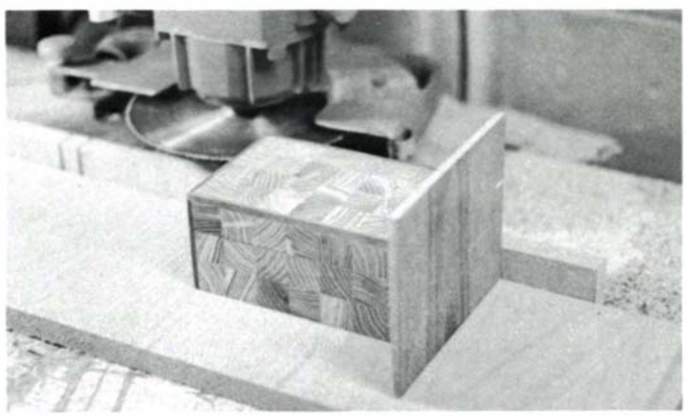
Branches sliced and stacked for drying. Weight, right, and strips of inner tube, left, keep oysters from warping.



Assemble oysters on a polyethylene-covered board, held in a vise.



Rabbet cut around top of box and corners receives edging. This box, veneered with assemblages of end-grain stock, is a variation on the oyster-shell technique.



Radial arm saw with fine-tooth blade cuts lid off box. Back-up board keeps veneer from splintering.

PEG for the Woodworker

What you always wanted to know about polyethylene glycol-1000

by R. Bruce Hoadley

No property of wood causes more perplexing problems than shrinkage and swelling as it loses and gains moisture. Traditional woodworking copes with dimensional change by predrying lumber to a suitable average moisture content, by designing to allow dimensions to change without consequence, by finishing to minimize moisture exchange, or by simply restraining the wood from changing dimension. Modern technology offers yet another alternative: stabilization by chemical treatment. Of the many chemical wood stabilizers, polyethylene glycol-1000* requires no special equipment. Just soaking wood in water solutions of PEG controls dimensional instability.

PEG research was begun more than 20 years ago by Dr. Alfred J. Stamm, then of the Forest Products Laboratory and later professor of wood science and technology at North Carolina State University. In more recent years Harold L. Mitchell of the Forest Products Laboratory (now retired and associated with the Crane Creek Co.) has been a leader in adapting PEG to practical product applications. Recent publicity suggests that PEG is a foolproof panacea for dimensional troubles with wood. Hardly. Its potential should be viewed with guarded optimism, and its merits carefully weighed against its cost, inconvenience and limitations.

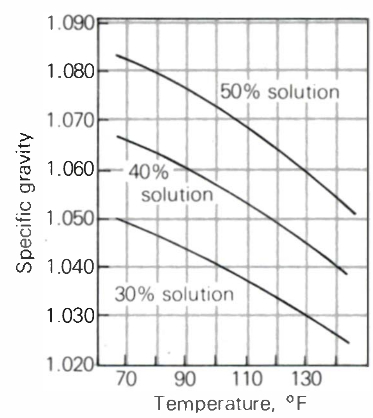
PEG at room temperature is a whitish solid that looks much like paraffin wax. Unlike wax, however, it is highly soluble in water and it melts to a syrupy liquid at 98°F to 103°F (36.5°C to 39.5°C). When green (fully swollen) wood is soaked in a water solution of PEG, the PEG molecules replace the water molecules in the cell walls. This bound water is responsible for the natural swollen state of the green wood. When the wood is dried, the PEG molecules remain, bulking the wood in its swollen condition and thus preventing shrinkage. PEG will not prevent already dried and shrunken wood from swelling. To be effective, therefore, PEG must penetrate thoroughly—it depends on diffusion through free water in the cell cavities to reach the cell-walls. So not only must the wood be green and fully swollen, but its moisture content must be above the fiber saturation point (about 30% moisture content). When wood with a moisture content near 30% is treated with PEG, its shrinkage will be reduced only 60%. When wood at 100% moisture content is treated, shrinkage is reduced by nearly 90%. The first key to success with PEG is to keep the wood at its original green moisture content. For woods whose green moisture content is low, such as white ash or the heartwood of many conifers, less than maximum stabilization can be expected.

The second key to success is grain direction. Just as liquid movement and diffusion are many times greater along the grain than across, PEG penetrates end grain much better than side grain. In practice, you cannot expect effective penetration into boards (of average density) much more than an inch in thickness, or into cross-sectional pieces more than 3 in. to 4 in. along the grain. These limitations suggest the most appropriate applications of PEG: stabilizing cross-sectional discs of wood, and small turnings or carvings.

Penetrability varies among species. In general, the greater the density, the more difficult the wood is to treat. Woods with high extractive or resin content may also resist PEG penetration. Sapwood and heartwood within a species may behave differently—sugar maple sapwood treats well for its density, but the heartwood is considered untreatable.

Strength of solution, temperature and soaking time are critical factors. Solutions of 30% to 50% PEG work best. Stronger solutions penetrate better but require more chemical to prepare. Equal parts (by weight) of PEG and water yield a 50% solution: 10 lb. of PEG in an equal weight (4.8 qt.) of water yield about 8.5 qt. of 50% solution. To mix a 30% solution, dissolve 3 parts of PEG in 7 parts water, that is, 4.46 lb. of PEG in 5 qt. of water, for 7 qt. of solution. Melting the PEG (in a double boiler) or fragmenting it speeds the process. Hot water also accelerates dissolving.

It is best to check the solution density with a hydrometer, as well as the temperature. At 70°F (21°C) a 30% solution will have a specific gravity of about 1.05; a 50% solution about 1.083. As the wood absorbs the PEG, the solution may become diluted, or if water can evaporate from the soaking vat, the solution may become more concentrated. A hydrometer, along with the graph at right, will indicate when to add more PEG or more water. Leftover solution can be reused by restoring it to its original strength.



Density of PEG solutions at various temperatures

Source: Union Carbide product manual F-4772G.

Soaking procedure and equipment can be quite simple. The objective is to find a container about the same size and shape as the wood being treated, to minimize the solution

* Polyethylene glycol is a polymer (multiple molecule) form of the monomer (single molecule) ethylene glycol. The polymer form found to be most effective as a wood stabilizer has an average molecular weight of approximately 1000; it is therefore designated polyethylene glycol-1000, abbreviated to PEG-1000 or simply PEG, pronounced "pee-ee-jee." Polyethylene glycols are polymers of ethylene oxide with the generalized formula $HOCH_2(CH_2OCH_2)_nCH_2OH$, where n represents the average number of oxyethylene groups. In polyethylene glycol-1000, n averages about 24. Although many will recognize the monomer, ethylene glycol, as the principal ingredient of permanent-type automobile antifreeze, antifreeze has no stabilizing effect on wood, so don't bother trying it.

volume needed for immersion. Any ceramic, enamel or plastic containers will work. Because metals (other than stainless steel) discolor many woods, line metal containers with a puncture-resistant rubber sheeting or 6-mil polyethylene. For large, long or irregular objects, you could make a wooden or plywood tub and line it with polyethylene. Where a great deal of treating will be done, line the box with fiberglass.

In open tanks or vats, some means of weighting or holding down pieces has to be improvised, along with separating strips to ensure that the solution circulates around all surfaces. You may get layering of high or low concentration during soaking, so stir at least daily with a stick or paddle.

The solution penetrates much faster at temperatures of up to 140°F to 160°F, so where the project warrants it, it is worth heating the treating vat. A thermostatically controlled heat source would be ideal (my wife's Crock-Pot would make a perfect soak vat for 6-in. discs). Even an improvised tank can be fitted with a thermostatically controlled immersion heater, and the walls insulated with fiberglass wool. A simple way to get heat is to put the tank over or near a radiator. Or suspend a light bulb of the reflector-flood type over the solution, inside a covered vat. Placing the vat outdoors in the summertime to be warmed by the sun will work, except that it will be difficult to assess the treatment in terms of reproducing it closely another time. One PEG supplier, Spielmans, sells insulated vats with thermostatic heaters.

How much PEG retention, how much stabilization and how much soaking time are obviously the critical questions; unfortunately they are difficult to answer and are best considered in connection with specific categories of treatment.

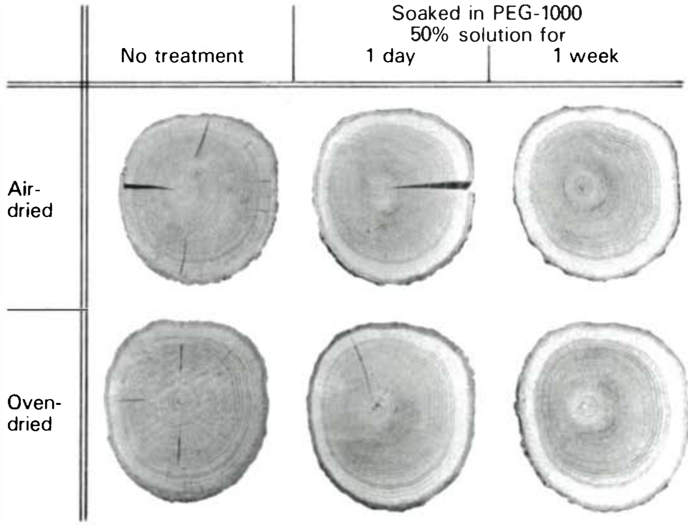
The first category involves pieces of wood with the pith included, where the greater tangential than radial shrinkage would result in radial cracks. Cross-sectional discs, intended for clock-faces, coasters, lamp bases or even tabletops, are typical examples. Although such pieces cannot be dried without defect when untreated, they are ideal subjects for PEG stabilization as long as their thickness (i.e., dimension along the grain) is not greater than 3 in. to 4 in. It is impossible to specify precise soaking schedules, but start with the guidelines (chart, top) suggested by the Forest Products Laboratory. These treating times have been successful in preventing cracks in black walnut discs treated green.

The advantage of elevated temperature and increased solution concentration is obvious. For lower-density woods, such as white pine, cottonwood or yellow poplar, try half to two-thirds the times listed; for higher-density woods such as beech or hickory, double or triple the times. I have soaked cross sections of red oak, 6 in. in diameter and about 1 in. thick, in a 50% solution for a week at 120°F. No defects developed whether they were then dried rapidly or slowly. But red oak is quite permeable; I would not expect the same good results with white oak. Experience will help identify the easy and difficult woods to stabilize: I have given up trying to treat sugar maple, but I have had excellent results with oak, black walnut, butternut and elm. Others report good success with a wide variety of species including pines, spruce, redwood, cottonwood, willow, soft maples, beech and apple. Cherry may tend to develop internal checks (honeycomb) if treated at temperatures above 110°F.

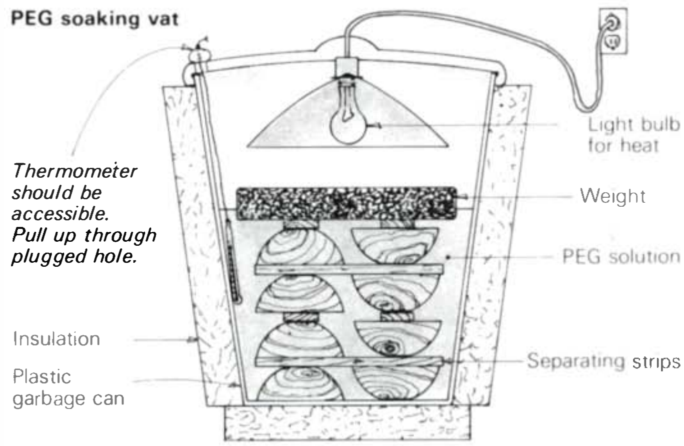
In preparing discs for treatment remember these two points: First, keep them from drying out—maintain the original green moisture content. It is even worth soaking the

Solution concentration and temperature	Suggested period of soak for walnut discs: Up to 9 in. in diameter and 1 in. to 1½ in. thick	More than 9 in. in diameter and 2 in. to 3 in. thick
30%, 70°F	20 days	60 days
50%, 70°F	15 days	45 days
30%, 140°F	7 days	30 days
50%, 140°F	3 days	14 days

The effects of PEG treatment



PEG soaking vat



Bowls are removed from a PEG soaking vat—a plywood box lined with fiberglass.

wood in water for a few days before treating. This will saturate only a thin layer, but will nevertheless improve PEG retention at the surface where drying defects are most apt to start. Secondly, cut the discs as close as possible to final thickness and flatness before treatment. This will maximize penetration and alleviate surfacing work later.

If discs are to have bark attached, it is best to cut the tree in winter. In summer-cut trees, where the cambial cells are active and fragile, the bark tends to loosen when dried.

To attain 80% to 90% stabilization (usually enough to avoid drying cracks), average retention of 25% to 30% PEG (based on oven-dry weight of wood) is desirable. In a typical disc this ranges from 40% or more near the surface to 20% or less at mid-thickness. These figures can be used to estimate how much PEG will be "used up," that is, absorbed out of solution during treatment. However, assaying the percentage retention is tedious, requiring weighing of dried samples, leaching the PEG by boiling, and reweighing the redried samples. In practice, treatment is evaluated on a success or failure basis. Be cautious, however, for although a treated disc does not have cracks, it may contain stress that can cause cracking later. Doming or dishing indicates near-critical stress. Only time will determine success. This is a "cut and try" endeavor where experience is the only good teacher.

A second major category of PEG application is where any dimensional change due to moisture variation is undesirable in the final product, and maximum stabilization is the objective. A good example is gunstocks for target rifles, where small changes in dimension in the stock may affect accuracy. Another application involves the maple strips used in core laminations for archery bows, where humidity changes can cause twisting. Other PEG-stabilized products are musical instrument parts, bases and framing, large engraving blocks and patterns. PEG-treated wood can be glued with resorcinol or epoxy, but polyvinyl (white) and aliphatic (yellow) glues do not work well. Treated lumber should be dressed with a jointer or surface planer as in routine gluing and laminating. Removing surface traces of PEG by first scrubbing with toluol and washing with methanol (methyl or wood alcohol) produces the best glue joints. If joints will not be subjected to high stress, washing with alcohol alone will suffice.

PEG is also used by bowl turners. It is difficult to dry blocks of considerable thickness (say 5 in. to 6 in.) without degrade. Thus turners often rough-turn the bowls in the green condition. But when an untreated rough-turning is dried, unequal dimensional changes may distort the bowl so much that final turning is impossible. With hard-to-season species or with irregularly grained pieces such as burl or crotch, where drying defects are common, PEG treatment of the rough turning will usually overcome these problems. If bowls are green-turned to wall thickness of ½ in. to ⅝ in., an average species like black walnut can be treated with a moderate schedule (e.g., three weeks at 70°F in a 30% PEG solution or one week at 140°F in a 50% solution) to achieve a high degree of stabilization.

PEG is described by the Forest Products Laboratory as "non-toxic, noncorrosive, odorless." It has been declared safe as an ingredient in cosmetics, ointments and lotions, and as a binder for pharmaceutical tablets. Results of tests involving laboratory animals also support this classification. Where PEG-treated wood is used for utensils or containers such as bowls, PEG contamination of food does not appear to present any problems. Possible toxicity of finishes should, of course, always be considered, as with any food containers.

PEG treatment is also applicable to large woodcarvings. The green wood is carved to within ¼ in. or ⅛ in. of the final surface. Between carving sessions the piece is kept wrapped to prevent drying. Then the wood is treated enough to stabilize the surface to a depth beyond that which will finally be carved, thus avoiding surface checks. Minor changes in overall dimensions are usually acceptable. For a rough carving of approximately 8 in. by 6 in. by 24 in. in yellow poplar, I found that a four-week soak in 30% PEG solution at room temperature was sufficient. For me as a hobby carver, the drawback is that I seldom finish a sizable carving quickly, so storing the green wood without stain or molding becomes a problem. Sometimes I put them in my freezer. Remember, this approach will offer only surface control of dimension; pieces containing the pith will still develop large radial cracks due to the tangential/radial shrinkage differential.

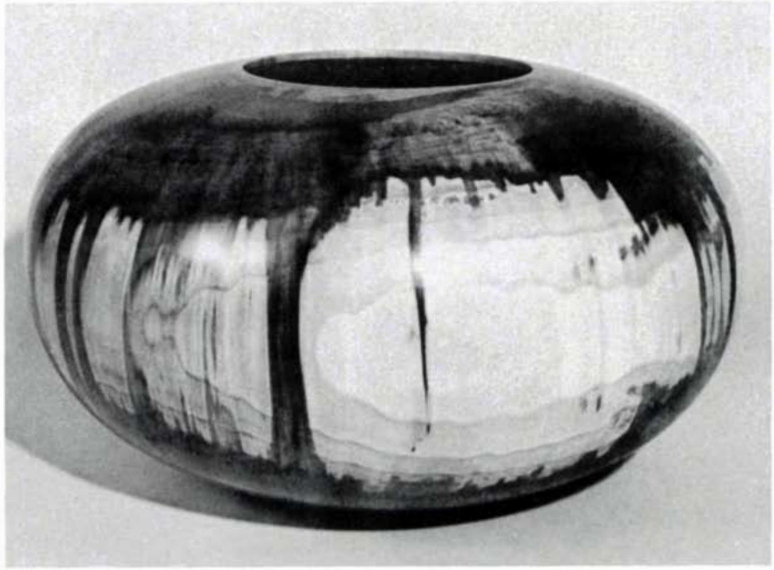
PEG has also proven useful in stabilizing waterlogged artifacts recovered by archeologists. Long immersion in water causes cell walls to break down by hydrolysis, and exaggerated shrinkage results when the wood is dried. PEG can stabilize such material. Woodcarvings produced in tropical climates will suffer disastrous checking when imported to drier climates. Soaking and then treating with PEG can prevent troublesome checks.

A final category of application is superficial treatment to eliminate drying degrade in thick planks or irregularly grained stock, used perhaps for furniture parts, gunstocks, carvings or bowls. The objective is to get just enough penetration to control surfaces, where many drying defects begin; the treated surface material will later be totally removed from the completed item. Thick planks, soaked for a week to 10 days in 50% solution at 140°F, can be air or kiln-dried without major defect even under drastic drying conditions. Surface checks, even end checks, are virtually eliminated. The retarded outer shrinkage apparently relieves internal compression that might result in collapse during early stages of drying. Since PEG is highly hygroscopic, it probably also reduces the severity of the moisture gradient by holding moisture near the surface. Elimination of surface checks, which can become internal checks, helps avoid honeycombing.

Treatment will leave a heavy concentration of PEG at the surface. In precarved sculpture, rough-turned bowls or thick lumber, this excess is routinely removed as surface material is machined away. In large cross sections for tabletops, where the original surface may have been cut with a chain saw, the surface might best be leveled using a router with a guide rack fixed above the disc surface. Abrasive belts will load with PEG-saturated dust, though they can be cleaned with a bristle brush and warm water. Other than sanding, PEG-treated wood is easier to carve and machine than untreated wood. The PEG lubricates the tool, and there is less splintering.

Small discs cut smooth in the green condition and requiring only fine sanding should be leached by flooding with hot water and scrubbing and sponging to remove excess PEG from the surface. Bark edges especially will retain excess PEG, which should be carefully rinsed away.

Before finishing, surfaces should be dried, which can be accomplished in a variety of ways. For thorough stability, drastic means, including ovens and direct sunlight, can be employed without harm. Wood dried in an oven, however,



Left, figured tulipwood bowl, 36 in. in diameter, turned by Ed Moulthrop (see p. 72). Moulthrop has been using PEG in turning, sculptures and sculptured furniture for 20 years. Starting from a green log, he rough-turns an entire cross section, then soaks it in PEG to stabilize it before finish-turning. That's his grandson in the bowl. Moulthrop's ellipsoid tulipwood bowl (above), 22 in. in diameter, was also treated with PEG.

may darken noticeably. Pieces can be placed over radiators or in improvised drying boxes heated with light bulbs or simply left to come to equilibrium at room conditions.

It is not a good idea to leave treated objects unfinished. PEG is very hygroscopic, and treated wood will pick up enough atmospheric moisture in humid weather to feel damp on the surface. Untreated surfaces, especially exposed to the light, may also develop a sooty and dirty discoloration.

After final sanding of dried pieces, apply a finish right away. Many finishes commonly used for untreated wood (such as shellac, alkyd varnish, lacquer) cannot be used. The two best finishes are oil and moisture-cure polyurethane-resin varnishes. Crane Creek Co. has formulated a special varnish for PEG-treated wood, and Spielmans recommends a two-part epoxy finish. I haven't used either of these myself.

I use regular Watco Danish oil, as it is easy to apply and gives the finish I prefer. Three or four well-rubbed coats are enough if the surfaces have been sanded smooth. It is the best finish for discs with the bark on, because bark retains heavy concentrations of PEG and varnish will not adhere.

If you prefer a built-up finish, try four or five coats of moisture-cure polyurethane, sanded between coats with 220-grit paper. The heaviness of this type of varnish makes it difficult to apply without leaving brush marks. A couple of finish coats of conventional urethane varnish, rubbed with pumice and oil, will leave a flat luster.

Wood treated with PEG and finished with oil usually darkens somewhat, but the effect is generally complementary to the appearance of the wood.

In considering whether to use PEG, the cost of the chemical may be important. In small amounts it currently retails for about $2 per pound in minimum lots of five or ten pounds. Ten pounds will make enough solution to treat a stack of discs in a small bucket. But a large cross-sectional disc, say 30 in. in diameter and 3 in. thick, will require several gallons of solution and some extra PEG to maintain the concentration. A black walnut disc of this size would weigh about 40 pounds oven-dry, so you would want the wood to absorb and retain 10 lb. or 12 lb. of PEG. Such a project might require $40 worth of chemical.

I often get inquiries from people who already have a large tree cross section and have heard about PEG, and want to know how to treat the wood to make it into a coffee table. Despite my advice, the project usually fails. Here's what happens: The wood is already cut and has started to dry, and it may already be checked; it takes a couple of weeks to order the PEG, while the wood continues to dry; the stuff is expensive so not enough was purchased to immerse the wood, or if it can be immersed, there isn't enough leftover chemical to keep the solution up to strength; and after all this the craftsman often can't wait to get on with the table, so he shortens the soaking time. Any one of these situations would be enough to allow the wood to crack. Thus I urge you not to start with such a large, expensive, do-or-die project. Instead, begin with something small, and consider one of the available retail PEG kits, which contain detailed instructions. Keep careful track of your procedures and learn from whatever happens, and in time you will be ready to tackle a large project with success. With some added courage for experimentation, you'll find that PEG treatment can accomplish the "impossible" with delightful and rewarding results.

One final suggestion: Whenever you treat wood with PEG, always process a few similar pieces *without* treatment. This will give you a much clearer indication of what effect the PEG really has. Without the control material for comparison you will not be able to assess the improvement. It will help you decide whether the treatment was worth it. □

SOURCES OF SUPPLY

Robert M. Albrecht, 8635 Yolanda Ave., Northbridge, Calif. 91324

Constantine & Son, Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461

Craftsman Wood Service Co., 2727 S. Mary St., Chicago, Ill. 60608

Crane Creek Co., P.O. Box 5553, Madison, Wis. 53705 (Supplies bulk and retail)

Industrial Arts Supply Co., 5724 W. 36th St., Minneapolis, Minn. 55416

Lemont Specialties, Box 271, Lemont, Pa. 16851

Spielmans Wood Works, 188 Gibraltar Rd., Fish Creek, Wis. 54212

Wilkens-Anderson Co., 4525 West Division St., Chicago, Ill. 60651

Tips from the Turning Conference

Every good turn has its teller

by Rick Mastelli

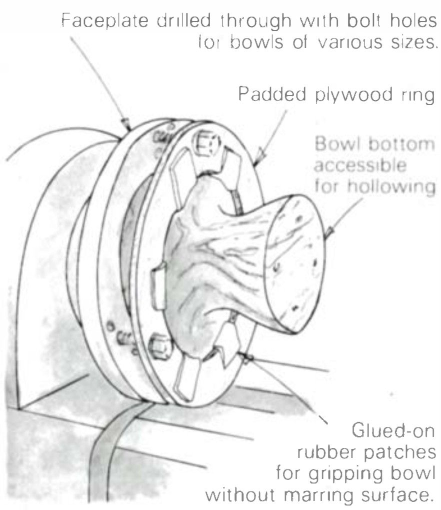
Equip a shop with twenty lathes and a slide projector. What better way to keep a group of woodturners happy for a weekend? Add to it a room with tables enough to display their work and a nearby Holiday Inn where they can wash off the day's shavings and you have the makings of the seventh semi-annual woodturning symposium at the George School woodshop in Newtown, Pa., June 22 to 24. On hand were six instructors, several resource persons and 50 participants (one-third of whom were returnees) to share their skills, to learn, to see each other's work and to turn. The schedule was full. Each instructor, and anybody else warranting an audience, was afforded 45 minutes to show and tell. Shop time included six two-hour rotations for hands-on work with each of the instructors, along with free turning time at night. Since the original 50 met in March 1976 (see *Fine Woodworking,* Summer '76), the symposium has been in touch with hundreds of woodturners, and contributors to previous conferences were represented in the work and talk of those they have influenced. Building upon a heritage for sharing, the symposium has become a trove of inventiveness and fine work.

Top, Ed Moulthrop chats with Rude Osolnik. Moulthrop's work here is of tulipwood, the largest piece 36 in. in. diameter. Above, Moulthrop checks thickness of turning bowl. His tool rest, attached to a 6x6 cherry beam and propped to the floor, steadies the 6-ft. long hook-bladed cutter he uses for inboard work. A 2½-HP motor turns the 3½-in. diameter spindle.

There were Ed Moulthrop's giant bowls and platter: whole cross sections of 36-in. tree trunks, turned with harpoon-sized tools on a lathe that moves like a cement mixer. Moulthrop is an Atlanta architect who three years ago gave up the frustration he had felt for 25 years turning only part time; now he feels his work proceeding apace. He designs and makes his own equipment—the lathe's 3½-in. diameter shaft and pillow bearings from junk, and the tool tips from ¾-in. reamer stock. He has perfected a polyethylene-glycol treatment (see p. 71) that dimensionally stabilizes otherwise impossible-to-turn shapes, sizes and grain configurations. And he exercises a special interest in trees which, removed of all but their most exquisite figure, reveal themselves in surfaces like stained glass. Moulthrop arrived with a U-Haul trailer, and each of us got the opportunity to feel the spray from a green tulipwood log moving at 80 RPM as we pushed the cutter in.

There were Jack Straka's koa bowls, concave both inside and underneath. Straka is a corporate dropout from Pennsylvania who came to bowl-turning by way of two days with Peter Child; now he makes his living in Hawaii wielding long-and-strong gouges, sometimes ten hours a day. Straka mounts his bowl blanks on a conventional four-screw faceplate, aligning two of the holes with the grain and two across the grain. This allows him to rough-turn the blank, remove it for drying and replace it on the faceplate, even though in drying the two holes across the grain from one another have shifted position. He screws first into the two holes *along* the grain. Then, though the other two screws cut slightly different holes as he drives them home, the bowl is mounted in the same position for finish-turning as it was for rough-turning.

To cut out these screw holes, Straka has developed a faceplate and ring-

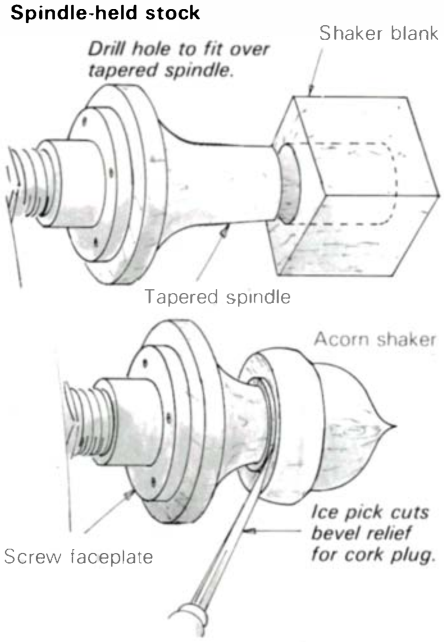


Jack Straka's faceplate assembly with various plywood rings and a finished bowl, whose 6-in. high pedestal is hollow.

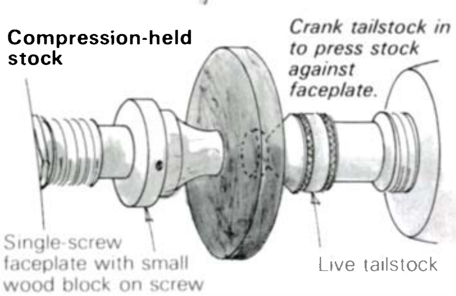
Photos: Staff; Illustrations: B. Mastelli clamp assembly that works well enough to turn long, hollow, delicate pedestals on the bottom of his bowls. The faceplate is koa (though any hardwood will do), 1 in. thick by 14 in. in diameter. Its face is scribed with concentric circles for centering the bowl and drilled through with holes for bolts, spaced equally along three radiating lines. The bowl goes mouth down on the plate, then a padded plywood ring fits over the bottom. Bolts through holes in the ring and in the faceplate clear the bowl and draw ring and faceplate together to sandwich the bowl securely, its bottom accessible for turning. Straka has prepared a number of plywood rings of various sizes to fit different bowls.

Production woodturner Ray Huskey, of Gatlinburg, Tenn., offered a bag of tricks including using an ice pick for scribing and delicate parting. It's perfect for undercutting a small bevel on the bottom of salt and pepper shakers, which he turns from drilled blanks pressed onto a tapered-spindle faceplate. He also described how to hold stock between centers by compression, an idea that allows you to turn plates without screw or spindle holes.

Spindle-held stock

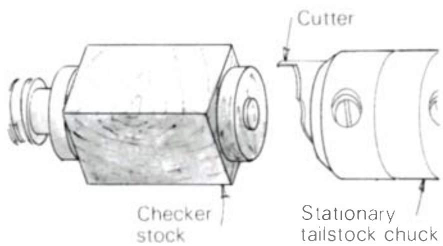


Compression-held stock

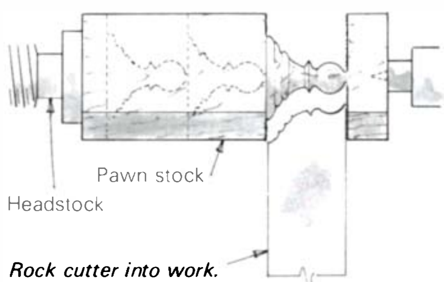


Rude Osolnik, of Berea, Ky., and head of the Southern Highland Handicraft Guild, brought to the symposium his years of experience at the lathe. He displayed bent and spiral laminated turnings, bowls from monomer-impregnated stock radiated in a particle accelerator to cross-link the molecules for exceptional strength, and irregularly shaped turnings from golf-club billets and figure-rich tree spurs. He demonstrated, for the production turner, form-cutting tools shaped to make checkers, chess pieces or any other simple shape in quantity.

Cut checker face by cranking tailstock in onto end of stock, part off checker and cut next checker face.



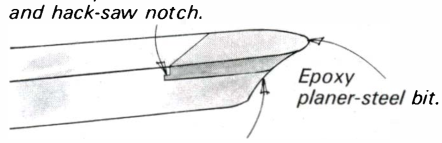
Contour-ground steel cuts simple shapes repeatedly. Then chop pieces off.



Richard Starr, who has been rediscovering primitive wood-thread techniques, displayed pottery for which he had turned wooden, screw-on fixtures; there were cruets with teak and putumuju tops, and a steamer and ladles with teak handles. Starr demonstrated thread-chasing with a serrated form-cutting tool and talked of slow-speed turning, long known to potters using variable-speed DC motors. From a potters' supplier (The Robert Brent Co., 128 Mill St., Healdsburg, Calif. 95448) Starr has bought a motor and controller to get lathe speeds from 1200 RPM to about 20 RPM at the touch of a foot-pedal. Since the system is electronically controlled, increased load on the motor automatically increases the voltage, so the speed at any setting is dependable. Consider the sculptural possibilities: Starr is practicing free-form spirals.

And there was Del Stubbs from Chico, Calif., who uses homemade tools to turn boxes with perfect-fitting, inlaid lids. Stubbs makes his tools from planer knives, either whole, by grinding an end askew and with a 30° bevel, or less expensively. He'll cut a planer knife into bits and epoxy one (with Devcon's white "two-ton" mix) to the end of a bar of cheap, cold-rolled steel, grinding a step in the bar with a notch to lock the bit. He then grinds the tool to shape and hones it. The epoxy holds, unaffected by the friction-caused heat that weakens brazed bits. And one planer knife yields many fine tools. Stubbs' tools were a delight to use. His ½-in. roundnose is ½ in. thick, affording a long, hollow-ground bevel along the lines of a ship's prow. Move it in on the work and it rests there in a position it finds for itself, chatter-free, throwing

Grind step in cold-rolled steel bar and hack-saw notch.



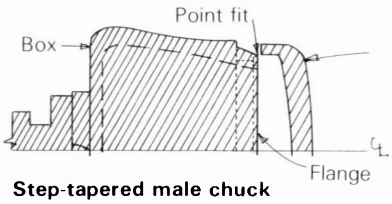
Shape and hollow-grind.

Top, tools made by Del Stubbs: two at top, ground from whole planer blades; second from bottom, ground from tool-steel bar; and the other two made more cheaply by epoxying planer steel bits to a length of ½ x ½ cold-rolled steel. Each of these tools has a deep hollow-ground bevel and is finely honed, as shown in the drawing. Above, the ½-in. roundnose at work.

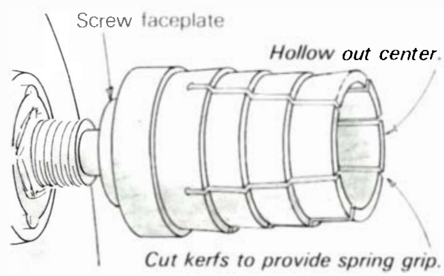
silky ribbons of wood over your shoulder. Stubbs does not sand his work. The surfaces are cut smooth.

Stubbs turns his boxes from end-grain stock (see "Small Turned Boxes," Winter '77) because the lid fit is more stable than with cross-grain stock. He also rough-turns first and puts the blank in a paper bag to hasten drying. Leaving the bag in the Chico sun or in his makeshift kiln (a refrigerator carcase heated by a light bulb) for a few weeks yields dry stock that does not check. The bag ensures even, though rapid, moisture loss. While the bags are in the refrigerator, Stubbs adds to his collection of inlay stock—thin discs from scraps of figured wood, which he turns between pressure plate and live tail center, then keeps on file according to size. When the rough-turned boxes are dry enough for finish-turning, Stubbs fits their lids precisely, using a "point-fit" technique. First, with the top of the lid attached to a glue block, he turns its inside edge parallel to the centerline. Then with the box bottom on another glue block, he turns the flange, concentrating on the first point of contact between it and the lid. When the lid can begin to go on, he turns the rest of the flange behind this first contact point parallel to the centerline, then steps it in a touch, leaving a ring for closest fit at the top. The method allows for sensitive final adjustment of a small area of wood and eliminates the problem of wedging. The box fits its lid the way an engine piston fits its cylinder.

Turn flange parallel to centerline and a touch deeper than first point of contact between box and lid.



Step-tapered male chuck



Stubbs finishes off the bottom by pressing the box onto a step-tapered male chuck. He makes one of these by mounting a 4-in., 3x3 blank on a screw faceplate and cutting 1/16-in. steps in it, each one tapered slightly backward as the diameters increase toward the headstock. Then he hollows out the center to leave a 1/8-in. wall and takes the chuck off the lathe to cut four or more radial kerfs. This provides a spring fit for hollowed stock pressed on.

There were more ideas and more fine work than can be told about here. People who attend these symposiums come away inspired by tricks that have been thousands of hours in development. And the closeness that develops in three days between so many people is a testament to sharing a common interest. The symposiums planned for March and June of next year are open to 100 woodturning acolytes. For details, write Albert LeCoff, 2500 N. Lawrence St., Philadelphia, Pa. 19133. □

Old-fashioned turners' gauges you can make yourself

by John Rodd

Before machines did the job, production turners used a number of devices that have since become rare. Yet their use may be of more than passing interest to turners today. Old-fashioned tools are often ingenious solutions to special problems, and most of them can easily be made. The sizing tool for instance, labeled *A* on the next page, was made when carpenters used spoon and center bits. These were of irregular size because sharpening would reduce the cutting diameter. For that reason Old Charlie (a woodturner friend), on receiving an order for a set of banisters, would ask for a sample hole. Once he had fitted a pin to the hole he had only to set the gap in the sizing tool to it, turn each pin slightly oversize (and he could do that quite closely by eye) and bring down the tool, which would cut a groove of the required fit. It was then a matter of seconds to finish the rest of the pin. If you should be turning a piece to a given size, you need not attempt the hand-forging and artistic attention to detail that went into the specimen pictured. You can make one out of brass, as shown in the drawing, to fit an existing parting tool.

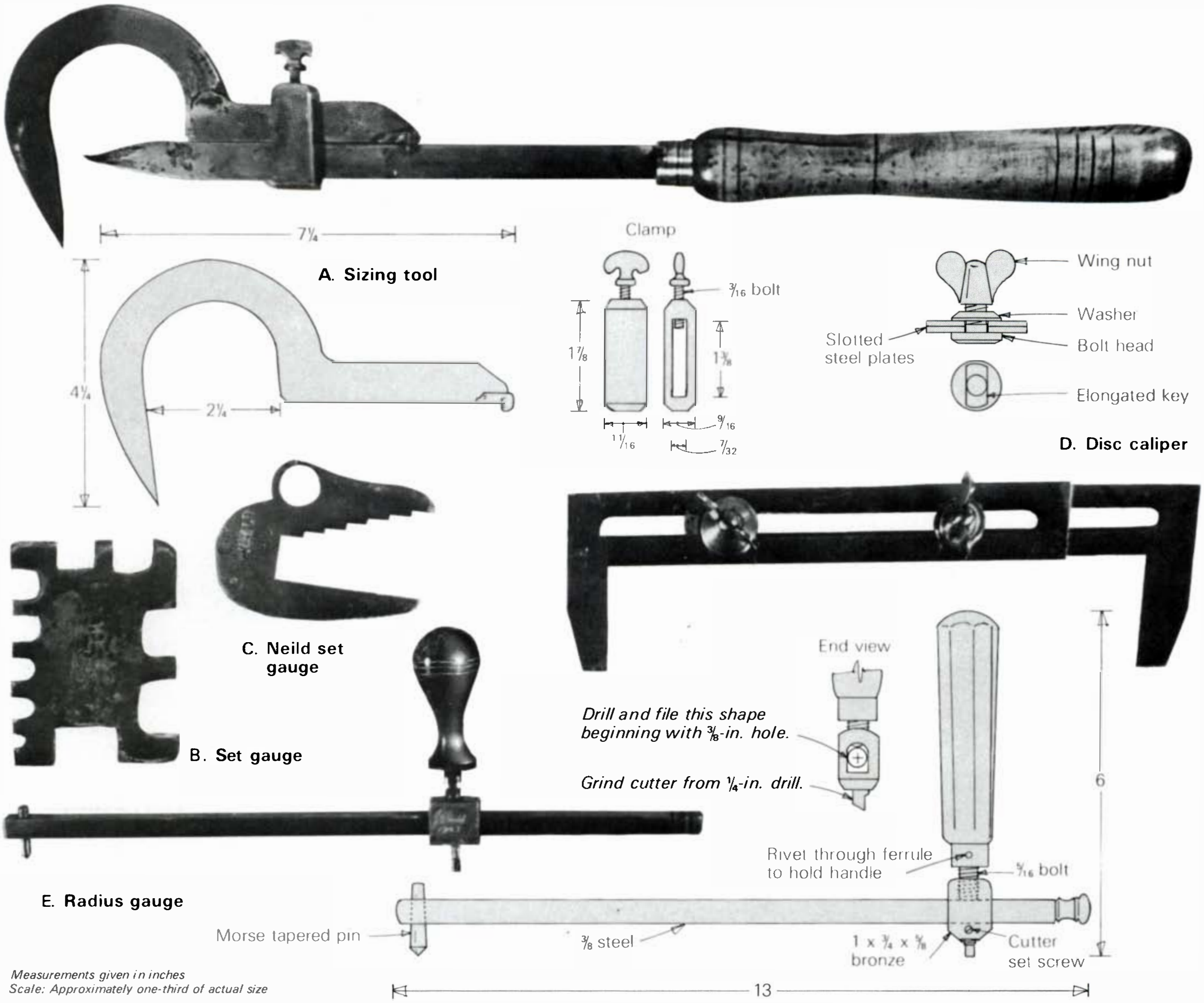
But odd-sized pins are rare nowadays, and the set-gauge *(B)* has probably done more work for me than all the other gauges combined. I see by my center-punch work that I made it in 1940. At that time I had gotten to know the chief saw-filer at one of the local mills and was able to get from him scraps of the head band saw, which was 1/8 in. thick by about 12 in. wide. With an abrasive cutting wheel I ground out slots in this material, covering a range from 1/4 in. to 5/8 in. by sixteenths and on to 1 in. by eighths. It is a hard steel, in no danger of bending, so I can press it on to an oversized pin and move left and right to produce a tight fit. Usually I undercut the shoulder with a skew chisel used as a scraper to make sure the edge will come up flush.

Tool *C* is a similar sizing tool, made around the turn of the century by P.H. Neild with a span of from 3/4 in. to 1 1/2 in. The steps are long enough to reach the diameter but not to feel the fit, and so I have used it only a little.

Tool *D* is a disc caliper by the same maker. It consists of two *L*-shaped, slotted steel plates, held together by two bolts and wing nuts. Below the head of each bolt is an elongated key that fits the slot in the plates and prevents the bolt from turning when the nut is tightened.

An explanation of the steps required to produce a gross of breadboards led me to make the radius gauge *(E)*. At that time a Mr. Willows had a used-furniture business but he had started life as a faceplate turner, mass-producing such items as small dished tabletops, alms dishes, breadboards and *paterae*. Never, he told me, had he turned anything between centers. I asked him about making breadboards.

With few exceptions, an old breadboard will show no mark of where a screw or nails held it while being turned. Instead,



the design of the bottom will include a ring, projecting about ⅛ in. from the general surface, which the chuck gripped while the top was being turned. The process was as follows: A disc about the same size as the board was mounted on the lathe, faced off and then furnished with a ring of brads about ¼ in. in from the edge; the brads were clipped to a length of 3/16 in., then filed sharp. The blank to be turned would be impaled on them and quite adequately held while the bottom was turned and sanded to include a raised ring. The whole batch, usually a gross, would receive this treatment.

To turn the face, a second disc would now be mounted and a recess turned in it providing a tight fit on the bottom rings. The fit required a mallet and block to mount the first two or three boards; later, a few blows with the heel of the hand would suffice. It requires skill and judgment, especially in the first cuts near the perimeter, to avoid dislodging the board, but Mr. Willows assured me that a gross would normally be finished in a single chuck. He would remove the ring of holes caused by the brad points when shaping the edge.

The uniformity of the diameter of the bottom rings was of course essential and explains the need for the radius gauge. It consists of a cutter, whose distance from the conical pin at the other end of a trammel bar is adjustable to the required radius by means of a set-screw-cum-handle, which is attached directly above the cutter. After having faced up, you center the blank with the point of a skew chisel and hold the conical pin against the center. Press the cutter into the work to form the ring.

When making my radius gauge, as with most workshop tools and jigs, the design was influenced by the availability of materials, which is why the drawing differs from the actual tool, *E*. The bar is a piece of ⅜-in. cold-rolled steel, 13 in. long; the fancy filing to the right is just decoration. The pin to the left is a Morse taper pin with the thick end filed to a conical point while revolving in an electric drill. I drilled and reamed a suitable hole to receive it. The sliding member is a piece of bronze ⅝ in. by ¾ in. by 1 in., bored lengthwise with a ¼-in. hole for the cutter and threaded for a 5/16-in. S.A.E. screw at the other end for the set-screw-cum-handle. Drill and file the cross hole for the bar to fit. The handle can be bored and threaded and the set screw cemented in with epoxy and riveted through the ferrule as shown, or it can be filed to a tang and driven in. The cutter is a ¼-in. drill ground as shown and secured with a set screw. Mine was ground to a slight taper and driven into a 15/64-in. hole. If you snap the drill it will be hard at the break but be careful not to soften it while reducing it to shape. □

John Rodd, 74, lives in Sidney, B.C., and is the author of Restoring and Repairing Antique Furniture.

Oil/Varnish Finishes

Experiment to find the right proportions

by Don Newell

Most finishers have probably experimented with mixtures of boiled linseed oil and varnish in an attempt to produce a better finishing material than either oil or varnish alone. Whether the resulting finish is really better depends on what is needed in terms of drying time, hardness, luster and film build. Because no information exists on the properties of specific mixtures of varnish and drying oils, the finisher must continue to experiment. To give the would-be experimenter some data on which to base the experiments, I ran a series of tests under controlled conditions, eliminating as many variables as possible.

The oil/varnish homebrew mix — I chose a typical soya alkyd varnish (because most varnishes on the market are of this type) and a commercial boiled linseed oil as the base ingredients. I blended the varnish and oil samples into mixtures of the following proportions: 100% varnish, 90% varnish/10% oil, 80%/20%, 60%/40%, 40%/60%, 20%/80%, 10%/90% and 100% boiled linseed oil. The 100% varnish and 100% oil samples were the standards against which I compared the various mixtures. The 90%/10% varnish-to-oil and oil-to-varnish mixtures were used to determine how a mere trace of oil changed the properties of pure varnish, and vice versa. The other formulations were varied by 20% steps to keep the total number of test mixtures manageable.

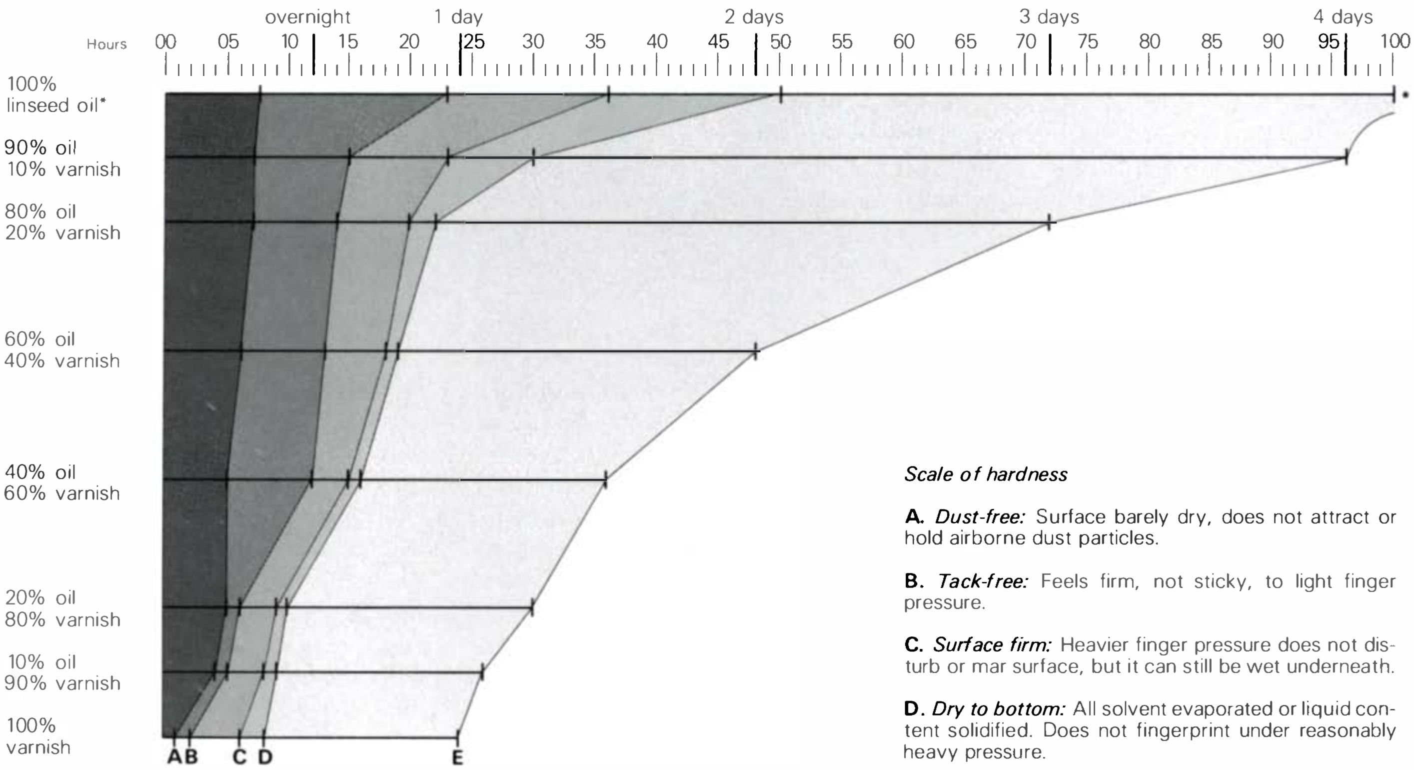
I drew out each of the mixtures on a piece of chemically clean glass to a uniform wet film .009 in. thick. The drying times are shown in the table. The only real surprise was that the addition of 10% boiled linseed oil to varnish produced a substantially softer film than one might expect, and that a 10% addition of varnish to oil produced a harder film. In the other mixtures, each material's properties were modified by the other's properties to about the same degree as the amount of each component present. In practice, this means the more oil you add to the varnish, the slower the film will dry and the softer it will remain.

Although I evaluated alkyd varnish and boiled linseed oil, any drying oil can be mixed successfully with varnish. Polyurethane and phenolic varnishes will work well in place of alkyd types, as will tung oil in place of linseed. But whatever the makeup of a given mixture, its overall properties will probably vary as the proportions of its components vary.

Only experimentation will provide answers. However, a 50%/50% mix of whatever components the finisher chooses is an excellent starting point. Chances are the finisher will never need to experiment with other proportions.

I didn't use thinner in testing because it would have introduced a variable without changing the ultimate results. In

Drying times of mixtures of soya alkyd varnish and boiled linseed oil. All samples drawn out on glass to a film thickness of .009 in.



Scale of hardness

A. *Dust-free:* Surface barely dry, does not attract or hold airborne dust particles.

B. *Tack-free:* Feels firm, not sticky, to light finger pressure.

C. *Surface firm:* Heavier finger pressure does not disturb or mar surface, but it can still be wet underneath.

D. *Dry to bottom:* All solvent evaporated or liquid content solidified. Does not fingerprint under reasonably heavy pressure.

E. *Maximum hardness:* Hardening reaction completed.

* *Still soft after a week, never really gets hard.*

actual finishing, however, such mixes are often thinned with either mineral spirits or turpentine.

Thinning helps the first coat penetrate the raw wood and seal its pores, but probably has no effect on subsequent coats. In most cases, the thinner present in the varnish as it comes from the can provides adequate penetration. But if you want to thin the first coat, mix equal parts of thinner and oil/varnish mix. Keep in mind that the more a mixture is thinned, the lower the solids (film-building) content. Consequently, you'll need more coats of a thinned mixture to produce the same film thickness as an unthinned mixture.

As mentioned, tung oil may be used to replace boiled linseed oil in the oil/varnish homebrew mix, and in fact it will produce results superior to linseed. To this end, I ran another test comparing a 50%/50% mix of polymerized tung oil and the same alkyd varnish. Chart 2, right, shows the results. Though the tung/varnish mix remained fluid long enough to rub out well under hand pressure, the film dried hard all the way through in the same period of time it took the linseed/varnish mix to become only tacky.

The three faces of tung — Tung, or China wood oil, has been used as a binding agent and finishing material for centuries, and many finishers consider it the ultimate material for the classic hand-rubbed oil finish. Tung is available in three forms: plain (so-called pure) tung oil, tungseed oil and polymerized tung oil. Plain tung is oil pressed from the nuts of the tung tree and filtered to remove impurities. Tungseed is basically the same as plain tung, but it is dissolved in thinner to provide maximum penetration of the wood. It contains about 21% oil solids. Polymerized tung is the most useful form. This is tung that has been heat-treated to initiate the polymerizing process (molecular cross-linking by which the oil dries to a solid film) but remains in a sort of holding pattern. Such oil need only absorb oxygen to complete the hardening process. Polymerized tung usually comes thinned to about 49% solids to make the oil fluid enough to penetrate the wood surface.

Any of the tung oils is suitable as an in-surface finish. Generally, two or three coats are applied by hand, rubbed in well and allowed to dry. This leaves the pores and grain structure of the wood open, yet protected by the oil film.

Tung oil films are about twice as resistant to moisture passage as are linseed oil films. In fact, they can stand up to a dilute solution of household lye that will completely strip away an equivalent film of aged boiled linseed oil.

While tung in any form dries faster and harder than linseed, the speed of drying varies among the three different forms. One indication of the differences in reaction speed can be seen on the shelf, assuming half-empty cans of each type. Tungseed oil is the most stable because 79% of the contents are thinners, which do not react with air. Yet tungseed oil will gel solid within 60 days when stored in a half-empty can. Plain tung oil absorbs oxygen from the air in the can more quickly, creating a gelled layer on the surface of the oil within a few days. Polymerized tung oil, however, is much more reactive. It is so hungry for oxygen that a solid layer can form overnight on the surface of the oil in the can.

Drying speed — In tests on wood and on clean glass, tungseed appears to dry a little faster than polymerized tung and much faster than plain tung (chart 3, top right). This is

(Continued on page 78)

Comparative drying time for 50%/50% polymerized tung/varnish and 50%/50% boiled linseed/varnish

	Dust free	*Tack free*	*Surface firm*	*Dry through*
Tung/varnish	55 min.	1½ hrs.	2 hrs.	6 hrs.
Linseed/varnish	6 hrs.	13 hrs.	16 hrs.	18 hrs.

Comment: The tung/varnish film was much harder at through-dry time than was the linseed/varnish film. Even after a week of drying time, the linseed/varnish film remained much softer than the tung/varnish film.

Comparative drying times of tung oil types

Type of oil	*Dust free*	*Tack free*	*Maximum hardness*
Plain tung	12 hrs.	20 hrs.	30 hrs.
Tungseed oil *(20% solids, 80% thinner)*	2 hrs.	4 hrs.	15 hrs.
Polymerized tung *(50% solids, 50% thinner)*	3 hrs.	6 hrs.	20 hrs.

Safe Finishes for Toys and Food Utensils

Finishing toys and utensils used for food service poses special problems for woodworkers. Many conventional clear finishing materials normally used for furniture and other interior wood surfaces contain compounds which, if ingested, are dangerous.

Driers pose the greatest threat. Ordinarily they are composed of metals or metal compounds; driers containing lead are the most dangerous, but no amount of any metal can be considered absolutely safe. Drying oils such as linseed and tung and most varnishes contain metallic drier compounds. Even though the actual quantity of metal in a given amount of finishing material is small, little by little it can accumulate to dangerous levels in humans.

In the case of wooden toys, a child can quickly strip and ingest the finish by chewing or sucking. Wooden dishes and utensils in food service are not so likely to be chewed, but with continuous exposure to foods and liquids the compounds can be leached out of the finish and carried into the human system together with the food.

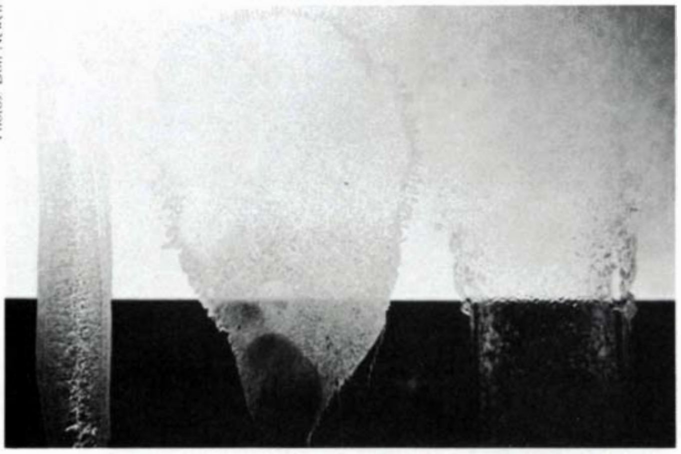
Countertops and food-preparation surfaces can safely be finished with most varnishes, because food is less likely to remain in contact with the finish for long periods of time, and the potential for drier compounds leaching out is reduced. Nevertheless, because the possibility of a hazard exists, the woodworker has a responsibility to select the safest possible finishing materials.

A report by the Safety Products Division of the U.S. Food and Drug Administration indicates that their major concern is with the presence of lead and mercury in a finishing material. The report concludes that as long as lead or other metals are not present, a finish can be considered nontoxic and acceptable for food service and toys.

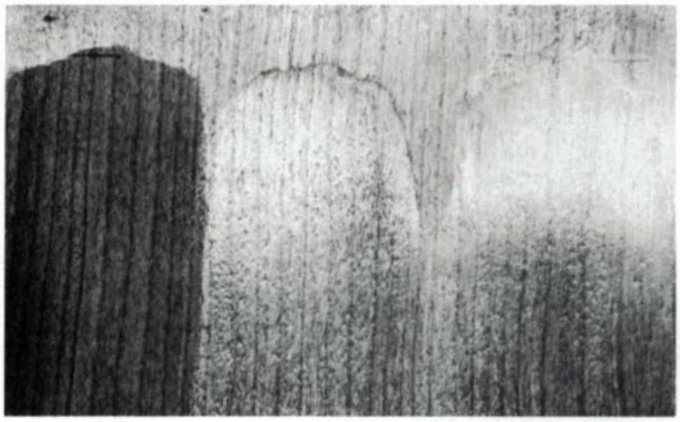
Consequently, finishing materials that fall into this nontoxic classification are clear woodfinishing lacquers, both spraying and brushing types, and water-based or "latex" varnishes. Among the finishes approved by the FDA are Behlen Salad Bowl Finish (Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801); Wood Bowl Finish (Craftsman Wood Service Co., 2727 South Mary St., Chicago, Ill. 60608); and Wood Bowl Seal (Constantine's, 2050 Eastchester Rd., Bronx, N.Y. 10460). The Watco-Dennis Corp. maintains that Watco oil leaves a solid, nontoxic finish, but stresses that at least 30 days should elapse between finishing and use of food utensils and children's toys to ensure complete polymerization. This is not the finish to use on Christmas eve for next-morning toys.

One other material particularly suited to finishing the end-grain wood of butcher blocks is plain paraffin wax. Melt the wax and pour it over the surface, then literally iron it down into the end grain with a hot electric iron. When cool, scrape the surface residue off, down to the wood. Such a finish remains soft, making it unsuitable for finishing any surface other than porous end grain. It can be renewed at any time simply by ironing in more wax. *D.N.*

Photos: Don Newell



Tests on clean glass show that plain tung oil (left) dries to a badly wrinkled, opaque film. Tungseed oil (center) dries to an opaque film with tiny wrinkles. Polymerized tung oil (right) dries to a fairly glossy, transparent film.



Plain tung (left), tungseed (center) and polymerized tung (right) films dried on cherry wood. As with the glass test, tung dries totally flat, whereas tungseed can be steel-wooled to a low gloss. Polymerized tung has a high sheen after only two coats on unsealed wood.

Walnut board sanded, whiskered and given three hand-rubbed coats of polymerized tung oil. The clear finish permits the grain to show with good contrast, and the medium luster enhances the appearance of the well-figured wood.

somewhat misleading in that upon evaporation of the thinners from tungseed, only a thin coat of the oil is left. This thin coat will harden faster than the heavier-bodied forms, but it takes many more coats of tungseed to equal the thickness of one coat of either plain or polymerized tung. Plain tung dries about four times more slowly than either tungseed or polymerized tung.

Penetration — To test the three forms of tung for depth of penetration into two different woods, one veneer and one solid, I flooded three adjacent areas of wood with the oils, allowed them to set for ten minutes and then wiped them dry. On 1/32-in. cherry veneer, plain tung oil penetrated through to the back in spots. Tungseed penetrated completely through at all points. Polymerized tung penetrated less than tungseed, but more than the plain oil.

I also tested the oil on 1/4-in. solid walnut. After wiping it dry, I sawed the wood through the center of the test areas. Plain tung oil at first showed little penetration. Tungseed showed some penetration (about 1/64 in.) and polymerized tung showed the deepest initial penetration (at least 1/32 in.).

However, several hours later I observed that plain tung continued to penetrate slowly, darkening the wood with its still-wet presence, though polymerized tung did not. Tungseed oil penetration could not be seen at all, perhaps because the high thinner content of tungseed had evaporated out of the wood, leaving a thin, virtually transparent film of oil behind. It's also possible that the polymerized oil had continued to penetrate, but because of its high reactivity had hardened to a more or less transparent state.

Surface appearance — Plain tung oil dried on the wood to an extremely dull film composed of countless microscopic wrinkles. No amount of polishing or rubbing improved the luster. Tungseed dried to a semivelvet surface that was also wrinkled, but because of the thinness of the film, the wrinkles took on the appearance of a haze. Repeated coats, with drying between, produced a satin luster which, with judicious steel-wooling, was quite attractive. Polymerized tung oil dried to a hard, transparent film with a high luster, without a matte or hazy appearance.

Film thickness — The thickness of any given finish is a function of the solids content of the material in liquid form. The three forms of tung were drawn out on clean glass to a wet film .009 in. thick. After drying for 24 hours, the plain tung oil film was .0005 in. thick, the tungseed oil film was .0001 in. thick, and the polymerized tung film was .0007 in. thick. The bigger the number, the thicker the film and the fewer coats necessary to achieve the same degree of protection. Seven coats of tungseed oil or about one-and-a-half coats of plain tung will produce a film the same thickness as one coat of polymerized tung.

Storage and handling — Tung oil in any of its forms should be treated as a highly reactive (oxidizing) material. Any papers, cloths or rags wetted with tung must be stored in covered metal containers to eliminate the possibility of spontaneous combustion.

Because in partially empty containers of tung oil there is sufficient oxygen present to react with the oil, often within just a few hours, always store it in full containers. Dropping pebbles or marbles into the storage can as the liquid is used, bringing the liquid level up to the neck each time, is one way to do this. Another is to obtain a quantity of small plastic or glass containers and transfer your stock of oil to those. Any spoilage thus will waste only small amounts of oil at a time. A third approach is to obtain squeezable or collapsible plastic containers and squeeze out the air after each use, prior to capping the container. Collapsible containers are used in photographic chemistry and sold by photo suppliers. □

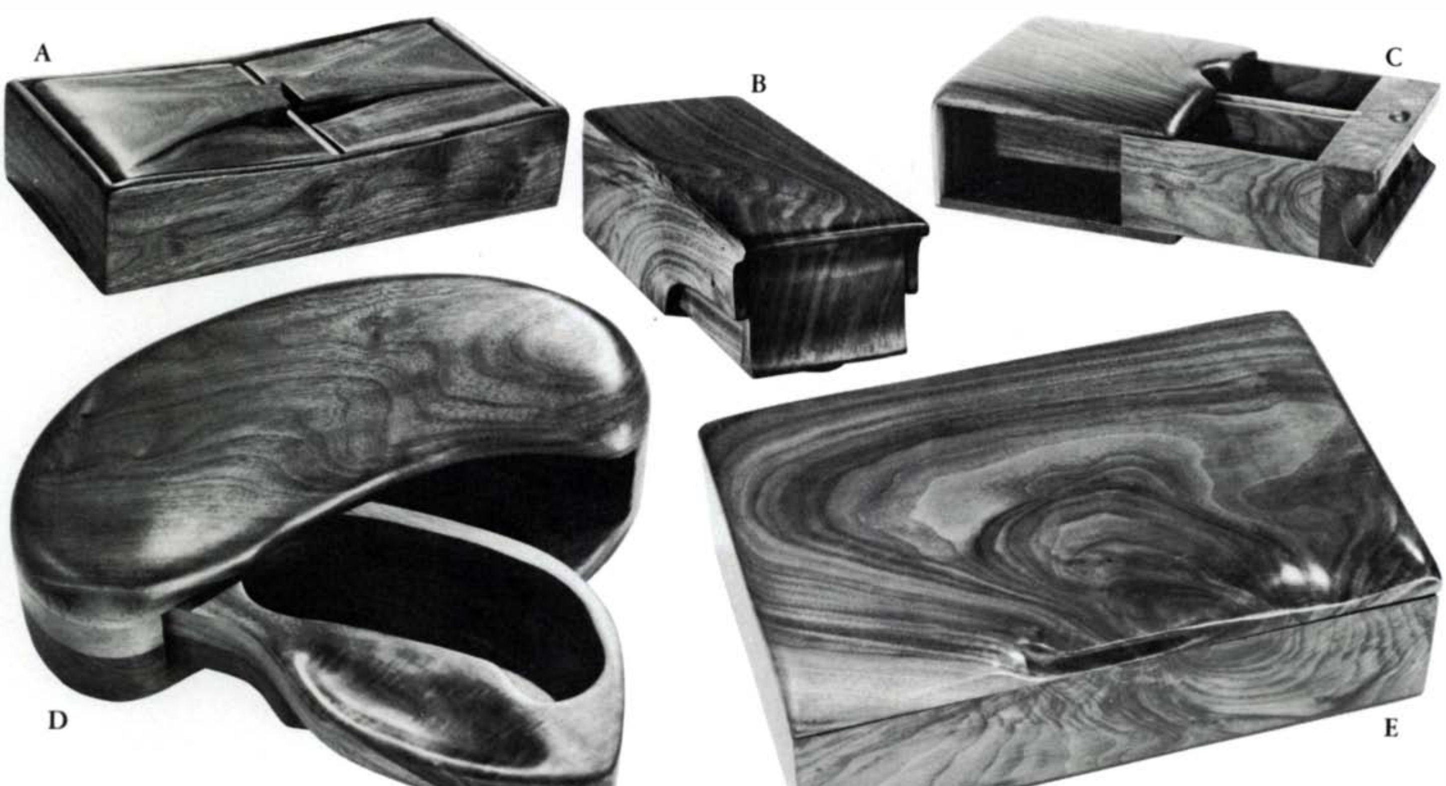
Don Newell is a frequent contributor to this magazine.

Portfolio: Charles Rombold

Boxes hold figure, design and construction in harmony

EDITOR'S NOTE: These photographs and comments were sent to us last year by Charles Rombold of Augusta, Kans., who then was 80 years old. Ten years before, Rombold had retired after 36 years as a busy orthopedic surgeon, which had left him no time at all for training in art or woodworking. He applied his new leisure to making some frames for his wife's enamels, and a couple of boxes to display them. This introduction to making boxes showed him the scope of the field, and until his death in December of last year, Rombold limited his practice to boxes, hundreds of them, no two alike.

"There seems to be no end to the innovations which come to mind for the next box, while working on the one at hand," he wrote then. The letter continues, "The only training I have had in woodworking was a very valuable three-week course under Tage Frid at Penland, N.C., in 1975. As an orthopedic surgeon I have always been adept in using instruments and tools. . . . I have been trying to develop a style of harmoniously combining design, wood figure and construction that would identify and enhance the beauty of wood. Each box is made without precise drawings and there are no duplicates. I have determined to remain fresh and progressive by never copying what I have seen or already done. Early on I graded each box on completion on the basis of craftsmanship, design, inventiveness and finish. After a year or so I discarded this practice because improvement of my techniques left me without a constant norm. I know that it is visionary to make a perfect box. However, I would be content if I could make only one that only I could see the defects of. After 339 recorded boxes (not including the trash pile) I still am a long way out, but I am progressing." □



A. *The lid, which was shaped with gouges, is hung on dowels that extend the full width. I made holes for the dowels by cutting off a strip from the end of the lid, routing a channel, then covering it with a strip of similar wood. 14½ x 7½ x 3¼.*

B. *The sides, joined with box joints, are from a resawn board. Removing the drawer and turning the box over reveals a panel set in a dado in each side. It can be pulled out, exposing a ⅜-in. chamber the width and length of the drawer. 11 x 4¾ x 3¾.*

All the boxes here are of black walnut.

C. *The sides of the drawers become the sides of the box. They are similar in figure, from matched pieces of resawn board. The front of the drawer is from a solid block shaped by repeated, gradually deepening cuts on a table saw. 7½ x 7½ x 3⅞.*

D. *The box is made of four laminated, ¾-in. boards. First I glued up the middle two boards and bandsawed the drawer. Then I cut the space inside with the bandsaw table set at 2° to 3°. Thus when the lower face was cut off this waste block and placed back as the drawer bottom, its beveled edges impinged upon the angled sides of the drawer. The drawer pivots on a vertical dowel embedded in the top and bottom boards of the box. There is also a hidden drawer cut from the middle two boards behind the hinged drawer. Two ceramic magnets, one in the carcase and the other in the back of the drawer, hold it in place; it drops out with a sharp blow of the hand on the front of the box. I contoured the body of the box with a band saw, auto-body sander and belt sander, and carved the pull with gouges. 11 x 6½ x 3.*

E. *The lid is on a double-hung, L-shaped hinge. 11 x 5½ x 2½.*

Photos: Jim Yarnell

Chip Carving

Simple cuts form complex patterns

by Rick Butz

Chip carving is one of the oldest forms of decorative woodcarving and also one of the simplest. A straight-edged knife sharpened to a fine point is all you really need, though a skew-ground knife and a knife with an offset blade are useful. Complicated geometric patterns are formed by arranging dozens of small triangular incisions.

The simplicity of technique and the personal satisfaction chip carving offers caused it to flourish well over 1,000 years ago. It seems to have developed simultaneously among peasant communities in many lands, including Scandinavia, Germany, Switzerland and Russia. As the centuries passed, many of the patterns and designs were freely exchanged, and in time it became impossible to identify which motif was developed by which nationality.

In its heyday, chip carving was used primarily to decorate household items. Many elaborately decorated objects were carved during the long winter and later given away as gifts. However, as the slow pace of country life was hastened by the pressures of industrialization, fewer evening hours were spent carving at the hearth. Eventually, chip carving faded into obscurity and was continued only in remote parts of Switzerland and northern Europe. In America, the tradition was carried on by the Pennsylvania Dutch.

Traditional chip carving was also used as a training device for woodworking apprentices—it remains a good test of self-discipline and sharp tools. Mistakes and overcuts, once committed, are not easily corrected or concealed.

To start chip carving, first make sure your tools are razor-sharp, because the final appearance of the work is judged by neat cuts and crisp, clean lines. In addition, a sharp knife will be less likely to slip while you are carving, minimizing injuries and the unnecessary frustration of spoiled work.

Test the sharpness of your knife by lightly, carefully scraping the edge across your thumbnail. If you can feel the edge grip and hold, then the blade is razor-sharp. If the edge slides and skips, it is dull. If the edge is dull, use a medium-fine Washita or fine India stone and a leather strop for sharpening. Lubricate the stone well with a lightweight oil to prevent clogging, and hold the blade at a fairly low angle. Sharpen one side at a time, using a circular motion until a fine wire burr forms on the cutting edge, indicating that the metal has been brought to as fine an edge as that particular stone will allow. This wire edge is difficult to see, and you can best check for it by lightly dragging your fingertip across the blade away from the cutting edge. Check both sides. The burr edge will feel rough, as though it is catching on the ridges of your fingerprint. When you can feel the wire edge along the entire edge, the blade is ready for the strop.

A strop is simply a strip of stout leather securely fastened to a length of wood. You can make one by gluing or tacking a piece of old leather belt face down to a wooden base. Stroke alternate sides of the knife blade slowly and evenly along the leather in the direction away from the cutting edge. Otherwise, the knife will cut into the leather and dull the edge. Several minutes of stropping should wear off the burr, leaving a razor-sharp edge. A little metal-buffing compound rubbed into the leather speeds this process considerably. Woodcarvers often have several strops coated with different grits of rubbing compound ranging from coarse to fine, with the leather left plain for the final touches to maintain a fine edge during carving. It's a good idea to strop the blade 20 or 30 strokes on each side after every half-hour or so of carving.

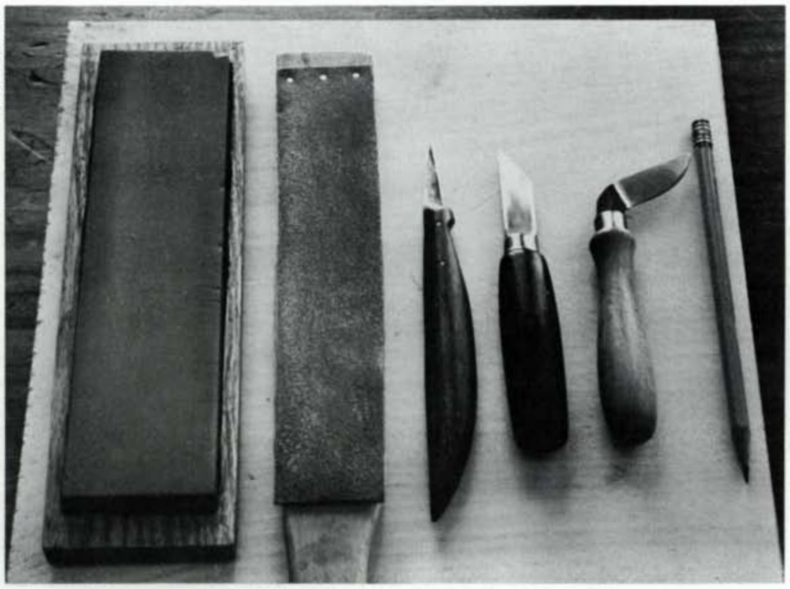
After sharpening, mark out your pattern. There are several ways to transfer a pattern. One way is to trace a paper pattern onto your wood with carbon paper. Or, you could glue the pattern directly to the wood with a little rubber cement. After carving the design, rub or sand off the remaining bits of paper. Another way is to draw your pattern directly onto the wood using a small straightedge and a compass fitted with a sharp pencil lead. A little knowledge of geometry helps. Bear in mind that many of the pencil lines will remain after the carving is completed because they mark out or cross high points in the design where little or no wood will be removed. Therefore, keep marks light to make cleanup easier. Also, when sanding off guidelines, wrap the paper around a flat block of scrap wood to prevent rounding off the crisp edges of the chips—easy to do if pressure is applied only with the fingers. Too much sanding can easily ruin a chip carving, and it is best to work with a fine grade of paper as lightly and as sparingly as possible.

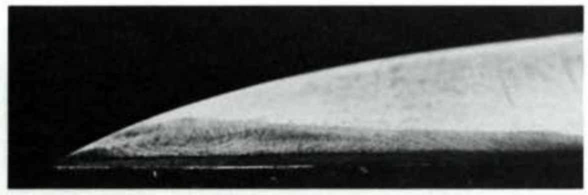
All traditional designs are made up of variations of two kinds of triangular chips. Both chips are quite simple, and it takes less time to carve them than to describe how. One chip is carved with three knife cuts, and the other is carved with six. Both types should be practiced until they become second nature, regardless of the direction of the wood grain. An hour in experimentation can save lots of frustration later.

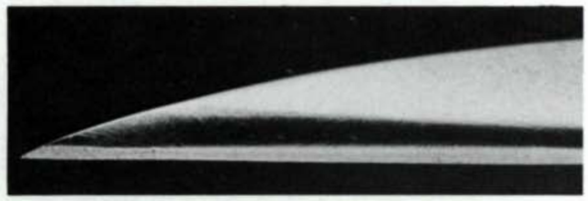
The triangular chip using three cuts is called the *Dreischnitt* by Swiss and German woodcarvers, who used it for border designs. The first step is to stab out shallow stop cuts on two sides of each triangle. The easiest way to do this is with a sharp skew-bladed knife, though you can use a straight-edged knife. Firmly press the point of the knife into the apex, the deepest part of the triangle, then vertically incise each wall so that it slopes up to the surface of the wood. With a straight-edged knife, carefully slice out the wood between the two stop cuts. Be sure to watch the direction of the grain to avoid running splinters into the design. When completed, you will have a neat, simple wedge-shaped chip cut into the wood. By combining and arranging these triangles, you can create a great variety of designs and patterns.

The six-cut chip is essentially three *dreischnitt* cuts combined to form one larger triangle. Place the point of the knife into the center of the triangle and cut out to each of its ver-

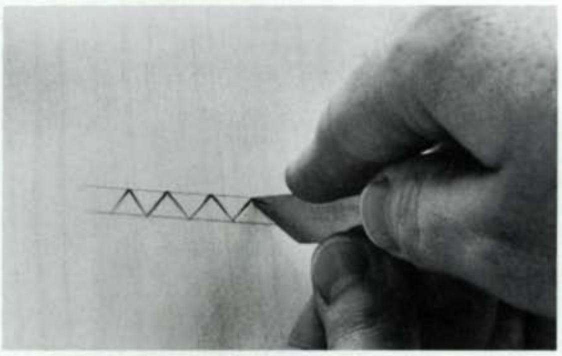
Photos: Ellen Butz

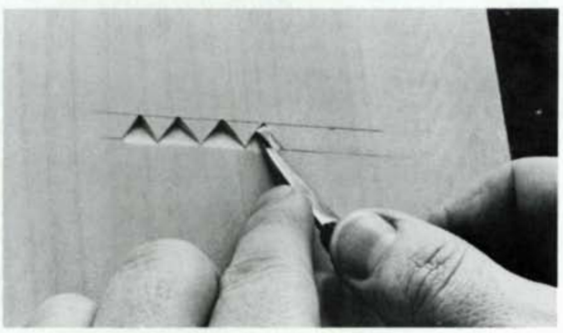


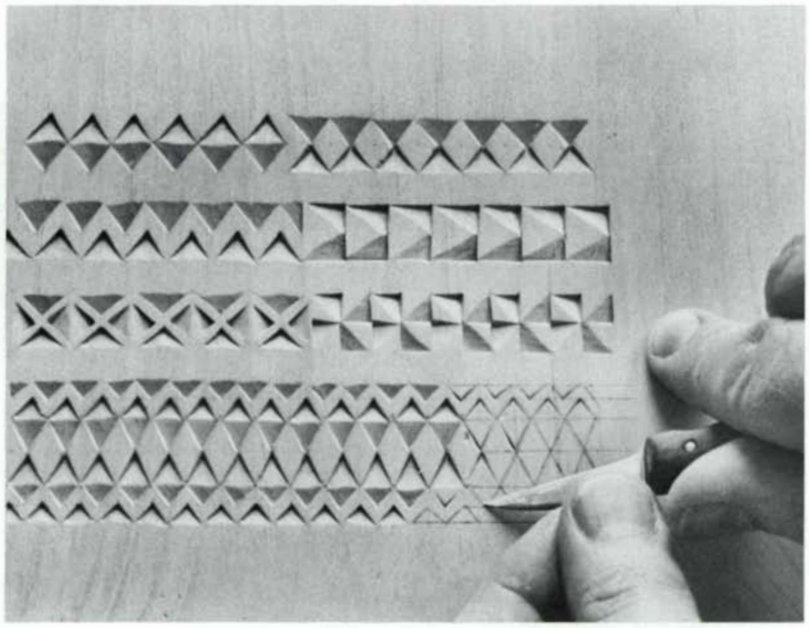




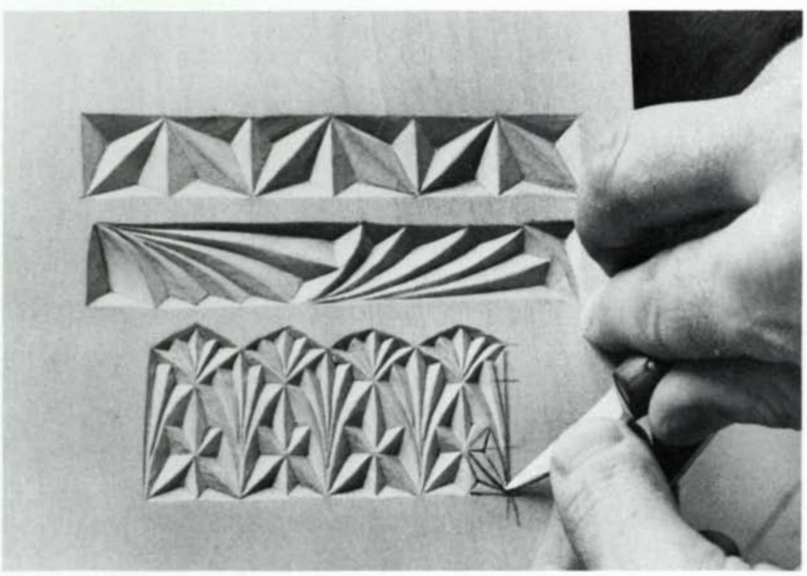
Left, chip-carving tools include a sharpening stone and leather strop for bringing knives to a razor edge, a straight-edged knife for making slice cuts, a skew-bladed knife for stab cuts, and an offset blade. The wood blank is pine, though any soft, even-grained wood will do. Top, a burr is left by sharpening on the stone; subsequent stropping leaves the edge razor-sharp, above.

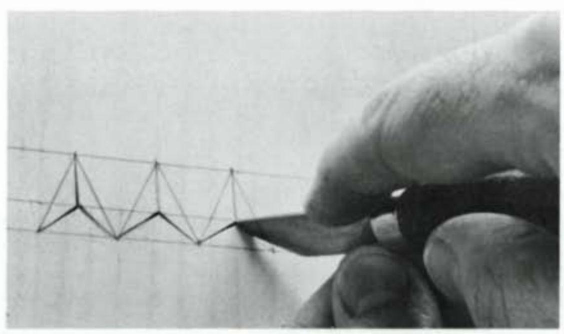


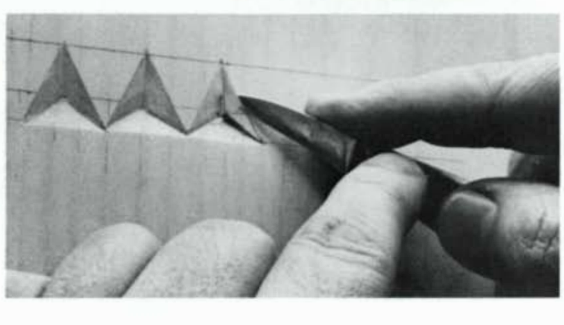




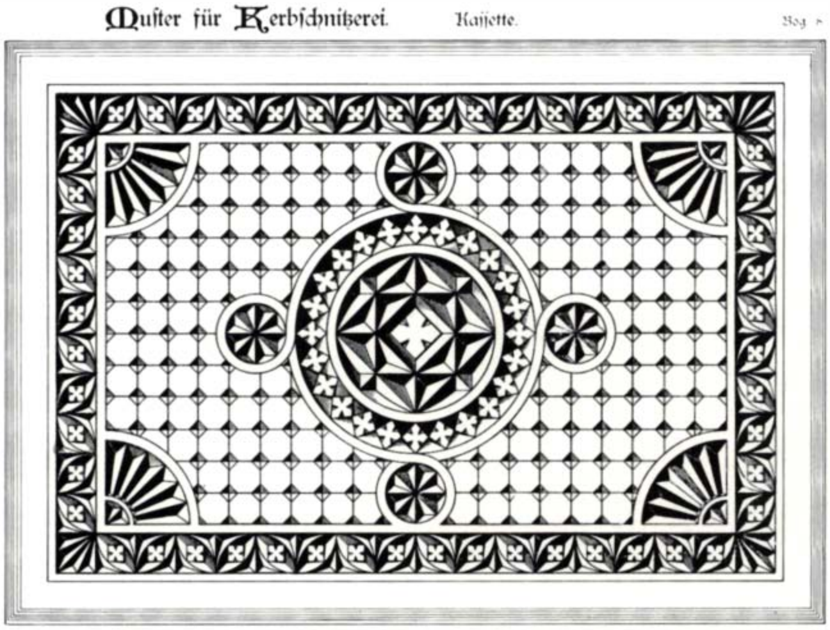
Make the three-cut chip by stabbing out the sides of the triangle with a skew-bladed knife, top left. Then carefully slice out the remaining wood with a straight-edged knife, left. Above, some traditional dreischnitt *border designs.*



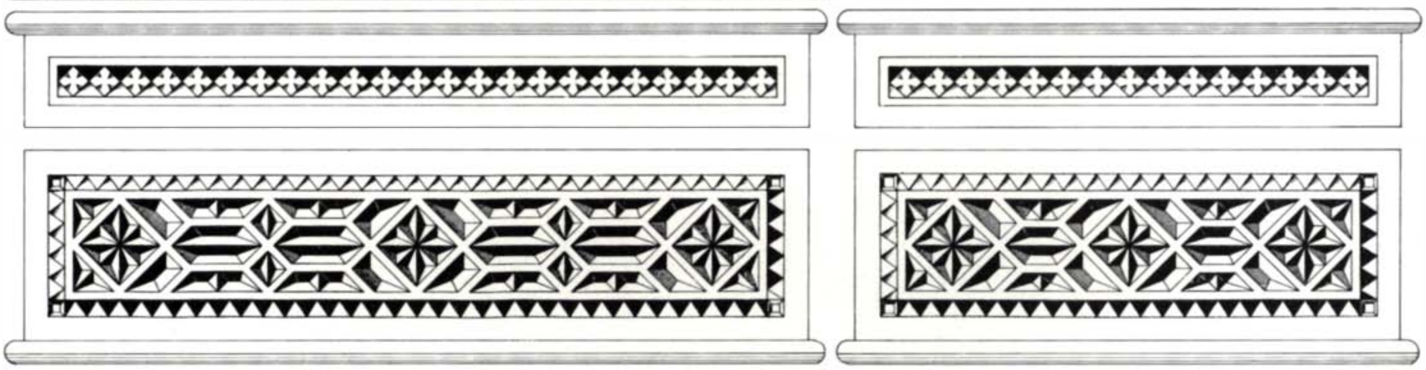




Six-cut triangles are made by stabbing into the center, top right, and then making a slice cut for each side, right. Above, traditional designs using six-cut triangles can have straight or curved sides.



Match holder, carved by the author.



Intricate box pattern used by woodworker Otto Dunnebier while completing his apprenticeship in Germany about the turn of the century.

tices. Next, slice out three chips, leaving a triangular carving with three sloping sides meeting at the center. In the three-cut chip, the stop cuts define two walls; in this chip, the stop cuts mark the bottom angles of the triangle and will eventually form a reverse pyramid. Again, avoid slicing against the grain. This chip can be carved in a variety of shapes and proportions, with straight or curved sides.

Keep all the chips relatively shallow. The deepest portion of any triangle should not be cut more than ⅛ in. to ¼ in. below the surface of the wood. Going deeper will cause unnecessary difficulties and will detract from the appearance of the carving unless you are working on a large scale. It's also a good idea to keep both hands on the knife when cutting. You'll have greater control, but more importantly, you'll avoid the natural but dangerous tendency to hold the wood with one hand and cut toward it with the other. Brace the work against a small bench hook made from scrap lumber. This will allow you to turn the wood frequently without having to fumble around with clamps.

For carving the match holder shown above, I used a piece of ¾-in. butternut and did all the carving before cutting the block to shape. It doesn't really matter which you do first, but I find working with a larger piece easier and safer. You can use just about any moderately soft, even-grained wood, such as pine, bass, some cedar, walnut and cherry. The English even used oak, but most oak available these days doesn't hold details well.

After carving the pattern and cleaning off the pencil marks, you can give the piece a protective finish. Many old chip-carved pieces were left unfinished, but you'll find a light coat of paste wax not only helps seal and protect the wood, but also makes the facets of the carving stand out more sharply. You can use other finishes, particularly on eating utensils, but avoid high-gloss lacquer, varnish or any other material that will make your carving appear plastic.

If you would like to use a traditional finish, you might try a beeswax mixture used in Europe for many centuries. Carefully melt about three ounces of bleached or raw beeswax in a double boiler over low heat. Stir in one or two ounces of good-quality turpentine, then let the mixture cool. Within an hour the polish should set up to a butter-like consistency. If the polish is too soft, melt it again and add more wax. If it is too hard, dilute it with a little more turpentine. A small amount of melted rosin can also be added to harden and darken the wax, although I prefer the simpler mixture. Remember that this concoction is highly flammable—if the wax begins to smoke, it is too hot. Should the mixture catch fire, snuff it out with an airtight cover, which you should keep on hand for just such a purpose.

Seal the beeswax mixture, when cool, in an airtight container to preserve freshness. To use, lightly rub or brush a thin layer on your carving. Let it stand for a day so the turpentine will evaporate, then buff with a clean horsehair shoe brush. In time the polish will age with the wood and darken slightly, leaving your work with a warm mellow glow. □

Rick Butz, a professional woodcarver, lives in Blue Mountain Lake, N.Y.

Hans J. Wegner, who participated in the original annual exhibitions, was represented by this thoroughly professional entry, left: a refinement of the chair he designed in 1948 for the Museum of Modern Art competition on organic furniture. Cabinetmaker: Johannes Hansen.

Ash chair (right), designed by painter-sculptor Gunnar Aagaard Andersen, made by cabinetmaker Soren Horn. By slicing each rail in the seat and back into a number of thin slats and allowing these a little longitudinal movement, the designer has utilized the natural resilience of the wood to a previously unexplored extent. Despite its formal appearance, the chair is truly comfortable.

Copenhagen, 1979

Young designers steal the show

by Per Mollerup

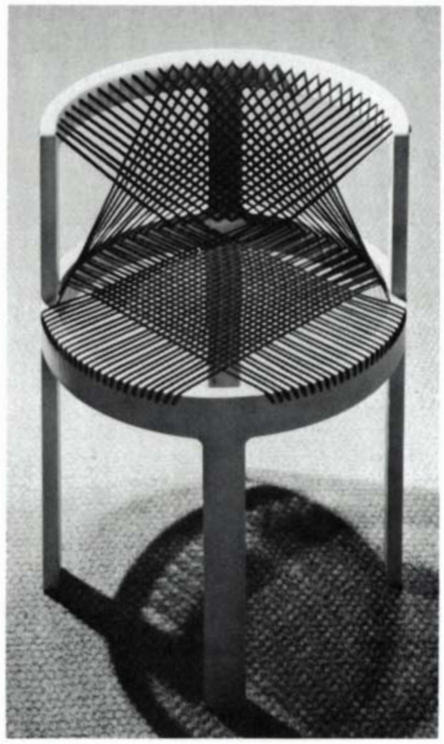
From 1927 to 1966 the Copenhagen Cabinetmaker's Guild held an annual exhibition to show the world what the cream of the cabinetmaking fraternity could create—the finest masters in collaboration with the best designers. The Permanent Exhibition of Danish Arts and Crafts (Den Permanente) has for the second year running tried to revive the tradition, quite successfully.

Attack is the best form of defense, and the original basis for the Guild's exhibitions was a period of depression as cabinetmakers sensed the juggernaut advance of industrialized furniture-making. The idea was to regenerate a sense of self-respect and to demonstrate that the craft was still capable of vigorous development.

The exhibitions eventually emerged as the finest display of items from the golden age of Danish furniture-making. Life throbbed back into the flagging workshops and for a time they catalyzed the very industry they had set out to defend against. Scores of items of Danish industrial furniture can trace their roots directly to these exhibitions.

But the 1966 show was the finale. Despite newspaper and general public interest, the cabinetmakers could not brush away the economic problems of their craft. The exhibitions quickly became something to be talked of as history—never more to be repeated. And yet the idea was kept alive. In 1978 Den Permanente, with Grete Jalk as designer and coordinator, arranged a retrospective exhibition with highlights from the 40 annual shows (*Fine Woodworking*, Sept. '78, pp. 49-51).

This retrospective was so successful that this year Jalk again was able to mount an exhibition of new work. With relatively modest means, a dozen workshops were persuaded to join forces with predominantly young designers and create a show every bit as exciting and eventful as any of the earlier 40. The exhibition brought out more talent in one year than a whole decade of furniture design competitions. It is to be hoped that this establishes a new tradition. □



Cabinetmaker Horn also made this maple chair with woven string back and seat, designed by Niels Jorgen Haugesen.

Per Mollerup is editor and publisher of Mobilia, *an international furniture design magazine ($50 for 8 issues to DK-3070, Snekkersten, Denmark).*

Mortise & Tenon by Machine

With help from jigs and fences

by Ian Kirby

Woodworkers have devised endless methods for cutting mortise and tenon joints, relying upon hand tools, machine tools and various combinations of the two. Deciding which method to use depends primarily on the tools one has at one's disposal.

Up to now in this series of articles, I have concentrated on hand-tool methods, which have several virtues. The tools are not special. There is a logic to the process. It is reasonably quick. Once one has mastered the skill, one can achieve the desired result exactly. Having designed a joint, the workman need never compromise in its manufacture. However, the result is always at risk and one must concentrate to avoid spoiling it. It can become exceedingly tedious if one has a lot of joints to do.

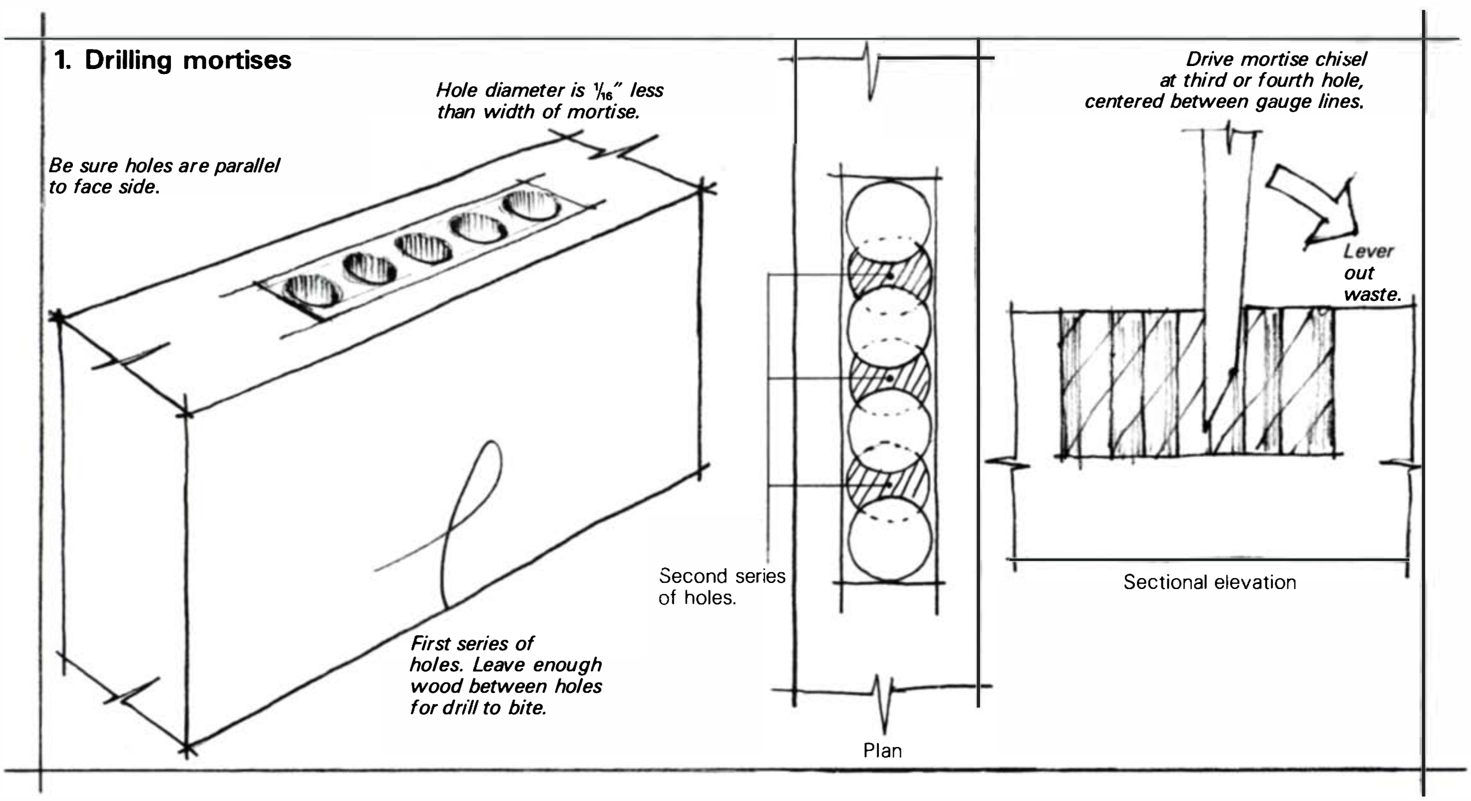
Special-purpose machines designed for mortising are one alternative. I'll discuss some of them later; they are generally fast and accurate, but expensive and beyond the needs of most shops. The middle ground is to use a machine not specifically designed to cut a given joint, such as the table saw, radial saw, drill press or router. These machines, with the assistance of suitable jigs, can remove the bulk of the waste accurately and efficiently. Some hand-finishing can then produce the desired result. The notion that there is only one way to achieve a result is simply wrong, for every workman develops his own techniques, and this article thus cannot be exhaustive. But regardless of methods, every workman should arrive at the same result in the end. The available tools do not determine the size or proportions of the joint, nor excuse inaccuracy in its manufacture.

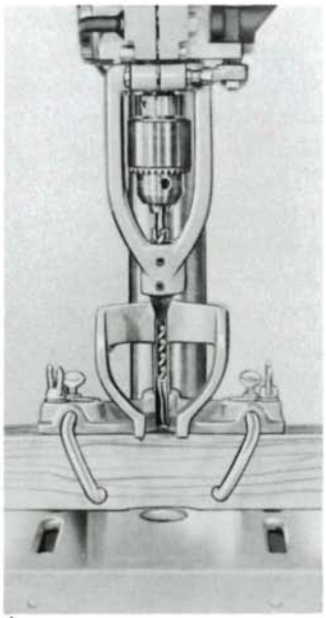
The mortise — To deal with the mortise first, and ignoring such details as sloping haunches, twin joints and dimensioning, the main consideration is that the two inside faces be parallel to each other and to the face side or edge of the stock.

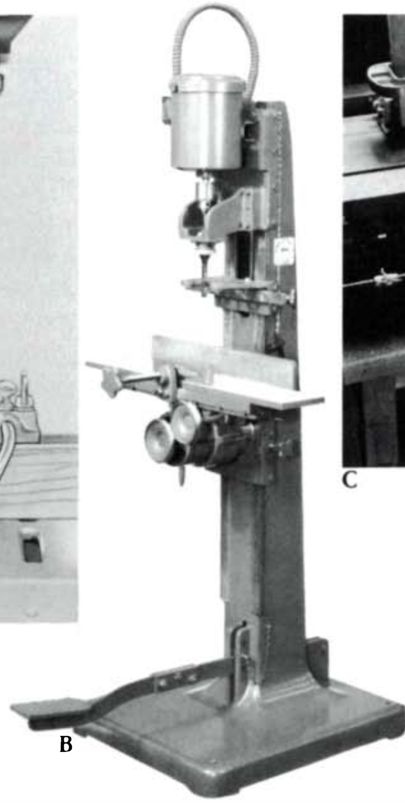
A frequent question is, "Can I drill out most of the waste and then pare down the cheeks with a wide chisel?" The answer is "yes" to the drilling, and "no—or only with great difficulty" to the chiseling. To keep the mortise square and parallel when using a wide chisel really requires a jig. Sighting the chisel while paring across the grain is too hit-or-miss. And a jig would probably be too complex because of the nature of the operation. An acceptable result can be achieved, however, by drilling a row of overlapping but undersized holes to remove the bulk of the waste, and squaring up to the line with a mortise chisel. The joint still has to be marked out with the mortise gauge, to assist at the chiseling stage.

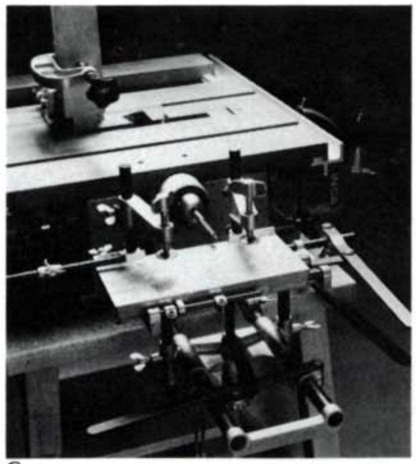
In any machine operation, one must think of the cutting tool itself in close association with the fences and guides related to it. Usually there is no marking out for a joint made entirely by machine. Layout marks tell where to cut a joint—with a jigged system one wants to be forced to cut where the jig directs. When using a drill press (not a portable drill) to remove the waste, the machine's depth stop establishes the mortise depth. A fence fixed to the table so the face side or

1. Drilling mortises

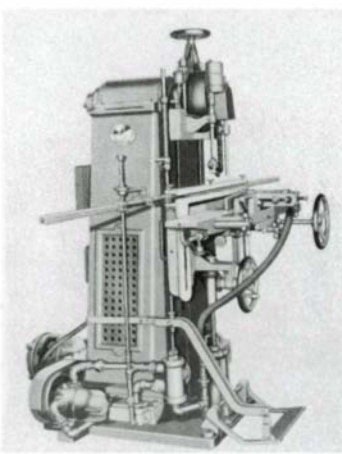


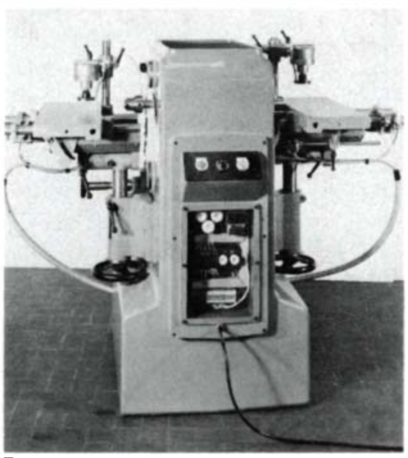

A


B


C


D


E


F

A. *Hollow-chisel mortising attachment for drill press (Rockwell model 15-840). Y-shaped yoke at top attaches hollow chisel to quill; lower yoke is part of fence arrangement clamped to drill table.*

B. *Hollow-chisel mortiser, Oliver No. 194. Table includes hand wheel for clamping work against fence, with hold-down mounted on vertical column. Wheels below table control sideways travel, tilt and height. Foot pedal moves chisel and motor assembly into the work.*

C. *Inca horizontal-boring and mortising option on 10-in. table saw uses three-jaw chuck attached to saw arbor. It includes work clamps and adjustable stops. Hand wheel at bottom raises and lowers table, and levers control infeed and crossfeed.*

D. *Griggio slot mortiser, from Italy, takes end-mill cutter in stationary horizontal chuck. Hand wheel raises table, clamp holds work, levers move table and work in and out, back and forth. Sold by H. Weigand Corp., Claremont, N.H., and Carpenters Machinery Co., Philadelphia.*

E. *Chain-saw mortiser has hydraulic clamp and feed—operator loads the stock, taps the foot pedal, and unloads it. Photo: Northfield Foundry & Machine Co., Northfield, Minn.*

F. *Bacci oscillating chisel mortiser, also from Italy, has double-ended cutter shaft and two tables for production work. Cutter rotates at 8,750* RPM *and also swings back and forth 200 times per minute. Pneumatic tables move synchronously in all three planes. Thus the size and shape of the mortise is virtually unlimited. Photo: Richard T. Byrnes Co., West Chester, Pa.*

edge of the wood can be placed against it establishes the distance to the center of the drilled holes. Two end stops determine the left-to-right travel of the workpiece, and if the wood is squarely placed within these fences, the correct side uppermost and the right way around, then the series of holes can be drilled only within the defined parameters.

The diameter of the drill, however, should be at least 1/16 in. less than the width of the mortise chisel that is to be used to clean out the remainder of the waste. The pattern of holes depends in part on the type of drill bit. Best is a bit with two scribing lips, like a Russell-Jennings. A Forstner bit also gives good results. An engineer's bit for drilling metal is not so effective; a spade bit gives variable results depending on the type of wood and on the feed and speed.

Drill the end holes first, then drill along leaving up to 1/4 in. between holes (figure 1). Drill out the remainder by positioning the spur on the webs of wood left between the holes. The edges of a drill may overhang, as long as the center is cutting into solid material. The drill drifts when the center is not cutting firmly into wood. Drive the mortise chisel straight down into one of the middle holes, about half-way to full depth, and carefully lever out the small amount of tissue remaining on the walls of the mortise with the chisel's bevel downward. Don't try to go to the bottom in one cut—you'll quickly get the feel and realize that the operation can be fast and simple. Finish the ends by knifing the line and driving the chisel straight down, just as when doing it all by hand.

Mortising machines — The hollow-chisel mortiser is freestanding, with built-in table, fences, clamps and stops. In small shops it is usually an attachment for the drill press—a square chisel with a hole in the center through which an auger-type drill fits (figure 2, p. 86). A yoke fastens the chisel to the drill-press quill, so the chisel and drill will move together into the work, but only the bit rotates. As the bit removes most of the waste, the chisel, sharpened on the inside to form four cutting edges, follows to shear out the remaining wood and force it into the auger. The chisel shaft has at least one window through which chips can escape.

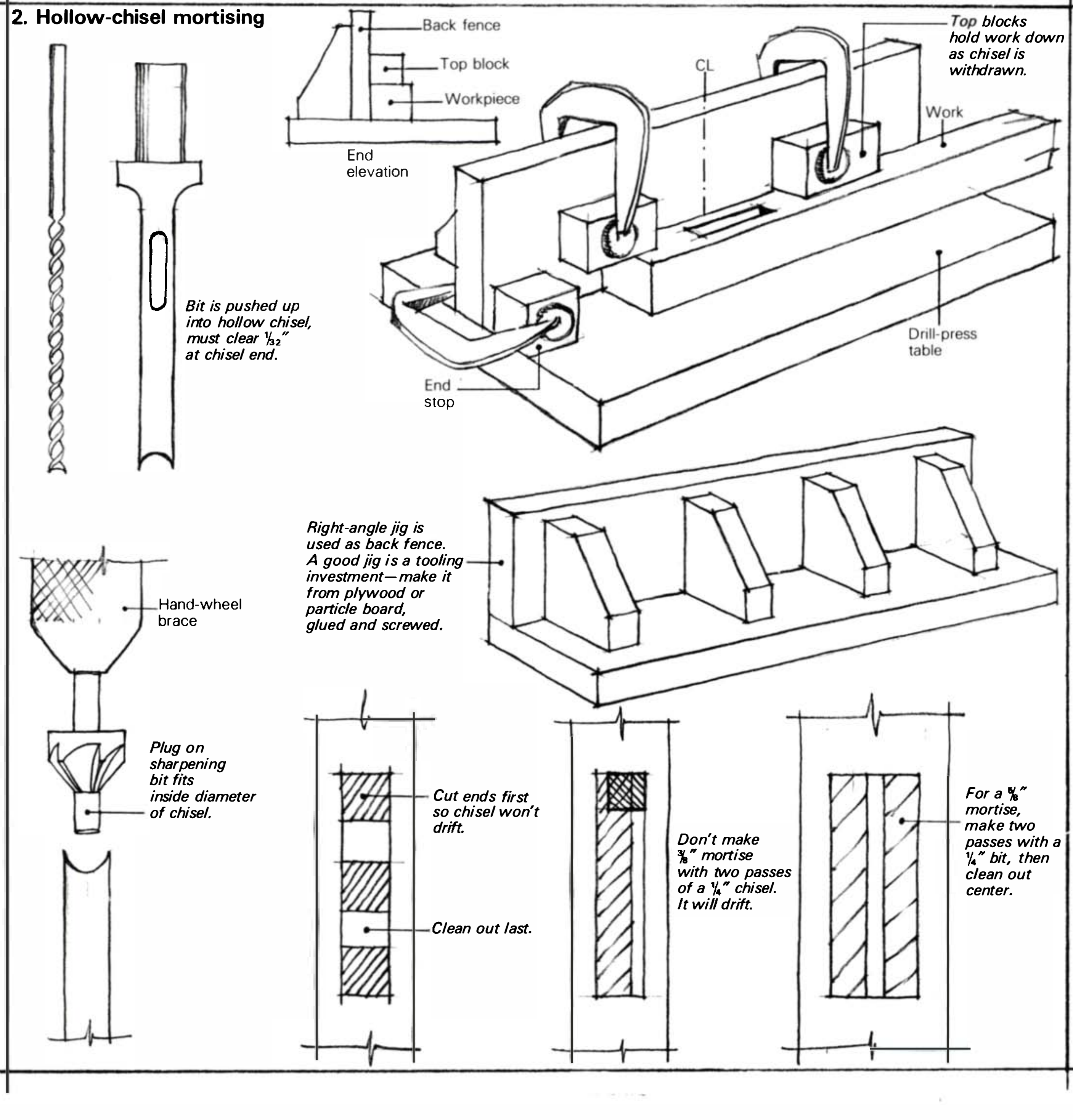
The quality of a hollow-chisel attachment is closely related to its price—a good set for ¼-in., ⅜-in. and ½-in. mortises will cost about $200. Before ordering any attachment, be sure it is compatible with your drill press. You don't have to worry about whether the drill press can stand the work load—it will.

When mounting the tool, make sure the plane of the table is at right angles to the bit. Also make sure that the square chisel has its inside face parallel to the fence. Adjust the bit so it does not touch the sharpened end of the chisel, otherwise both will overheat. Aim for a gap of 1/32 in., enough to loosely fit a business card. It's usually possible to jig the hollow-chisel mortiser so that you don't need any marking out on the wood (figure 2). For short runs, it's probably easier to square pencil lines across the wood and omit the end stops.

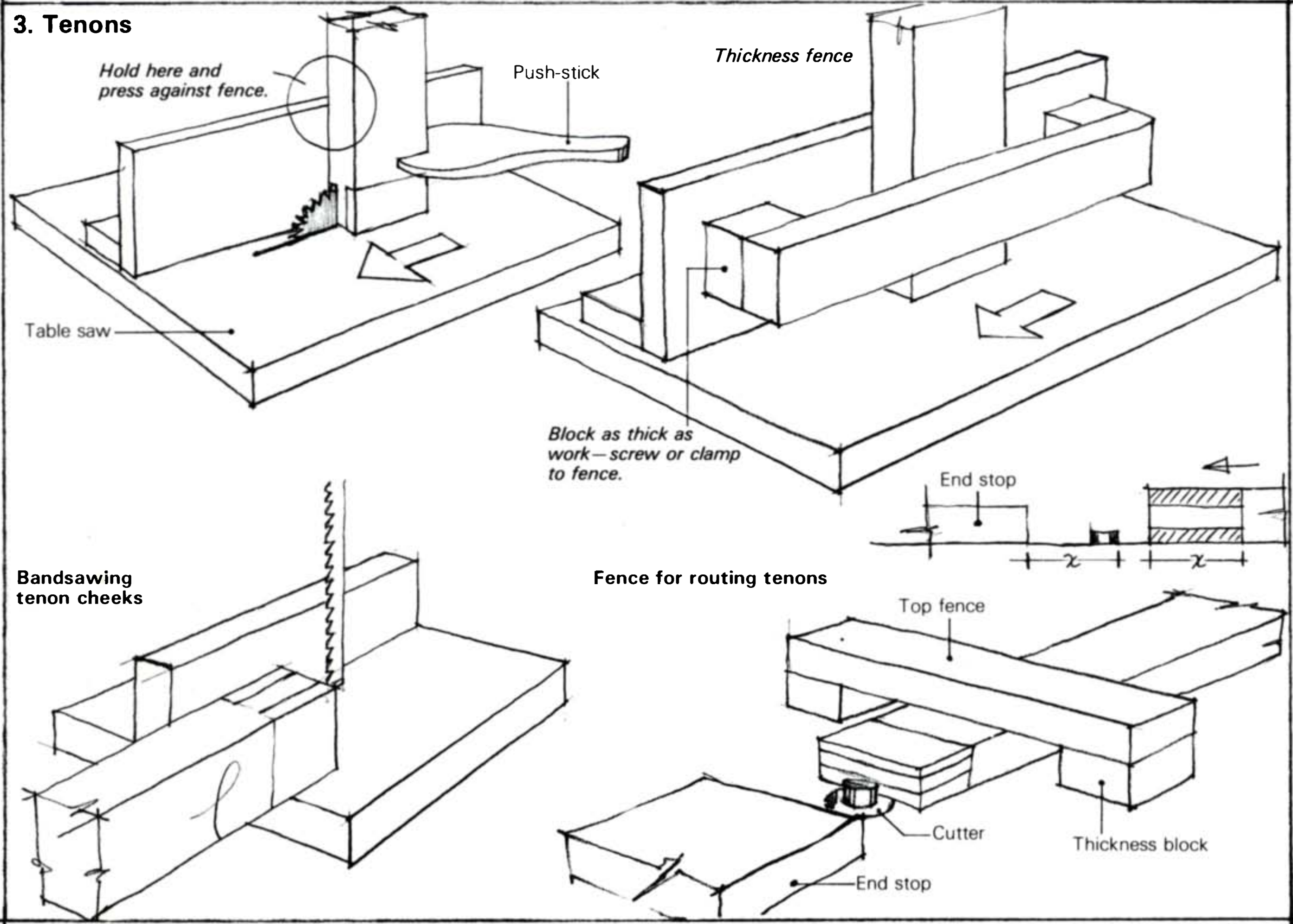
It is normal to cut the end holes first, then to cut intermediate holes with wood left between them, and finally to clean out with another pass along the work. This is because the hollow chisel tends to drift if it is not cutting on all four edges, or on two opposite edges. Each worker will find a pattern that suits him. The square chisel is reluctant to withdraw from some woods. The remedy is to polish the outside of the chisel to reduce friction, and to reach full depth by ¾-in. bites. Withdraw the bit, clear the waste, and take a second ¾ in. in the same place. This characteristic of the machine makes it imperative to hold the wood firmly down on the bed, by clamping one or more blocks onto the back fence. The fence shown in figure 2 is simple and sturdy, and worth making well since good jigs are a tooling investment.

A small but important point is to keep the whole of the fence rig clear of chips, so they don't get between the workpiece and fence. In industry, a squirt of compressed air does it. Next best is to keep a brush at the machine and sweep off the bed and jig after each cutting. Many people minimize the

2. Hollow-chisel mortising



3. Tenons



problem by cutting grooves and reliefs along the inside corners of jigs and fences, but the brush is still necessary.

It is not good practice to make a ⅜-in. wide mortise with two passes of a ¼-in. bit. The bit will be cutting on only three sides during the second pass, and it will probably drift. The ¼-in. bit will make a ⅝-in. mortise, via two passes on each side and a third down the center.

A hollow chisel is sharpened with a bit that looks like a rose countersink with a cylindrical plug on the end. The outside diameter of the plug is a hair smaller than the inside diameter of the chisel. Set the chisel upright in a vise, load the bit into a wheel brace, and place the plug into the chisel's bore. The reamer flutes are very effective and only a few turns of the drill with light pressure will remove enough metal. Don't use an electric drill for sharpening—it goes too fast and you can't feel the action. Sharpen the drill bit in the usual way, from the inside of the auger so its diameter doesn't change.

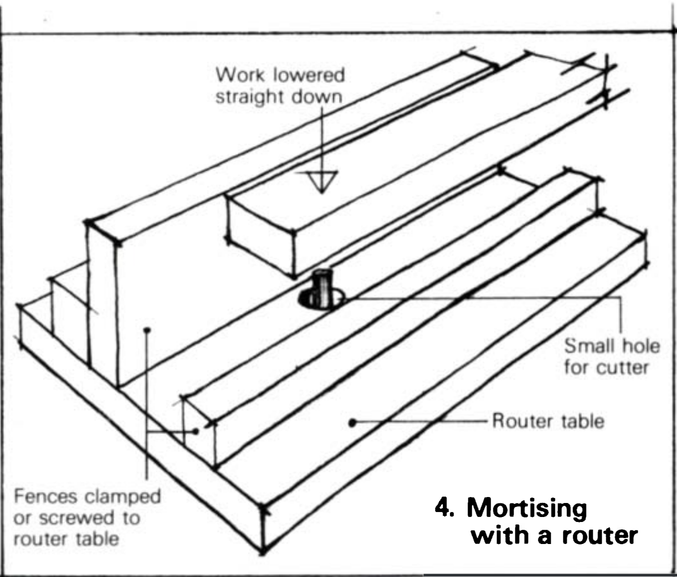
Among the more specific machines for mortising is the horizontal slot mortiser or long-hole borer. Like the router, it leaves a round end. Fundamentally, it consists of an end-mill style cutter, with a sharpened end and sharp flutes, revolving horizontally over a traveling bed much like the cross-slide of a metal lathe. The bed moves the work into the cutter to full depth, then traverses to make a mortise. The same machine can also make tenons, forming one cheek and shoulder with each horizontal traverse. Some versions of this machine hold the work stationary and move the cutter into it.

A chain mortiser is akin to a chain saw, with its bar held vertically and set into a slide device. The system is not used much in the furniture industry, being better for long and deep mortises in large-sectioned material such as fence posts.

Probably the most sophisticated mortising machines use a swinging and orbiting cutter, driven by a cam system and a little like a sewing machine writ large. These machines can cut an absolutely accurate mortise through any kind of wood, even plywood, without regard for knots or end grain.

Tenons — Generally, making tenons with a nonspecific machine is not as difficult as mortising—although there are probably as many variations on the theme. The most common tool for cutting the cheeks is the table saw, with the work held vertically by a fence and passed over the blade. A carbide-tipped blade gives best results. If the tenon is centered, both cheeks can be cut at the one setting. You can build or buy a suitable fence that rides in the crosscutting slots. A stationary fence must have enough overhang before and after the sawblade to support the full width of any piece being tenoned, and it is probably best to make it the full width of the table. Using the simple fence shown (figure 3), the left hand (assuming you are right-handed) holds the top of the workpiece against the fence, while the right traps the work and pushes it with the aid of a push-stick. If you feel at risk using this method, then arrange a thickness fence as well. A home-built version of the traveling jig sold by most manufacturers was shown in Methods of Work, Sept. '79.

The simplest way to cut the shoulder, of course, is to saw it



4. Mortising with a router

with a transverse fence. Whether you cut the shoulder first or the cheek first is a matter of personal style and there are arguments both ways. I prefer to cut the cheek first in order to have the largest bearing surface while the work stands on end. Also, if the shoulder has already been cut, the small block of scrap often wants to get back on the saw teeth and then fly around the room in an unsettling way. If one has a dimension saw—that is, one with a traveling table—the same fence system can be mounted right on it. The workpiece can then be clamped onto the vertical fence, and both hands can be employed pushing the bed and workpiece past the blade.

The slowest method is to set the saw for the shoulder cut and move the work along one kerf thickness at a time. It may be the handiest method with a radial arm saw, however, and the operation speeds up considerably when one substitutes a dado head. Most radial arm saws can be rotated through 90° and locked parallel to the table surface, whereupon the wood can be laid flat on the table and the saw pulled through the cheek. The work requires a platform and fence, plus room to clamp each piece in place, as the amount of outward thrust can be considerable. The method is efficient for quantities of identical parts.

When used to cut tenons, the band saw could be considered an automated backsaw, since it is easy to use freehand. The wood must be truly square and the blade running perpendicular to the table, otherwise the tenon will come out at some odd angle. This is workmanship of risk, and the decisions about where to cut and where to stop are no different than when working by hand. It is feasible to use a fence with the band saw, although the blade has to be sharp and tensioned just right, else it will wander. Some band saws just do not seem to have the capacity to saw a straight line when using a fence, no matter what one does to try. Feed speed and the hardness of the wood are contributing factors (see p. 96), and generally a slow feed gives the best results.

Because the waste being removed is shallow, a router can mill a good tenon. In most cases it is best to cut the shoulder lines with the radial arm or table saw first. Then lay the work flat on the router table and pass it over a straight cutter or any end-mill style cutter. Fences are as necessary here as with any other method, although the cut is easy and it is tempting to wing it. Please don't take the chance.

There are also a wide variety of industrial tenoning machines, many of them using shaper-style cutterheads mounted in pairs to mill both faces of the tenon at once. Such machines are very efficient and suitable only for high-volume work.

The router — The electric router, combined with a careful system of jigs and fences, is a useful mortiser. When making a wide mortise—anything over ½ in.—it's better to make two slots ¼ in. wide at each side, and then to remove the waste from the middle. When making a deep mortise, go to the depth in two or more bites.

Don't try to drop the router into the work. Use a table with the router hung underneath, the bit projecting through its surface (March '79). The minimum number of fences is two, one along each side of the work. End stops are always a help, but their use is often limited by the size of the router table. The common method is to rest one end of the work on the table and lower the other end onto the cutter. This is not the best way, since the work comes down in an arc. Instead, hold the work parallel to the table against the fence (figure 4), and lower it straight down with both hands, keeping the hands well away from the cutter. The dimensions of the work will dictate the dimensions of the fences, but the aim is to arrange the system so you can keep a tight hold on the workpiece. We usually make fences long-grained in the direction of travel, and if the workpiece projects well above the fences, control is not hard to achieve. But if the workpiece is small in cross section, make the fences by simply clamping wide boards, cut off square, flat on the table.

Most problems in routing mortises arise because of the small size or make-do nature of the router table. It's worth investing in a piece of coreboard or good-quality plywood and making a proper large table, once and for all. Rout a recess underneath so you don't lose the table thickness from the depth of cut, and keep the cutter hole small so the table will support the wood right up to the cut. The larger the hole, the harder it is to measure and to visually assess cutter height, and the easier it is for fingers to get into the hole.

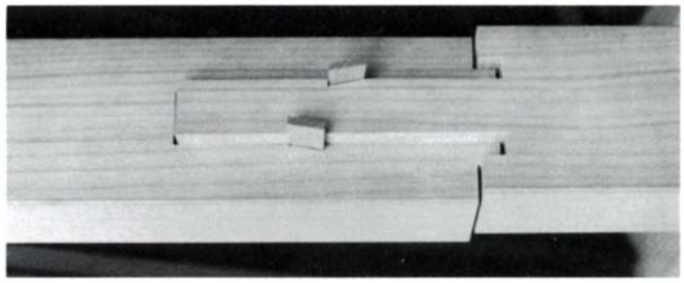
It also pays either to devise adjustable fences for the table, or else to screw the fences down. It may seem odd to go to some trouble to get a clean, often expensive working surface only to mar it with screw holes, but the life of the surface will be longer than you imagine. If you keep the fences with screw holes already drilled in them, the system is easy to use and quickly set up. It's usually safer and more accurate than clamping down whatever comes out of the short-ends box.

A routed mortise has round ends. One can shape the tenon to match, or one can finish the mortise square with the conventional chisel. There are points on both sides. When the mortise goes through, round ends make a most acceptable design detail. It takes some skill to round the tenons, but it's worth the effort. An alternative is to leave the mortise round and the tenon square, and to force the two together. This procedure is not unusual in production. The width of the tenon is made so that its corners will bite into the semicircular ends of the mortise. The crushed corners create a tight friction fit, enabling the assembly to be taken from the clamps after a very short pressure time. □

Ian Kirby operates Hoosuck Design and Woodworking in North Adams, Mass. This completes his series of articles on the mortise and tenon joint; previous installments appeared in March '79, May '79, and Sept. '79. Readers are welcome to contribute their own variations; another appears on p. 95.

East Comes West
An exhibition of Japanese joinery

by Alan Marks



In June of this year the Works Gallery in San Jose, Calif., together with the Fine Arts Commission of that city sponsored an exhibition of intriguingly complicated and well-crafted Japanese framing joints. Shown also were floor plans and elevations for various tea and country houses in which these joints had been used. All designs and joinery on display were the work of one man, architect/carpenter Makoto Imai, who capped off his show with an impressive demonstration of the Japanese joiner's ancient art.

By tradition the Japanese architect and master builder are one and the same. The man who does the construction plans also wields saw, chisel and plane. Only for roughing-out are power tools of any kind used, even today. Japanese architecture is a highly ordered craft. There are at least three different types of traditional Japanese structures: the teahouse, the temple and the country house. Each classification is subdivided, and each subdivision goes hand in hand with a type of joinery peculiar to it. Each joint requires a long series of precise operations in a fixed order. To perform with this precision, tools are kept in condition with unusual thoroughness.

The majority of joints on display were scarf joints, and their predominance in Japanese building deserves some explanation. According to Kiyosi Seiki in his book *The Art of Japanese Joinery* (reviewed in *Fine Woodworking*, Sept. '78, p. 22), Japan's originally abundant supply of timber encouraged almost exclusive attention to wood construction. When the best timber was depleted, carpenters were challenged to develop new and elaborate joints to deal with the shorter, crooked second growth. Another reason is that Japan sustains frequent earthquakes and typhoons; buildings must be not only strong but flexible enough to withstand twists and severe lateral and vertical stresses. Extraneous joints are purposely introduced to permit flexion—the "bending reed" philosophy of the East in practice. Soft woods such as pine, cedar and cypress are in widespread use in Japan partly because of their availability, partly because of their resistance to rot, but most advantageously because of their tendency to bend rather than snap. And there is an aesthetic rationale for the predominance of scarf joints. Many of the beams in Japanese construction remain visible in the finished structure. Doubled-up members, steel reinforcing plates and hanging supports, features common to Western stud-wall construction, would look clumsy left exposed. Nails and even glue are avoided in Japanese joinery as extraneous materials. Many joints are secured by strategically placed wedge pins or locking keys. But these and other intricacies are not displayed decoratively in the finished building; in most cases only a simple line reveals the presence of a joint. Hiding the interlocking puzzle pieces permits the eye to wander over junctures without distraction—subtle and intricate means achieve the illusion of simplicity.

Alan Marks is Fine Woodworking'*s California correspondent.*

Imai selected a scarf joint from the many possibilities to exemplify his work. He began by squaring a timber with plane and try square, a 50 mm by 75 mm (2x3) length of Port Orford cedar. (Its distinctive fragrance is familiar to anyone who has made arrows; it combines lightness, strength and flexibility.) Imai then laid out both mortise and tenon somewhere in the middle of the piece, intending to cut two halves and rejoin them. For marking the lines he used a simple bamboo striking stick with one end flat and chisel-pointed and the other bluntly pencil-pointed. This stick he poked at intervals into a chalkline container holding red chalk. Because the bamboo fibers are hollow and spread slightly at the tips, they hold a quantity of the chalk dust and release it during marking through a kind of capillary flow to produce well-defined, thin lines. When the complicated layout was done he used the thicker, pointed end of his marking stick to make several heavy red checks, indicating the waste side of the line.

Then Imai girdled the piece with his saw so accurately and quickly that the finished cut might have been done on a table saw. He marked out lines on the ends of the halves to be joined. The next cuts were for the stub tenons, executed with a *dozuki* saw, the fine-toothed backsaw Western woodworkers find most useful for dovetail work. Like Japanese planes, it cuts on the pull stroke, but is surprisingly easy to get used to. When the stub-tenon waste was chiseled away, Imai defined the mortise sides with sawcuts from a double-edged *ryoba* saw 500 mm (19½ in.) long and chiseled the mortise out, tapping with a steel-headed hammer; he reserved his wooden mallets for adjusting his planes and driving in lock keys. Another lightning barrage of chisel cuts and parings yielded slots for the two lock keys. He next tackled the tenon piece, and when all was done the two socketed nicely into place with a minimum of adjustment to close the gap. His last step was to fit the two keys, hammer them in and flush them with the *dozuki*. Finally all four sides of the scarf were planed and chamfered lightly. Imai had produced a tight-fitting, wedge-locked, lapped mortise and tenon scarf joint with a half-blind stub tenon.

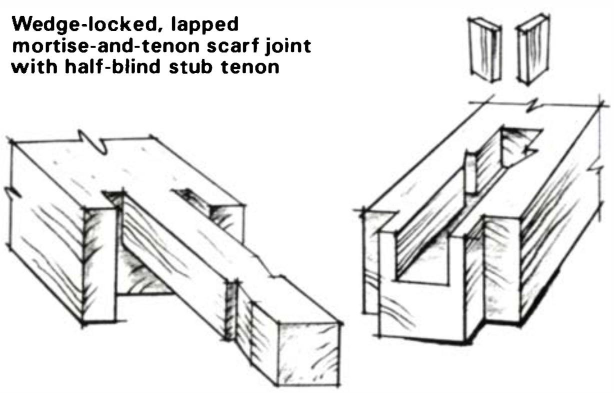
I arrived an hour early for this demonstration and observed some important preparations. I was told Imai inspects his planes daily before starting work. On this occasion they required about 15 minutes of sharpening, alignment and adjusting before he felt they could do an adequate job. After considerable attention to the sharpness of the irons, using water on two stones of varying grit, a red one and a white one, he spent as much or more time on the soles. The explanation was that a change in air humidity from Berkeley to San Jose, 60 miles south and inland, had significantly affected the wood. He used winding sticks for sighting, a steel straightedge and a small scraper plane to work the plane bottoms.

I purposely avoid saying he "flattened" them because the

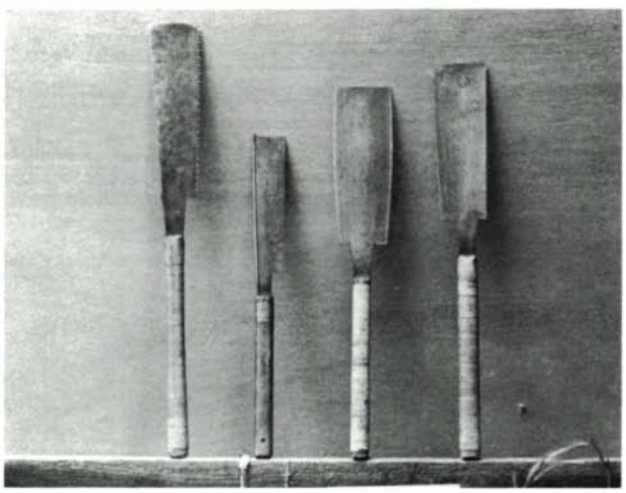
Photos: Alan Marks

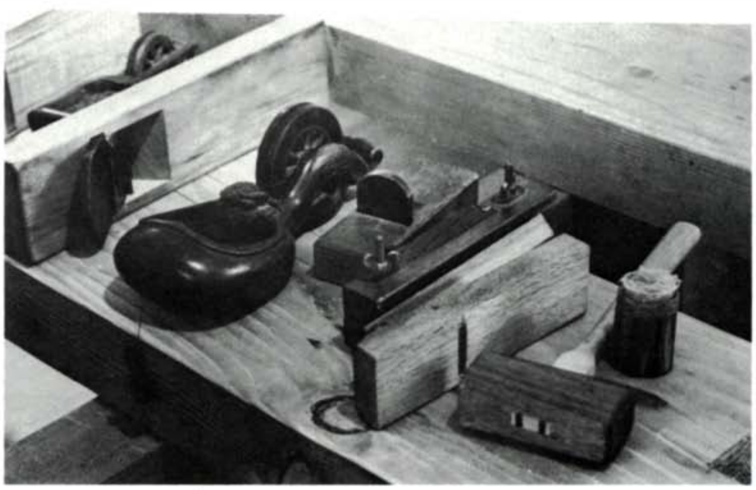
Imai lays out a lapped mortise and tenon scarf joint with a bamboo striking stick, which he dips at intervals into a chalk pot. At right, he cuts the mortise sides with a double-edged ryoba *saw.*

Wedge-locked, lapped mortise-and-tenon scarf joint with half-blind stub tenon



Using only his leg as a clamp, Imai chisels the mortise waste, above. His bench consists of two fir planks on trestle horses: one plank for work, the other for tools. At right, the lock-key half-cuts are chiseled in the sides of the tenon.





Imai's saws, from left to right: a ryoba *for crosscutting; a* dozuki, *the backsaw; a* ryoba *with special teeth for hard wood; and a fine-toothed* ryoba *for finish cuts; other tools, right, include a chalk pot, a mallet, an oil dauber and various planes.*

plane soles are not perfectly flat. Portions of them are relieved so the plane rides only on its leading edge and on the area immediately in front of the iron. The area behind the iron is entirely relieved, but only by a hair's thickness. Two benefits result: The pressure necessary to hold the plane down on the work being less, the friction is less so the plane slides more easily. Probably it gives greater sensitivity as well, since the balance need not be shifted to the rear at stroke's end, as with Western planes, to eliminate front-end dip.

I wouldn't have imagined that a plane could be so affected by a slight humidity change. My own wooden planes require attention from season to season but certainly do not vary from day to day. A close look as the end grain reveals why. Because grain in Japanese planes is not vertical but flat, cupping occurs with relatively small changes in air moisture content. Imai explained that since the plane blade is tightly wedged into its groove, pressure bears on the sides. A vertical grain would be prone to splitting, but the flat grain withstands this pressure. Flat grain, however, wears away faster than vertical, another explanation for frequent adjustment. I noticed that the growth rings were fairly symmetrical and curved upward in every case. Keith Mesirow, a former student of Imai's, explained that this is so the cupping, when it occurs, is even and downward. If the warp is not immediately noticed and corrected, the plane will still ride properly on the work. If instead the bottom were to belly, it would rock on the work. A concave plane bottom is also easier to flatten than a convex one. Mesirow once made a plane that included, ever so slightly, the center of the log, and even though the growth rings curved upward, the plane bellied. He concluded that the stock should always be cut from below the center of the log.

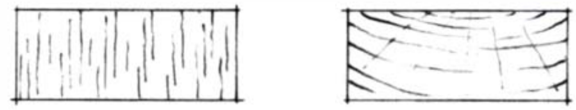
One preparatory operation involved a small applicator that looks like a small section of bamboo with a roll of fabric stuck in one end. When he had put the plane bottom in trim, Imai rubbed it and the ends of the plane with this dauber. I guessed it was either wax or oil, applied to protect the wood from moisture and to reduce friction as well, though traces of oil might create blotches on the workpiece. Later I was told that the applied substance was indeed a light oil, but that it did not stain the work because the plane body absorbed and retained it. Sensitivity is a major advantage of the wooden plane over the steel. Wax would cause a wooden plane sole to glide uncontrollably, whereas the oil lubricates mildly. The wood transmits amplified feelings to the hands, which can then properly adjust speed, pressure and direction.

Imai used four different planes of various sizes, each with its own special application and each prepared somewhat differently. These were supplemented by the aforementioned scraper plane, which had a vertical blade sharpened to a chisel point, and an ingenious little 45° chamfering plane held in a grooved frame made up of split halves of a single piece of wood with adjusting screws for depth control.

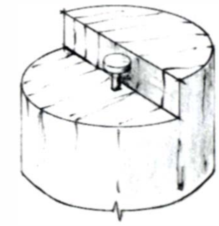
Imai does not use a wooden try square, but prefers a steel engineer's square with a blade about 150 mm (6 in.) in length. In addition he uses a narrow, thin builder's square about 15 mm (5/8 in.) wide with a long leg of perhaps 300 mm (12 in.). Its graduations are Japanese, not metric.

The bench Imai used was not a bench at all, but two fir planks, each about 100 mm by 300 mm (4x12), resting on two trestle horses about 750 mm (29½ in.) high. His tools sat on the far plank, and the near one was his working surface. It had bench dogs of sorts, but these moved only up and down

Grain configuration of Western planes, left, and Japanese planes, right.



and were not part of any screw vise. They were nothing more than friction-fit dowels in through-holes, about 15 mm to 20 mm (11/16 in.) in diameter. Half the top of each dowel was step-cut away for a depth of perhaps 10 mm (3/8 in.) and a flat-head nail driven to within a few millimeters of the lower step, as near to the center as possible, served to grip the work. In planing, he pulled the workpiece against the dog, which kept the piece from sliding. The only clamp I saw him use during the demonstration was one most of us are endowed with by nature, to wit, a leg.



A grant from the California Arts Council brought Imai to this country for the first time in 1976. Thirteen years before, at the age of 15, he had apprenticed himself for six years to a builder of country houses. He then worked for a teahouse construction firm and also built temples. Together with a hand-picked crew of workmen from Japan he erected a teahouse that had been disassembled in their native land and shipped in pieces to Grass Valley, Calif., where it now stands. Imai returned to Japan. But the enthusiasm of the woodworkers he met here had planted a seed. He came back to California, this time to stay, his life's task to introduce traditional Japanese architecture to this country.

Makoto Imai, 31, is an intense, wiry man. Currently he devotes six days a week to a project for the Zen Center just north of San Francisco. There, with three apprentices, he is constructing a teahouse and residence for the tea master. In addition, he teaches four small classes that meet every other week for on-the-job training. Work on the Green Gulch project, as it is called, is expected to be completed next fall. It will be the third such teahouse standing in the United States and the only one originally constructed here. He has given several joinery demonstrations for various groups, most recently one at the De Young Museum in San Francisco. Whether it will be possible to propagate traditional Japanese woodworking here remains a question. Certainly interest and enthusiasm run high, especially in California with its large number of Japanese-Americans. And contemporary American architects openly admire the intelligence, integrity and simplicity of Japanese design. But the professionally trained architect/craftsman has no place here as yet. One can find employment only as one or the other in our present society. East is East and West is West, Kipling tells us. But if ever the twain shall meet, surely no one is more capable than Makoto Imai of successfully executing the joinery. □

Further reading

The Art of Japanese Joinery, Kiyosi Seiki. Weatherhill, 149 Madison Ave., New York, N.Y. 10016, $8.95 paper, 126 pp.

The Care and Use of Japanese Woodworking Tools, Kip Mesirow. Woodcraft Supply, 313 Montvale Ave., Woburn, Mass. 01801, $7.50 paper, 95 pp.

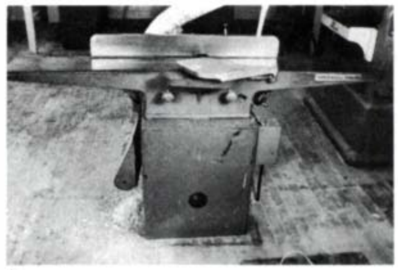
Japanese Homes and Their Surroundings, Edward S. Morse. Dover, 180 Varick St., New York, N.Y. 10014, $4.50 paper, 372 pp.

Traditional Domestic Architecture of Japan, Teiji Itoh. Weatherhill, 149 Madison Ave., New York, N.Y. 10016, $15.00 cloth, 152 pp.

The Jointer

How to adjust, sharpen and use this basic machine

by Tage Frid



1

After the circular table saw, I feel that the jointer and the thickness planer are the most important big machines in a woodshop, especially for a person who wants to make a living from woodworking. These two machines are a big investment but will pay for themselves over the years. An old out-dated jointer and thickness planer can sometimes be bought quite inexpensively and will usually do as good a job as a new machine. Don't buy an old jointer with a square head—it's too dangerous. The smallest jointer I would buy would be a 6-in. model (an 8-in. one is preferable), with a 1-HP motor. The smallest thickness planer I'd buy is a 12-in. one with a 2-HP motor.

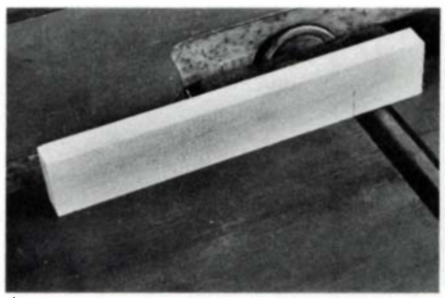
A jointer is a machine that planes, joints or surfaces a board, ending up with one side perfectly flat (1). The table in the front of the rotating knives is called the infeed table, and the one in the back is the outfeed table. The difference in height between the infeed and outfeed is the thickness of wood planed off with each pass.

On a jointer with a round cutterhead, I would never run a piece shorter than 10 in. Jointers with square cutterheads have a larger opening. These aren't made anymore, but if you buy a used one it might be of this type. I would never run anything shorter than 15 in. on such a jointer. When jointing the face of a board, use a good push-stick. Never run end grain over the jointer—it is too dangerous. End grain is very hard and often shatters rather than cutting. Don't pass the edges of plywood over a jointer either—the glue will put nicks in the blade.

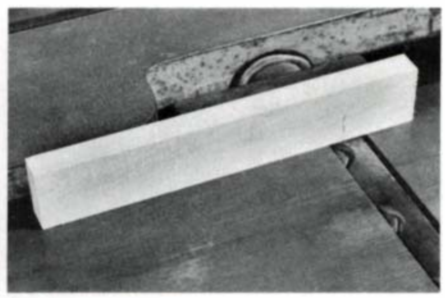
1. Setting jointer knives — Knives on a jointer should be parallel to the outfeed table and all at the same height. Use a straight stick to set the jointer knives. *First unplug the machine.* Then make a pencil mark on the stick at the beginning of the outfeed table (A), while the cutterhead is below the table.

(B) Then move the cutterhead forward (carrying the stick with it) and (C) make a second mark, again at the beginning of the outfeed table (D).

Now move the stick to the opposite end of the knife and repeat the procedure. If the stick moves the same amount, the knife is parallel to the outfeed table. If it does not, loosen the nuts that hold the knife in place and correct before retightening. When that knife is parallel, be sure to tighten all the nuts. Move to the next knife and set it in the same way, using the same stick and the same two markings (so the height of the second blade is the same as the first). Continue until all the knives are aligned. Be sure all the knives are secured before you start the machine. Raise the outfeed table so it is level with the knives.

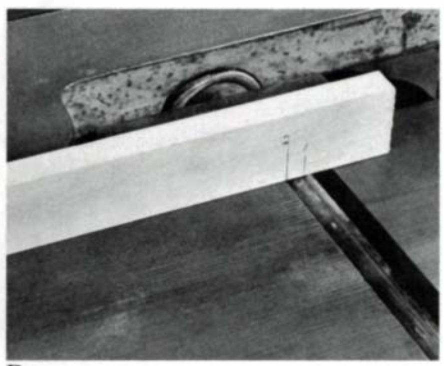


A



B

C



D

2. Sharpening the knives — An easy way to sharpen the jointer knives without removing them is to use a router. Remove the plastic plate from the base of the router and (A—see p. 93, top) screw on a piece of ¾-in plywood. Place a medium-grit grindstone in the router. The two grooves in the bottom of the plywood have nothing at all to do with the sharpening process—I used a scrap piece of plywood.

You must be able to control the position of the knives so they will all be ground the same amount. To do this, drill two holes in the center of the infeed table (B). The first hole, closer to the knives, is about 1½ in. from the opening for the cutterhead. The second hole is directly behind the first, about 3 in. from the edge of the opening. Thread the first hole to receive a $\frac{3}{16}$-in. or ¼-in. screw. Then cut a thin but stiff piece of sheet aluminum or steel about 7 in. long. Drill a hole in the center of the metal strip about 2½ in. from the end of the piece on the side closer to the cutterhead. Be sure the screw fits snugly into the hole. Then drill a second hole in the strip corresponding to the second hole in the table. The exact measurements may vary; the important thing is that the metal strip keep all the knives in the same position.

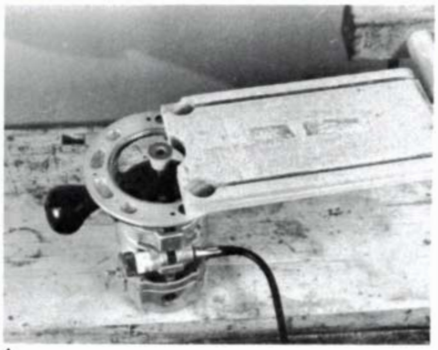
Fasten the metal strip to the infeed table and (C) insert a steel pin into the second hole (I use the end of a nail set). Push the cutterhead tight up against the metal strip. Then lower the infeed table until the bevel of the knives is parallel with the outfeed table (D). Secure the cutterhead by inserting wooden wedges at both outside ends of the knife head.

Set the router on the outfeed table with the piece of plywood resting on the table. Set the depth of the grindstone so that it just touches the bevel of the blade. Be sure you are wearing proper face and eye protection. Start the router and (E) carefully move it back and forth over the blade until the stone stops cutting. Be sure to keep the plywood piece flat on the table.

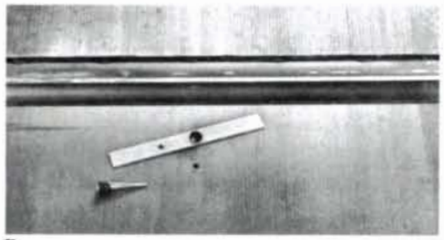
When the first knife is ground, remove the wooden wedges and the tapered steel pin. Swing the metal strip out of the way and move the cutterhead so that the next knife is on top. Reposition the metal strip, insert the steel pin and wedge the cutterhead again. Continue sharpening until all the knives are ground. Do not change the height of either the infeed or outfeed tables, or of the grindstone in the router.

The knives are sharp when a small burr appears on the back of each knife along its whole length. It is not necessary to remove this burr. If you want to make the knives a little sharper, you can hone each one by hand with a honing stone. I usually don't bother with this step at all.

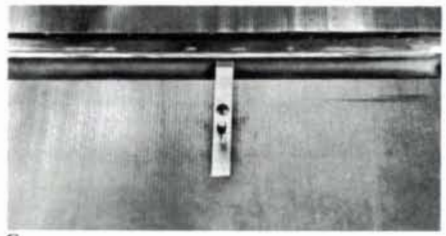
If the knives still are not sharp after one grinding, repeat the process. They can be sharpened this way about five times before you will have to reposition them farther out. After each sharpening you have to raise the outfeed table to the same height as the knives.



A

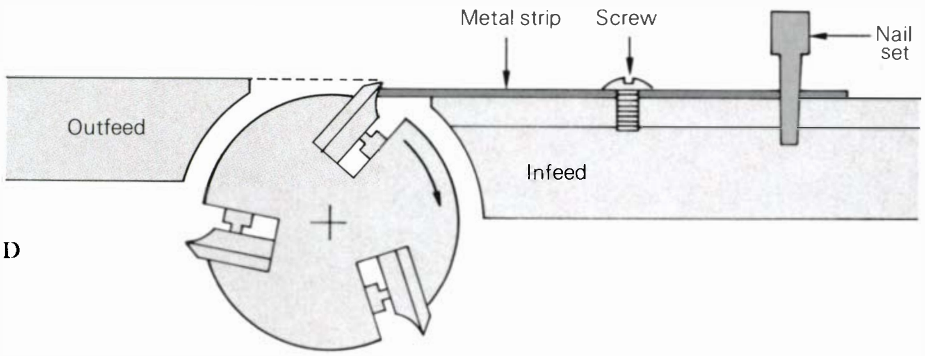


B



C

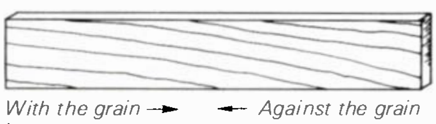
E



D

3. **Operating the jointer** — The infeed table controls how much of a cut is to be taken off the boards. In a soft wood, I would never take off more than 1/16 in. in one pass. In extremely hard wood or a wood with unusual grain pattern (like curly maple), I would take much less at each pass.

Before you pass wood over the jointer, look at the edge of the board to see which way the grain runs. Running the board so that the cutting action goes with the grain produces the smoothest edge (A). However,



A

the grain sometimes reverses direction in the middle of the piece and you cannot avoid roughing up some of the wood. Either handplane the board or take the roughness out later by scraping and sanding after milling is complete.

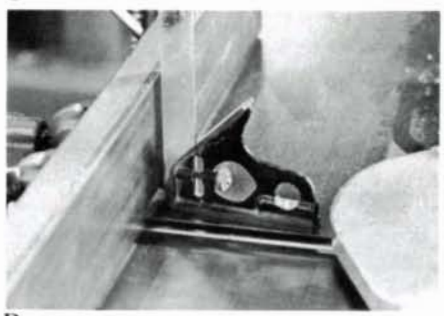
When using the jointer for a board that is slightly bowed, either take the same amount off of each end first or start jointing in the middle to correct the bowing on one face. Here (B) I took it off each end. When one face is roughly straightened out, feed the wood in again with the straight face down. When approximately five to six inches have passed over the knives, push the wood down on the outfeed table and ease up the pressure over the infeed table (C). Because the board is perfectly flat after passing over the knives, putting pressure only on the outfeed table keeps the board flat and straight. Otherwise, if the board is twisted and all the pressure is on the infeed table, the board will continue to be twisted and the twist will get jointed into the piece so that very shortly you will have a piece of uneven thickness that follows the twist.

Once one face is flat, you can joint the edge. First put a square at the end of the infeed table (D) and check that the fence is square. Then (E) joint the edge, keeping the face of the board tight against the fence. When matching edges are jointed, check to see how they fit. If they do not fit tightly for their entire length, joint the boards again. Note: The safeguard has been removed for clarity of the photograph.

If the joint is convex, of course the boards have to be jointed again. To correct a convex

B

C



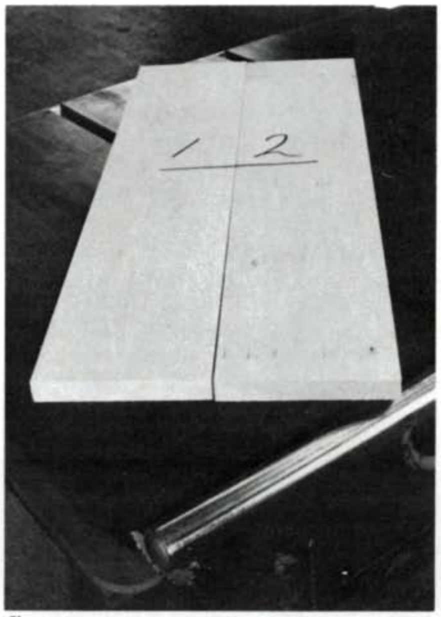
D

E

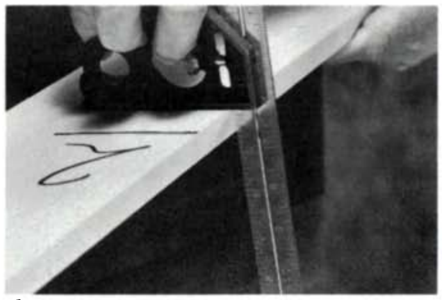
edge (F), flatten the curve by running the center of the board over the jointer. Then take one full pass. Whenever you joint an edge for a glue joint, pass the board over the jointer slowly so that the surface gets very smooth. If this burnishes the surface, the knives need resharpening.

When you are jointing boards to be edge-glued, joint each board with the opposite face against the fence. If the fence is slightly off square, the next board will be off square the opposite way and the two will fit together, gluing up straight. But the two faces of the board must be parallel, to use this technique. That is, the board should have been put through a thickness planer.

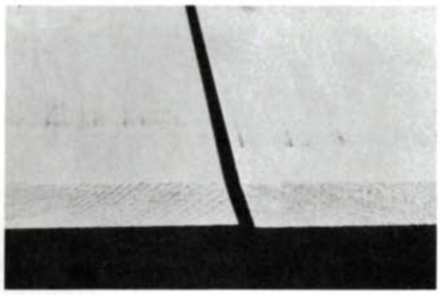
To demonstrate this point, the fence was set well off square. (G) Note how the edge of the board slopes down under the square. Even if the two edges are not square, but the opposite faces of the board are run against the fence, the two boards will still glue up straight (H).



F

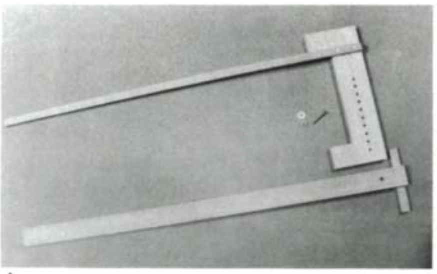


G

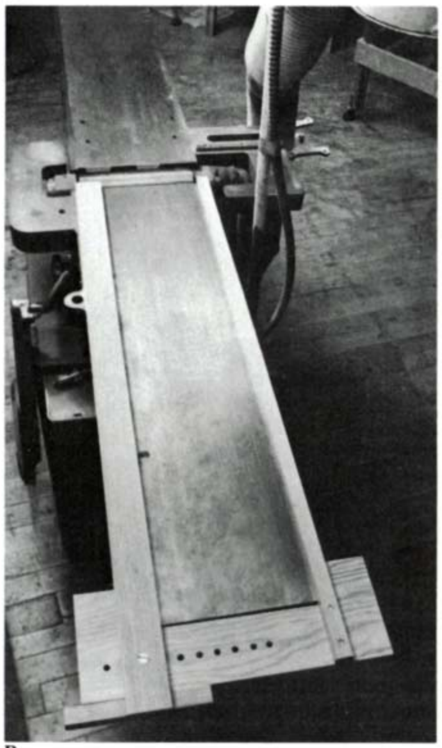


H

4. Thicknessing with the jointer — If a thickness planer is not available, the jointer can be used. First you must make a jig to fit the jointer that can take different widths of board. The photo (A) shows the jig apart and upside-down. You use it by cutting a rabbet all along both edges of the board, at the thickness you want. The rabbets ride on the jig while the board goes over the jointer and this way keep the board the same thickness from end to end (B).



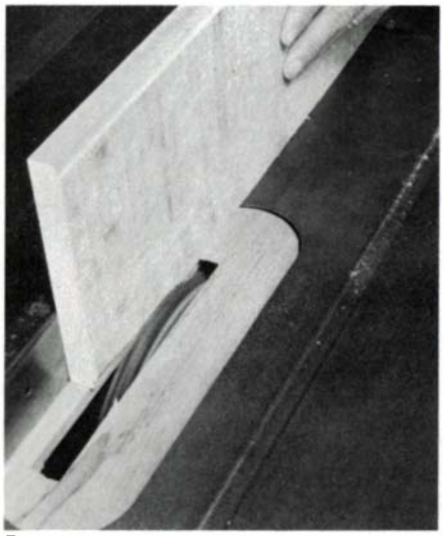
A



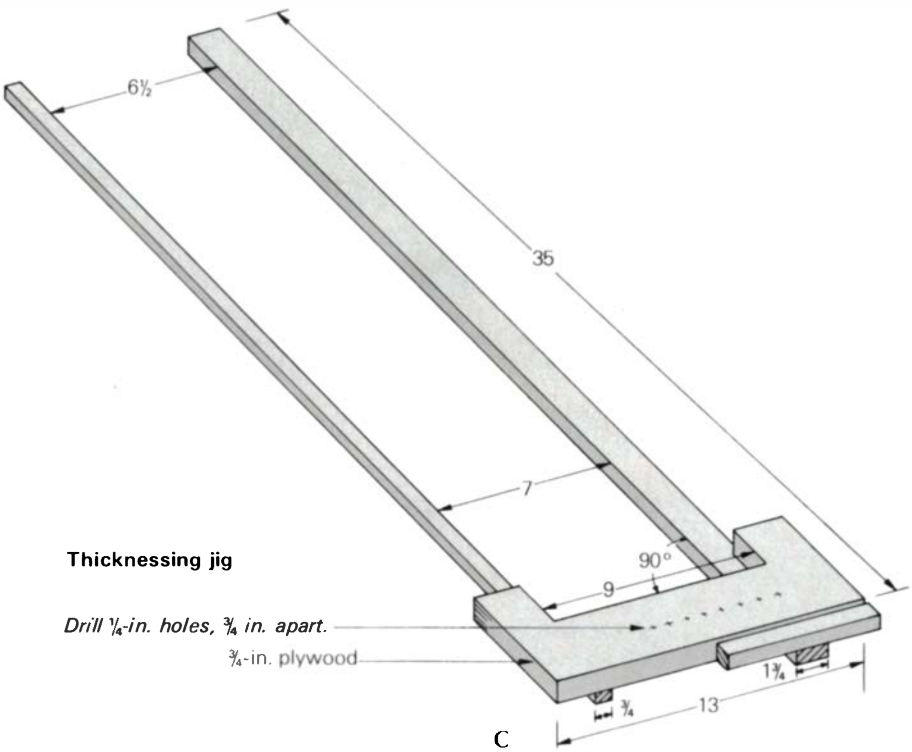
B

The jig shown in the drawing (C) is made to fit my 8-in. jointer. The long 1¾-in. piece is made like a *T*-square and is movable so it can be adjusted to the width of the board, either by making a slot for a bolt in the ¾-in. plywood back piece, which holds the jig in position, or by drilling several holes through which a bolt can go. I feel the holes are safer because even if the bolt is not tightened down properly the *T*-square piece cannot slide.

The *T*-square has to be exactly 90° to the plywood back piece. The long ¾-in. piece, which is fastened to the back piece, is slightly off 90° toward the inside of the jig. This way the two long pieces will fit tightly into the rabbets cut along the board. If used right, this jig is safe. For an extra precau-



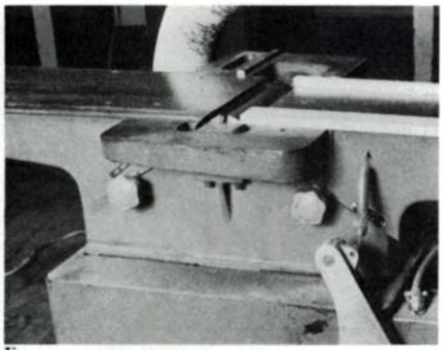
D



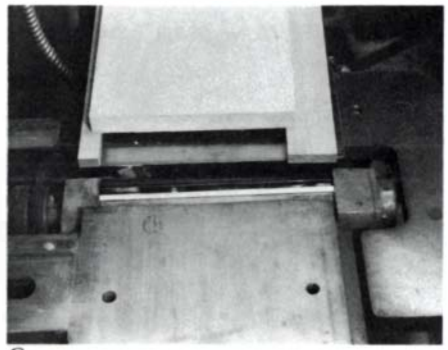
C

tion, secure the plywood back piece to the infeed table, either with bolts or clamps.

To use the jig, joint one side of the board flat and also one edge, then cut the board to width. Using either an electric router with a fence or a dado head on the table saw (D), run the rabbet on both edges of the board. Set the rip fence to the exact finished thickness you want and raise the dado head at least 1/2 in. above the saw table. Now lower the infeed table, but make sure the tops of the two long pieces of the jig are still higher than the outfeed table. You gauge how much to adjust the tables by how much wood you have to remove (E). Run the board over the jointer (F) and gradually lower the infeed table until the top faces of the two long pieces of the jig end up level with the outfeed table (G). Remember that the rabbet should still be at least 1/16 in. deep for the final cut, so the board will be able to ride securely in the jig. Now the board is flat and the faces parallel. If you made the rabbet a tiny bit fat at the start, you can still joint a finishing cut without the jig, without throwing it out of parallel. □


E


F


G

This article is adapted from Tage Frid Teaches Woodworking, Book 1—Joinery, *published this fall by The Taunton Press (see p. 13). Contributing editor Frid is professor of woodworking at Rhode Island School of Design.*

More mortising: sloping wedges, shims

by Kenneth Rower

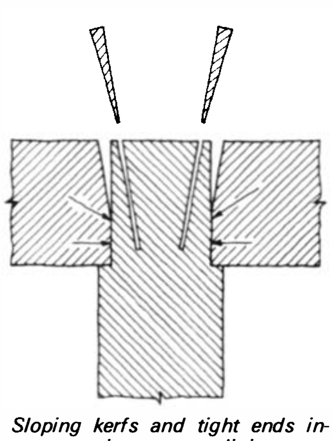
For mortises of ordinary width, say from 3/8 in. to 3/4 in., I find that the quickest method is to scribe a centerline during the layout and to bore out the waste with an undersized bit. This leaves ledges 1/8 in. or so wide at the sides of the mortise, giving excellent support to the mortise chisel, which follows. The majority of the waste is out of the way, permitting a deep stroke. I chop close to the ends but leave them strong for paring later.

A somewhat slower method is to bore only one hole, in the middle or at one end, simply to give some space for getting started. Then I chop away, keeping the chips 1/16 in. or less in thickness. I do this when I want the pleasure of making all those (somewhat miraculous) chips, or when the mortise is very narrow. The slowest method is to bore out as much of the waste as possible, knock out the remaining webs, and pare the sides and ends of the mortise. I do this for very large mortises, and while it is tedious it can yield beautiful results.

I prefer the outside-wedged tenon (figure 1) when the mortised piece is fairly shallow. When it is wide, shrinkage will cause trouble at the shoulders or at the bearing ends. Two design points: First, instead of cutting the saw kerfs for the wedges parallel to the edge, I slope them inward to create continuously increasing resistance to splitting. Second, I taper the mortise for only a part, say two-thirds, of its depth, so the remaining straight sides can tightly grip the base of the tenon. I cut the tapers using a block made for the purpose and clamp it across the stock at the appropriate distance from the original end of the mortise. I test the wedges in the space alongside the tenon to make sure they are correctly tapered and thick enough. While I am sawing the tenons, I often cut the wedges from the waste and number them so they pretty much disappear when driven home. I don't glue them.

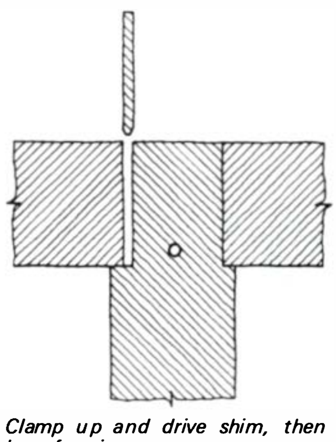
A joint I call the shimmed tenon (figure 2) can achieve a much tighter fit than the ordinary joint. As to the cheeks, because of the clearance at the ends, the tenoned piece can be rocked home, overcoming friction that would be insuperable on a straight push. As to the ends, the shim (cut from the tenon itself) is made a trifle thicker than its space, and when well-waxed and driven in creates a compression area just where you want it. This design requires exact squaring of the mortise ends, since any discrepancy will knock the shoulders askew when the shim goes home. I normally leave this joint dry and pin the tenon. In well-seasoned oak or mahogany, this joint keeps its bearings summer and winter. □

1. The outside-wedged tenon



Sloping kerfs and tight ends increase resistance to splitting.

2. The shimmed tenon



Clamp up and drive shim, then bore for pin.

Kenneth Rower makes furniture in Newbury, Vt.

Sources of Supply

A survey of small and medium-sized band saws

Many readers have asked for advice on choosing a band saw. To establish some criteria and to compile the comparison chart at right, we talked with manufacturers and with woodworkers who rely on band saws. A band saw with a miter gauge and a rip fence can handle most ripping and some crosscutting. Basically though, band saws saw curved lines and resaw thick planks into thin boards or veneers, two different operations requiring different blades and saws of different capacities. Deciding what you expect to do with your band saw is the first step in deciding which machine to buy.

Most band saws have two wheels, one above and one below the table (the Du-er, with four wheels, and the Emco, with three, are novel exceptions). Manufacturers list their saws according to wheel diameter, but the relevant dimension is throat size, measured from blade to column. This distance, marginally less than wheel size, is closely related to price. Our chart includes saws ranging from 9½ in. to 24½ in. of usable throat; throats of 30 in. and 36 in., common in industry and production shops, are beyond the scope of this survey. Throat size limits not only the cutting reach before the stock bangs into the column, but also blade thickness; a wide, thick blade may break running around a small wheel.

The other critical parameter is depth of cut, the distance between the saw's table and its upper blade guide. This governs the maximum width of boards you can resaw. Three of the machines listed (Rockwell 14 in., Powermatic 24 in., and Sprunger 10 in.) can be bought with a column extender for increasing their resawing capacity. But the deeper the cut, the more important it is to have adequate horsepower, the right blade and high-quality blade guides.

Choosing the right blade is a matter of matching a number of variables. In general, low-density woods cut best at a relatively fast speed, with a light feed and with a blade having relatively few teeth per inch. For denser woods, some blade manufacturers recommend a slower speed and more teeth per inch; others suggest a fast speed and a relatively coarse blade. Because most band saws do not offer various woodcutting speeds, getting the best cut amounts to choosing the right blade. To avoid bellying caused by inadequate chip clearance, resaw thick stock with a coarse blade (no more than three teeth per inch in stock 6 in. or more in thickness). Thin stock should be cut with a blade of up to ten teeth per inch. Blade width is also an important factor: use the widest blade possible for the job. The two constraints are the capacity of the machine and the nature of the cut. A ½-in. blade, for instance, can cut a radius no tighter than 2½ in. If you plan to use your saw mainly to cut curves in thin stock (rather than to resaw), large blade capacity, large depth of cut capacity and high horsepower are not important.

A steady cut also depends on the quality of the saw guides, which support the blade on either side and at the back, both above and below the table. Ball-bearing thrust rollers are standard behind the blade, but opinions differ about what is best for side guides. Rubbing blocks present a larger bearing surface than ball-bearing side guides, especially when set at an angle, which also allows them to be brought close to the work surface. Ball bearings have the expensive disadvantage of clogging, seizing and requiring replacement, especially below the table where falling sawdust accumulates. Those who prefer ball-bearing guides, however, point to the greater control that comes from being able to bring the guide into direct contact with the blade. Although the blade-guide system is important, it is replaceable on most saws, and so need not be critical to your choice. At least two firms (Carter Products Co. Inc., 23 Ottawa Ave., Grand Rapids, Mich. 49503, and Woodworkers Tool Works, 222 S. Jefferson St., Chicago, Ill. 60606) sell replacement guide systems.

Accurate cutting also depends on the band-saw frame. A sharp blade of the right width and tooth configuration for the job will always cut well, but blades do not stay sharp, and when dull they wander in spite of the best blade guides. A larger, heavier and more rigid machine can apply more tension to the blade, to keep it cutting true. Another enemy of accuracy is vibration. Here again the advantage may be with the heavier, cast-iron-frame machines, though good engineering in lighter machines can substitute for mass. You can always add sandbags or braces.

The larger and more solid the saw table, the better. But tables can be enlarged with homemade extensions, so the listed table size need not be critical. Also significant is the location of the slot by which the blade is removed and replaced. The slot can run toward the front of the table, or toward the side. The front slot may be convenient, but putting it there usually disallows a support trunnion in front of the blade. Trunnions allow the table to tilt. Side-slotted tables with trunnions fore and aft are more stable.

After accuracy and sturdiness, consider convenience. Are the wheel covers easy to remove for changing blades: Are they hinged or must they be taken completely off? Is there a tensioning gauge? Changing a blade can involve up to five blade-guide adjustments, above and below the table. Guides with thumbscrew adjusters and cam-mounted bearings offer finer and easier control than slide-adjusted guides. And thumbscrew locks eliminate the need to keep separate allen keys. Blade and blade-guide adjustments often involve test-running and resetting, so a machine with a foot brake can make blade changes go faster.

Finally, consider versatility. How far does the table tilt? Will you be cutting metal or plastic, which require much slower speeds than wood? Remember that machines can be modified, and manufacturer's specifications need not be limitations. For those who have the inclination to build to suit, there are a couple of band-saw kits on the market: Gilliom sells 12-in. and 18-in. saws for $74.99 and $119.99, respectively. There's also the option of buying used machinery.

Our chart includes the specifications of most common band saws; below it is a list of manufacturers. However, the proof is in the sawing. We'd like to hear about readers' experiences with band saws—what machine do you have, what's good and bad about it, how have you modified it for specialty work, would you buy the same machine again, and if not, what would you replace it with? Our thickness planer comparison (July '79) elicited a number of interesting comments, some of which appear on p. 34 of this issue. *—R.M.*

Band-saw Model	Blade to column (in.)	Maximum depth (in.)	Maximum blade width (in.)	Blade speed (sfm)	Blade guides & adjustment	Tension Gauge	Brake	Cover	Table	Table tilt; & accessories	Frame	Overall dimensions	HP	Weight (lb.) (w/motor)	Price per lb.	Price (complete)
Du-er B-12	11¾	9	½	200/ 600/ 1150	Oilite rollers; slide adj., allen key	no	no	R	14 x 14 S front slot	45° right, miter gauge & rip fence optional	S	68 x 24 x 18 (w/stand)	⅓	108	$2.50	$270
Du-er B-24	24½	6	½	200/ 600/ 1150	Oilite rollers; slide adj., allen key	no	no	R	14 x 14 S front slot	45° right, miter gauge & rip fence optional	S	61 x 40 x 23 (w/stand)	⅓	122	$2.62	$320
Emco BS-2	14½	5¾	½	394/ 2461/ 3937	Phenolic blocks, horizontal & 45°; slide adj., allen key	no	no	R	15¾ x 15¾ A front slot	45° right, miter gauge & rip fence optional	S	56 x 28 x 16 (w/stand)	½	57	$8.75	$499
General 490-1	14¾	6¾	¾	3000	Hardened steel blocks, horizontal; screw adj., thumbscrew	yes	yes	H	15 x 15 C side slot	45° right, 10° left, miter gauge & rip fence optional	S	66½ x 26¾ x 18 (w/stand)	½	210	$3.06	$644
General 390	20	12½	1	4500	Hardened steel blocks, 45°; screw adj., thumbscrew	yes	yes	H	24 x 24 C front slot	45° right, 12° left, miter gauge & rip fence optional	S	79¼ x 45¼ x 31½ (floor model)	1½	885	$2.06	$1830
Holz NRA-600	22⅞	15	¾	4940	Ball bearing (Carter); cam & slide adj, allen key	yes	yes	H	25 x 32 C front slot	45° right, miter gauge & rip fence standard	S	80 x 38 x 25 (floor model)	3	660	$2.97	$1960
Inca 310	10¼	6¼	⅝	2800	Hardened steel blocks, horizontal and 45°; slide adj., allen key	yes	no	R	12½ x 12½ A front slot	45° right, miter gauge optional, rip fence standard	A	64 x 22 x 22 (w/stand)	¾	106	$5.19	$550
Northfield 20	19½	14	1⅜	4712	Hardened steel blocks, horizontal; slide adj., allen key	yes	opt.	H	25 x 25 C front slot	45° right, 10° left, miter gauge & rip fence optional	C	75 x 36 x 25 (floor model)	2	925	$3.13	$2895
Parks 2	17½	12	¾	3500	Fiber blocks, horizontal; slide adj., allen key	yes	no	H	18 x 20 C front slot	45° right, miter gauge standard, rip fence optional	S	74 x 32 x 23 (floor model)	1	370	$3.37	$1248
Poitras 355	24	12	1	5517	Ball bearing; screw adj., ring lock	no	yes	H	24 x 26 C front slot	45° right, 12° left, miter gauge & rip fence optional	C	80½ x 41 x 26 (floor model)	2	873	$2.72	$2376
Powermatic 141	14	6½	¾	3000	Ball bearing (upper), steel plates (lower); slide adj., allen key	yes	no	H	15 x 15 C side slot	45° right, 15° left, miter gauge & rip fence optional	C	71 x 25½ x 13¼ (w/stand)	¾	225	$3.95	$889
Powermatic 81	19¾	12 (24 opt.)	¾	2000/ 4000	Ball bearing (Carter); cam & slide adj., allen key	yes	yes	H	24 x 24 C front slot	45° right, 15° left, miter gauge & rip fence optional	C	76 9/16 x 45 x 35 (floor model)	2	895	$2.33	$2089
Precision Concepts SR 360	14	6¼	¾	3000	Hardened steel blocks, slide adj., bolt lock	no	no	R	14 x 14 C side slot	45° right, miter gauge standard, rip fence optional	C	65½ x 18 x 14 (w/stand)	¾	225	$2.64	$595
Precision Concepts SP 600	24	8	1¼	3000	Ball bearing (Carter); cam & slide adj., allen key	no	yes	H	23 x 32 C front slot	45° right, miter gauge standard, rip fence optional	C	92 x 43 x 23 (floor model)	4	950	$2.31	$2195
Rockwell 28-120	9⅝	6¼	⅜	2400	Hardened steel blocks, horizontal; slide adj., allen key & bolt lock	yes	no	R	10 x 11 C front slot	45° right, no miter gauge or rip fence available	C	63 x 20 x 10⅝ (w/stand)	⅓	120	$2.75	$330
Rockwell 28-230	13¾	6¼ (12¼ opt.)	¾	3000	Hardened steel blocks, horizontal; slide & screw adj., allen key	yes	no	R	14 x 14 C side slot	45° right, 10° left, miter gauge & rip fence optional	C	65½ x 25 x 17½ (w/stand)	½	224	$2.68	$600
Rockwell 28-651	19¾	13½	1	2000/ 4500	Steel plates, 45°; slide adj., allen key	yes	yes	H	20 x 24½ C side slot	45° right, 12° left, miter gauge & rip fence optional	S	79½ x 42 x 30½ (floor model)	1	755	$2.71	$2043
Sears 12	12	6	½	2900	Hardened steel blocks, horizontal; slide & screw adj., allen key	yes	no	R	14½ x 12½ A front slot	45° right, miter gauge & rip fence optional	A	68 x 24½ x 20 (w/stand)	⅓	127	$2.49	$316
Sprunger 10	10	6 (12 opt.)	⅜	2400	Hardened steel blocks, horizontal; slide adj., allen key	no	no	R	10 x 10 C side slot	45° right, miter gauge & rip fence standard	C	50½ x 20 x 13 (w/stand)	½	115	$3.39	$390
Sprunger 14	14	6½	½	2600 (metalcutting speeds opt.)	Hardened steel blocks, horizontal; slide adj., allen key	no	no	H	14 x 14 C side slot	45° right, miter gauge & rip fence standard	A	66 x 28 x 18 (w/stand)	½	140	$3.79	$530
Toolkraft 4500	9½	4½	½	4310	Brass rod, horizontal; slide adj., allen key	no	no	H	11 x 10 C front slot	45° right, no miter gauge or rip fence available	C	59 x 17 x 11½ (w/stand)	⅓	90	$3.56	$320

Key: H= hinged, R=removable; A=aluminum, C=cast iron, S=steel.

Band-saw manufacturers

Du-er Tools, 5448 Edina Ind. Blvd., Minneapolis, Minn. 55435.

Emco-Lux Corp., 2050 Fairwood Ave., Columbus, Ohio 43107.

General Mfg. Co., 835 Cherrier, Drummondville, Que., Canada.

Gilliom Mfg. Co., 1109 N. 2nd St., St. Charles, Mo. 63301.

Holz Machine Co., 45 Halladay St., Jersey City, N.J. 07304.

Inca, Garrett Wade, 302 5th Ave., New York, N.Y. 10001.

Northfield Foundry & Machine Co., Northfield, Minn. 55057.

Parks, 1501 Knowlton St., Cincinnati, Ohio 45223.

Poitras, Danckaert Woodworking Machine Co., 891 Howell Mill Rd. NW, Atlanta, Ga. 30318.

Powermatic Div., Houdaille Ind. Inc., Morrison Rd., Box 70, McMinnville, Tenn. 37110.

Precision Concepts, 4200 Westgrove, Box 918, Addison, Tex. 75001.

Rockwell International, 400 N. Lexington Ave., Pittsburg, Pa. 15208.

Sears Roebuck & Co., Chicago, Ill. 60684.

Sprunger Corp., Box 1621, Elkhart, Ind. 46515.

Toolkraft, 700 Plainfield St., Chicopee, Mass. 01013.

These firms make larger band saws:

Oliver Machine Co., 445 6th St., Grand Rapids, Mich. 49504.

Polamco, 755 Greenleaf Ave., Elk Grove Village, Ill. 60007.

Tannewitz Div., 3940 Clay Ave. SW, Grand Rapids, Mich. 49508.

Wadkin Ltd., Green Lane Wks., Leicester, England LE5 4PF.

by James W. Fiddes

THE WOODCHUCK Helping kids build their own toys

The workshop, an extra room in a public library converted only that morning for the third Saturday session, bustles with the rhythms of hammers and saws. Mingled with that is the happy banter of young voices, filled with the anxieties and satisfactions of giving ideas tangible form in wood.

—Mr. Woodchuck, how do I put these pieces together?

—Well, if you look at these two parts here, I think you can figure it out.

—How do I cut this line here?

Photos: Jim Fiddes

Streeter and Makowicki, top and middle, with students. Above, making a boat.

—You use a coping saw, but remember to clamp the work.

James Makowicki, the Woodchuck, has been bringing his toymaking workshops to boys and girls all over western Connecticut for nearly eight years. Though teaching is an unpaid sideline, it's an important one: "Most custom woodworkers make things," he says, "I make woodworkers."

Makowicki's own toys, made in his basement workshop, have an irresistible, play-with-me appeal. He makes no compromises with production difficulties, deciding what he wants first and figuring out how to make it afterward. Baltic-birch plywood, favored for its strength and visual appeal in cross section, often appears as a structural component, though almost every toy includes solid hardwood, sometimes more than 100 pieces. Makowicki has found that toys are best made from the inside out—his trolley-car seats, for example, were made first, then the trolley built around them. Drilling holes into stock before rather than after it's shaped is easier and neater—no special fixtures need be made to hold irregularly shaped stock nor steps taken to prevent tear-out. Makowicki uses paint only to highlight small parts; the garish colors of commercial toys are there to capture parents' eyes, he says. Children like subdued, organic colors; they like wood.

A packaging designer by profession, Makowicki's work on his own children's toys led to his becoming the neighborhood toymaker. A local librarian liked one of his pull-along crickets and suggested he show some of his toys in the library. Since it was Christmastime, Makowicki was invited to help the children build their own toys. The class was an immediate success. Now, with the help of Nancy Streeter, a high-school junior, Makowicki conducts free workshops to bring tools, wood and kids together.

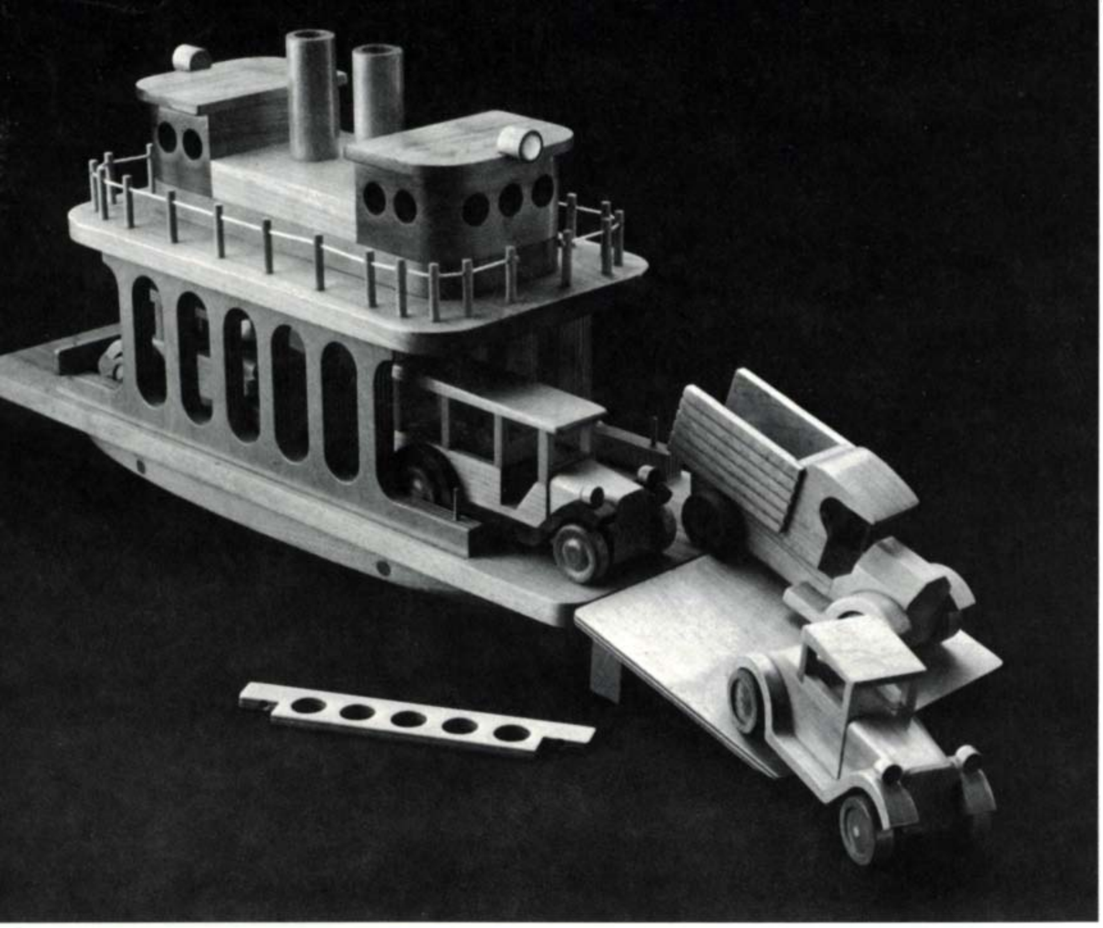
A typical class begins with discussions on tools and safety, after which the 18 or so pupils are pretty much on their own. Whatever else they learn comes on a need-to-know, problem-solving basis, with only occasional whole-class illustrations of points of general interest or safety. With Makowicki's own creations on hand for reference, and with tools (three jigsaws, a drill press and all the basic hand tools) donated from various sources, the fledgling woodworkers begin with pieces of scrap from boxes around the room. A number of the scraps are actually precut boat hulls and car bodies. Thus, even an inexperienced child has a chance to succeed, and gain the confidence necessary for advanced projects.

The easy informality of the classes belies the fact that some 30 hours a week, 20 weekends a year, go into planning and preparation. Though young attention spans might be thought strained by the three-hour sessions, in fact there are no bored faces. Makowicki and Streeter emphasize creative exploration, keeping technical admonitions to a minimum. If a child is enjoying hammering nails to bring plane wing and body together, he's let be. There are no plans or models, but plenty of encouragement for students to find their own ways to make their own toys. Parents are required to be at the first session to help establish the ground rule of no horseplay, but they're excluded from participating in the rest of the classes. This ensures Makowicki's control of the learning environment and avoids the Little League syndrome. The children experience woodworking as a means of expression, learning at their own rate and according to their own interests.

Some of these youngsters will no doubt adopt woodworking as a lifetime hobby, but most of the benefits come even sooner. One of Jim's favorite stories involves a girl confined to a wheelchair, but with the full use of her hands. She had done extremely well over the several weekends of the workshop. On the final day, a cookie-and-Kool-Aid feast in which parents viewed the completed projects, the girl wheeled herself across the room to Jim after most of the others had left, pulled herself up close to him and whispered, "I love you." It's this sort of reward that keeps him going, for, as the Woodchuck says, "They get the experience, we get the memories."

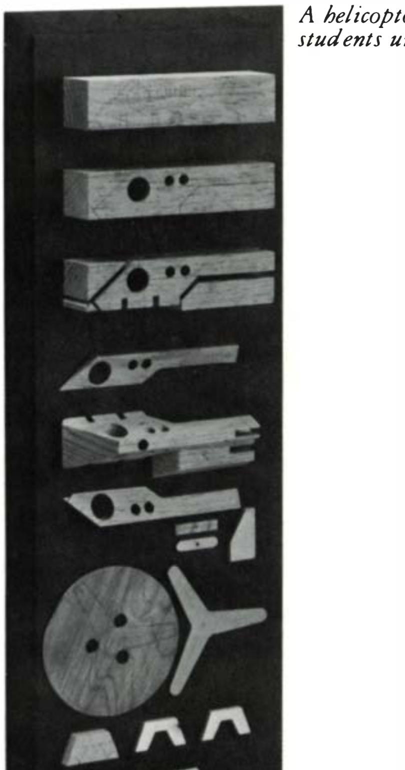
For information on the Woodchuck's programs, write James Makowicki, 21 Beechwood Dr., Sandy Hook, Conn. 06482. □

Jim Fiddes is a junior high school English teacher in Danbury, Conn.



This ferry boat, 19 in. by 6¼ in. by 10¼ in., has sides, gates and ramp of birch ply. The rest, including the cars, is of solid wood: birch, maple, pine and walnut—140 pieces in all.

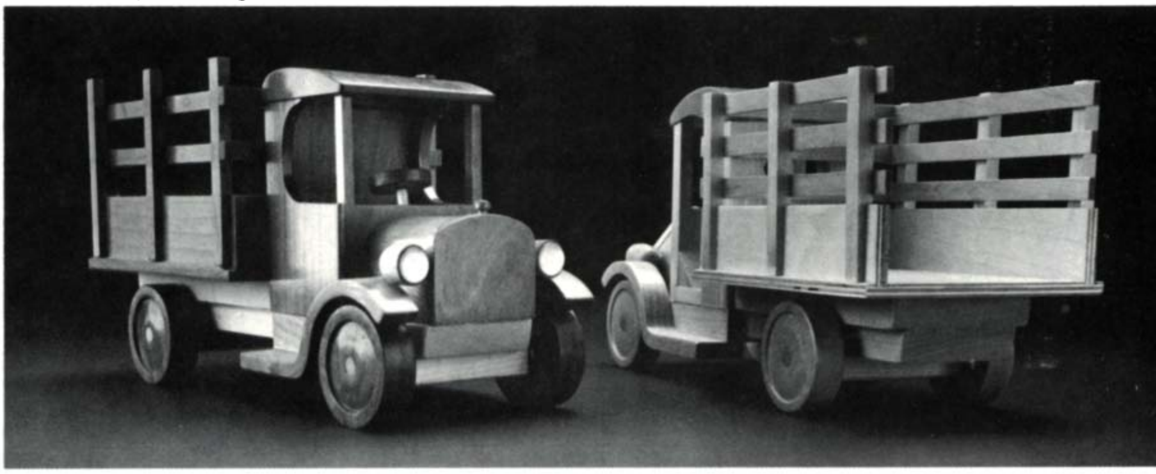
Above, waddling duck of pine—while head bobs and wags, wings wave. Below, simple toys: jet, tugboat and crane; trolley in background is a challenge in accurate drilling.



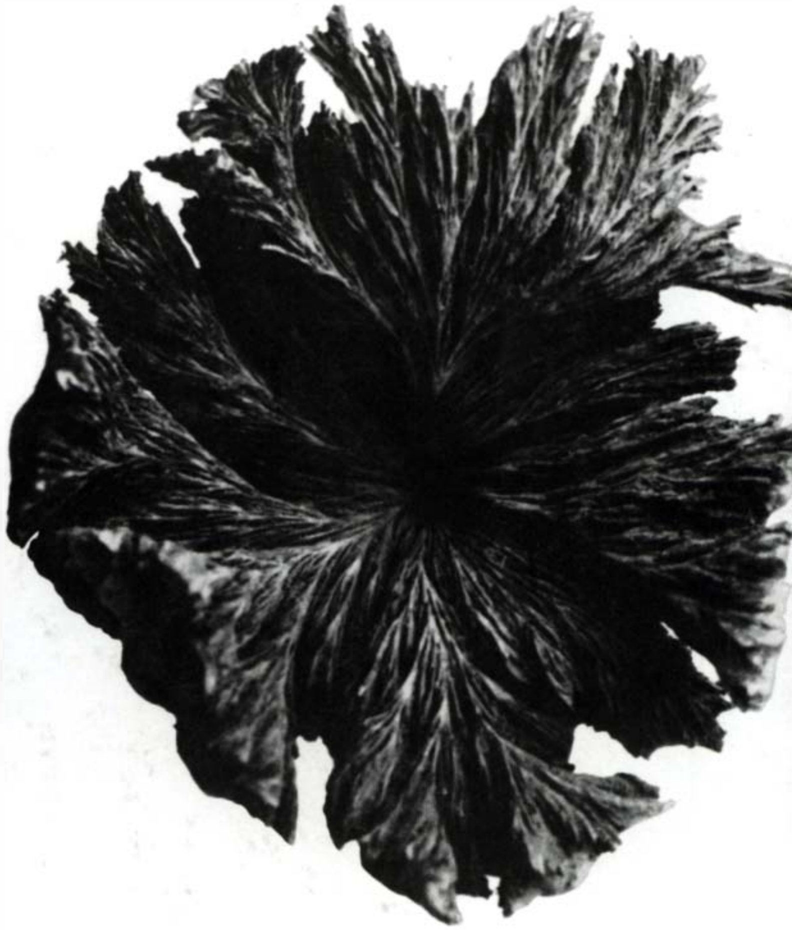
A helicoptor-construction panel, shown at the workshops to help students understand the steps in constructing their own toys.

Photos: White Light

1930s-vintage trucks, 10½ in. long, are of cherry and pine with walnut and maple wheels. They include 58 pieces of wood and shirt buttons for headlights (all small parts are epoxied in).



Two passenger trains, 39 in. and 22 in. long, are of birch, maple and birch ply.

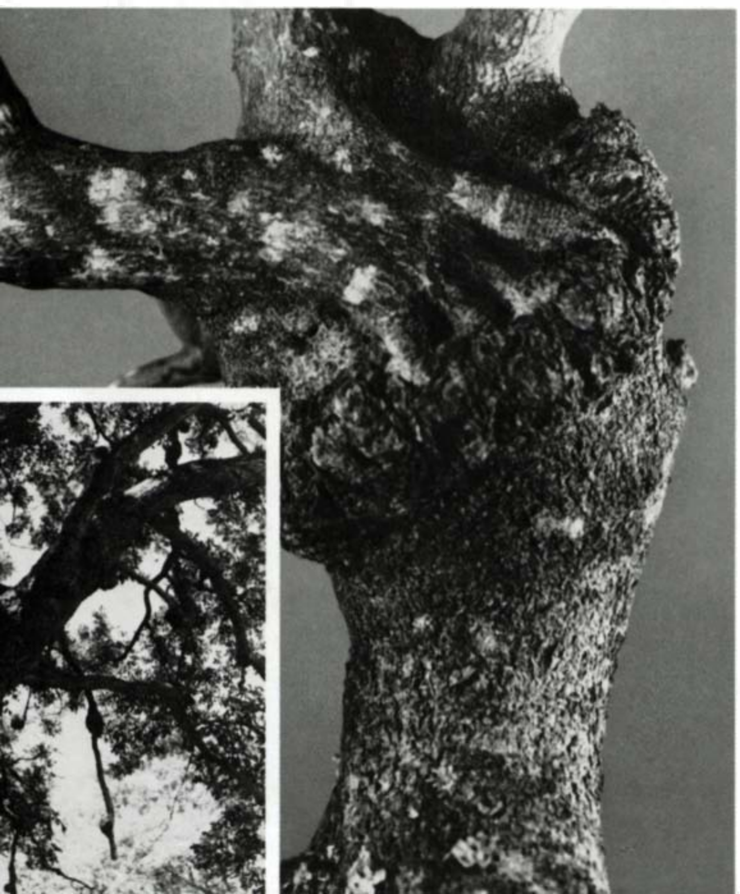


Mother Nature, Woodcarver

These strange and beautiful flowers are solid pieces of wood, carved by Mother Nature herself. Her material is the living oak tree and her tools are the roots (called haustoria) of the parasitic mistletoe plant.

The carving begins when birds or animals leave a seed of *Loranthus calyculatas* (a semitropical species of mistletoe) on a tree limb. As the seed germinates and begins to grow, the mistletoe haustoria invade the wood of the host tree. The tree responds by trying to grow around the invader—hence the spreading and curling fingers of wood. The haustoria reach deeper into the wood for sustenance—hence the deep fissures. Usually the parasite pre-empts the limb's nourishment for its own growth, whereupon the outward portion of the original branch atrophies and dies. Sometimes a balance is struck and both plants flourish. Either way, an irregular nodule containing the flower forms where the two plants intersect.

The two are so intimately grown together that separation seems impossible at first. But the two plants have different rates of decay and different shrinkage coefficients. Left to the weather, the mistletoe will decay first. I speed up the process by repeatedly soaking, boiling and drying the burls, then I chip the bulk of the mistletoe away with carving gouges, followed by knives, scrapers, dental picks, wire brushes and toothbrushes. It takes hours to prepare a perfect specimen, for all debris must go, the grooves must remain unscarred, and the natural wood surface must be carefully washed and polished. I have experimented with a variety of finishes and conclude that the wood is best left untreated, although sometimes a very dark flower can be improved by bleaching. Sometimes I display the flowers as they are, and sometimes I cut off the handle and mount them in picture frames, against colored cloth. —*John M. Haller*



These flowers are 4 in. to 6 in. across, and they can range from 1-in. miniatures to 3-ft. mammoths. Besides oak, avocado, wild cherry, elm and a number of leguminous tropical species are susceptible to mistletoe invasion.

The diagonal ridge through the center of the branch (left) marks the union of mistletoe (top) and the host tree (Inga jacanicuil). *A 'higher plant' phylogenically as well as in altitude, mistletoe produces stems, leaves, flowers, fruit and seeds just like any shrub, except it grows on a tree limb rather than on the ground. Some Australian species grow on tree roots and produce the same bizarre flowers, but one has to dig them up.*

Each knot on the branches of this pecan tree (far left) is the site of a mistletoe invasion. Temperate-zone species do not form flowers, but one semitropical species that does is Loranthus calyculatas, *native to southern Mexico. Its leaves are yellow, orange and even red, not the green of Christmas mistletoe.*

Photos: John M. Haller