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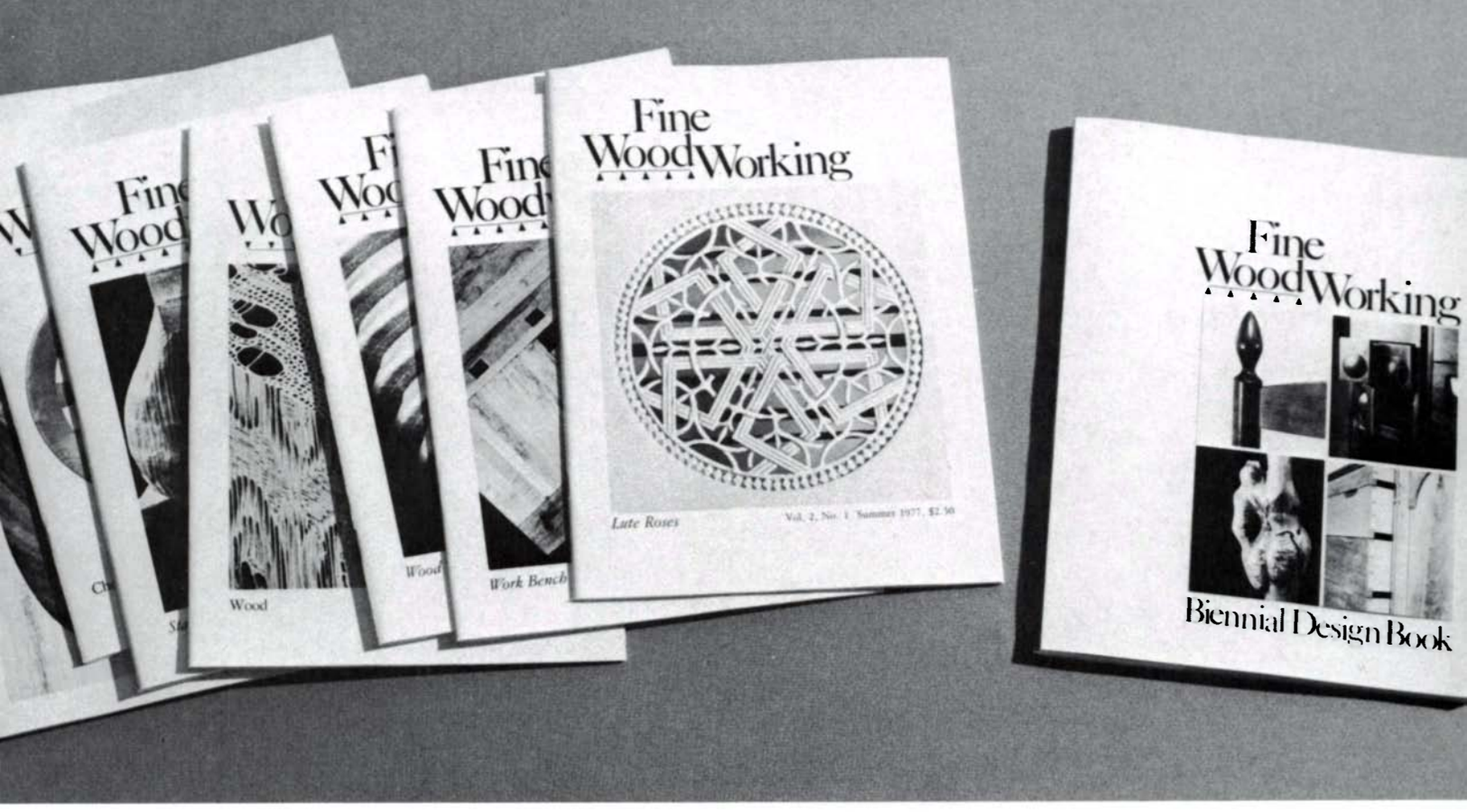

There's a wealth of information and ideas in the back issues of Fine Woodworking and the Biennial Design Book

Our readers tell us they regard *Fine Woodworking* more as a reference resource than as a magazine because of the timeless and hard-to-find nature of its contents. And because there is so much material to cover (new ideas and techniques pop up all the time) we don't intend to repeat ourselves editorially. All eight back issues are now available and you can have a complete set for your shop.

The *Biennial Design Book* is something else again. Conceived as a way of showing all the fine work being done today, the 8000 photographs readers sent to us exceeded all our expectations. We managed to cull them down to a wide-ranging 600. Taken together, they represent the highly creative and incredibly varied work being done today. Some of the pieces are traditional, most are contemporary, and some skillfully blend the two. Innovation abounds throughout. A source of inspiration for today and a record for tomorrow.

Winter 1975, Number 1
The Renwick Multiples, Checkered Bowls, Tramp Art, Hand Planes, Carving Design Decisions, Woodworking Thoughts, Marquetry Cutting, Which Three?, Library Ladders, A Serving Tray, Stamp Box, All in One, French Polishing, Birch Plywood, Bench Stones.

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Fall 1976, Number 4
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Winter 1976, Number 5
Stacking, Design Considerations, Keystone Carvers, Carcase Construction, Dealing With Plywood, Patch-Pad Cutting, Drying Wood, Gothic Tracery, Measured Drawings, Wood Invitational, Guitar Joinery, The Bowl Gouge, English Treen, Shaper Knives.

Spring 1977, Number 6
The Wood Butcher, Wood Threads, The Scraper, California Woodworking, Bent Laminations, Dry Kiln, Expanding Tables, Two Sticks, Stacked Plywood, Two Tools, Pricing Work, Going to Craft Fairs, Colonial Costs, Serving Cart, Woodworking Schools.

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Fall 1977, Number 8
Out West, Steam Bending, Triangle Marking, Painted Furniture, Chain-Saw Lumbering, Rip Chain, Getting Lumber, Sawing by Hand, Gaming Tables, Two Contemporary Tables, Wooden Clamps, Elegant Fakes, Aztec Drum, Gout Stool, Two Tools, Measuring Moisture, The Flageolet, Young Americans.

To order the back issues or the *Biennial Design Book*, send us your name, address and payment along with a list of what you want. Each back issue is $2.50 postpaid. The Design Book is $8.00 postpaid. Make your payments to the Taunton Press and send to the address below.

The Taunton Press, 52 Church Hill Road, Box 355A, Newtown, CT 06470

Fine WoodWorking

Winter 1977, Number 9

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Cover: Late 18th-century Philadelphia highboy. A pinnacle of the cabinetmaker's art, this chest exemplifies what is usually praised as 'exquisite proportioning.' Although it is commonly asserted that the old-time craftsmen had some mysterious instinct for proportioning, the evidence is that as apprentices they were taught how to apply a careful mathematical framework. The discussion begins on page 38. (Photo courtesy of Yale University Art Gallery, Mabel Brady Garvan Collection.)

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I would like to offer a couple of offbeat sources for hardwoods that may have escaped the attention of other woodworkers.

Near here is a veneer mill that makes face veneer and assembles it to order for the many furniture factories in the East. As you know, fine veneer is cut from logs, whole or half, and there is a "remainder" of the log, which has served as the holding surface, when the knife has cut as close to the holding mechanism as it can safely go. Confusingly, this remainder is called the flitch, just as is the bundle of veneer cut from it. These flitches become waste material to the mill, and are stacked outside until disposed of, in whatever way they can be. They are sold to whoever comes along and is willing to take them at the offered price.

The center of the flitch includes the pith, leading to less-than-ideal drying (twists, warps, etc.). But it is a piece of hardwood, 8 ft. to 12 ft. long, out of which a dressed 2x6 can be gotten—and, of course, turning squares, blocks, etc. By gluing up, you can get any size you want. Cost: largely what the market will bear, but low. Walnut is at $0.70 per board foot. Last year maple was $0.20 per board foot, but right now it's in excess supply and they're using it to fire the boiler, and selling it for $0.25 a board, 8 ft. to 12 ft. long; similarly with oak, at $0.40 per board.

Now, disadvantages exist. One must have a heavy saw (I use a radial) and a planer to do anything with it. It's strictly self-service; bring your own truck and load it by hand yourself. . .

I don't know how many such mills there are around the country, but for those near enough, it's a source of fine wood hardly available elsewhere.

Now to a second source, mostly for the amateur, but worth knowing about and probably available anywhere in the country. The Japanese have virtually a monopoly on motorcycle sales in this country. And they ship them in crates made from the group of timbers generally termed "Philippine hardwoods:" red and white lauan, tanquile, tiaong, almon, bagtikan, mayapis, and some other strange things I can't identify. It's rough-sawn and out of square, and in short and medium lengths (30 to 80 in.). Density of the woods found varies from not much better than balsa to some pieces resembling narra or satinwood, very hard and dense. You pick them up at the motorcycle dealer, who thanks you for getting them out of the way, and about a day of nail-pulling will reduce a small pickup-truck load to a large stack of rough boards. It's hard work, and you've got to be sure to get all the nails and staples out before running them through the planer, but the net result is a free supply of good-grade hardwood for use in small items to be naturally finished, or large ones to be painted (the nail holes mar them, as there is invariably a black rust stain, so only small items can be made without a nail hole to cover up).

—Donald L. McKinsey, Charlotte, N. C.

In your Fall '77 issue, p. 63, you refer to the use of epoxy glues for gluing up ivory and wood. Recently I had occasion to repair an ivory bracelet, and on consulting a restorer connected with the Walters Art Gallery in Baltimore, Md., I was

advised to use an animal-based glue such as Elmer's, and against using an epoxy because various components in the latter glue would leach out various elements in the ivory.

—Josef Rosenblatt, Baltimore, Md.

Tight controls and rigid standards are essential in the workshop, but must this single-mindedness be extended to the ideas expressed in this magazine? A presumedly accomplished woodworker fumes over an article on stacked plywood and calls one of the pieces "ugly." Is it asking too much that some sort of coherent critique accompany such a sweeping esthetic judgment? This semantic quibbling over what is and what is not "fine" woodworking appears rather unenlightening also. After all, if chain-saw lumbering, heat treating and dry kilns fall within the scope of the magazine, why exclude plywood? Maybe someone else might find the information useful.

While walnut and teak are not in themselves "political," does not the use of expensive or endangered species raise certain economic and environmental issues? To choose to ignore the implications of using, say, redwood, is indeed to make a political choice. Is quality in woodworking a mere function of technical sophistication and precious material, or do we allow a social criterion in addition? Since these concerns are not likely to surface in the pages of *Popular Mechanics*, I hope they are not to be banished from the pages of your magazine.

—Christopher Loekle, Skowhegan, Maine

By way of remark rather than criticism I suggest you have

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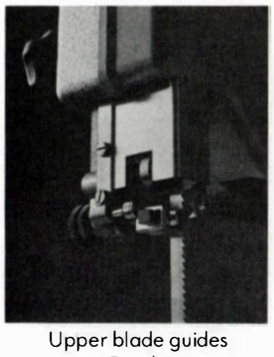

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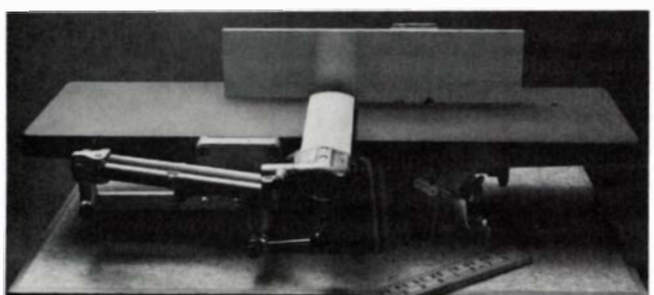

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been inadequate in your coverage of traditional joinery and cabinetmaking of the simpler varieties. The normal, natural way to make most things out of wood is to join pieces in various ways. Too many of the newer generation treat wood as a plastic material. Their designs, often marvelous, are *tours de force* rather than logical solutions to construction problems.

—W. G. Raoul, Lookout Mountain, Tenn.

Re Joseph T. Ponessa's letter (Fall '77, p. 14): I am puzzled as to how one could conclude that the excerpt on doweling from my book pertains to joining edges. As both text and illustrations show, it is about joining parts of cabinet cases and the like—usually (I hope) end grain to flat surfaces. Edge joining is, if I am not mistaken, gluing together two edges along the grain of both pieces.

—James Krenov, Stockholm, Sweden

Everything in Keyser's estimable article on steam bending (Fall '77, p. 40) agrees with my experience, such as it is. However, I'd like to comment on one or two aspects of this process when not bending large (in cross section, not length) pieces.

First, the faster one gets the wood out of the steam box and bent to the desired shape, the better. During the first 30 seconds, less for small cross sections, the wood should bend with little or no resistance. In fact, failure of a bend (compression failure usually) happens instantaneously with no pressure being exercised at all. Failures usually lie in a particular piece of wood, not in excess bending pressure. . .

Second, to achieve rapid bending, avoid using clamps and heavy straps if you can. Obviously, they work but they take time. The larger the cross section of the wood, the longer it stays hot and limber, and the more likely clamps and straps will be required, so some of this is self-correcting. But the time during which easy flexibility remains is much shorter than the touch temperature of the wood would suggest, once it has lost its "softness" and begun to stiffen. Ask any wooden boat builder who is fitting new steamed ribs to existing planks.

Third, to achieve a rapid bend, in seconds if possible, two or three people are frequently required. I try to make my molds—leaving room for springback—so they may be fastened to a large piece of plywood or another flat surface.

The molds are always for the concave side of the curve, never the convex. Fit a stopper or end block at one end of the mold (usually the greatest curvature if asymmetrical), then fasten a series of blocks, and fashion wedges for each, so when driven home each wedge will clamp the piece to the mold.

Rehearse yours and your assistants' moves. Take out the steamed piece. Moving as quickly as deliberation permits, run the steamed piece up against the stopper. The assistant immediately wedges it tight at the first block, so you cannot pull it free, but not so tight that it will not seat flat on the plywood base. Then, as fast as each assistant can wedge the piece by each succeeding block, wrap the thing around the mold, securing as you go. Fifteen seconds is not a bad time.

—Henry Kramer, Somerville, N. J.

An alternative to Jim Richey's planemaker's saw (Fall '77,

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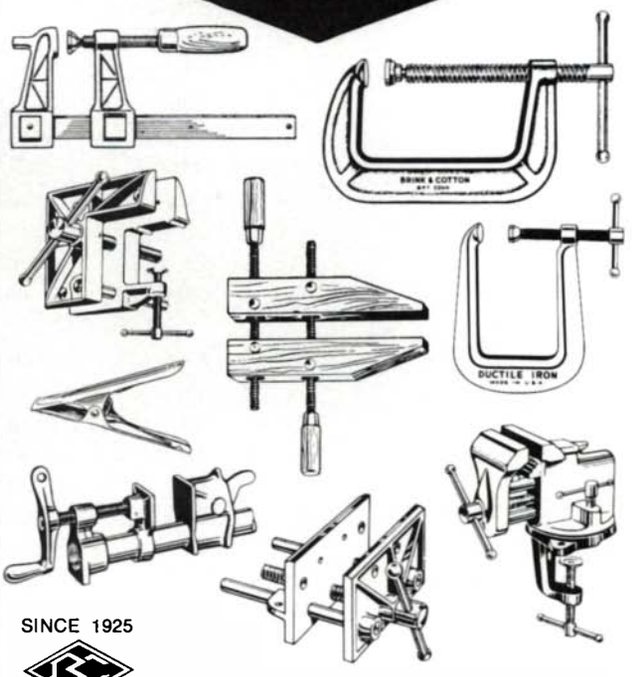

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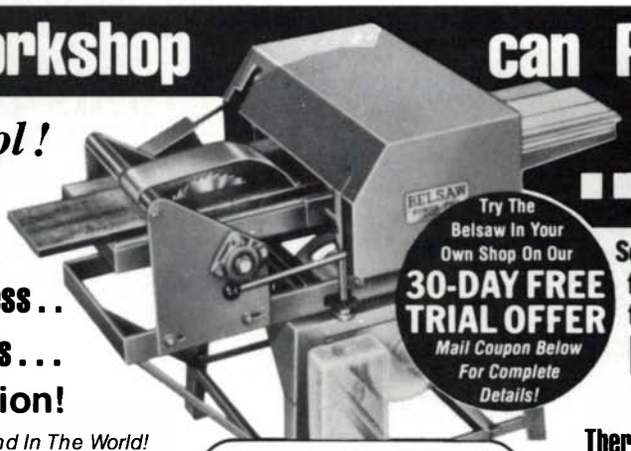

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LETTERS (continued)

p. 77) can be made by using a power hacksaw blade. After grinding to the desired shape, a suitable handle can be riveted in place. This method eliminates the step of cutting teeth. Also, used blades can be had for zilch.

—Bruce Sampson, Arlington, Ohio

Re your review of John Rodd's *Repairing and Restoring Antique Furniture* (Summer '77, p. 21): Rodd's book has a lot going for it, but not "sound common sense" when it comes to many of his methods of restoration. The first sentence of chapter one strikes at the heart of a basic dilemma a furniture conservator doing private work faces—the desires of the customer versus the continued integrity of the artifact. He states, "When the restoration of a piece of antique furniture is contemplated, it is important that the owner and the individual or firm which is to carry out the work come to an accord regarding exactly what is to be done." Within this statement lies the hoped-for understanding that the conservator has a firm commitment to transfer to future generations as much of the original artifact as possible. To do otherwise is to indulge in the pilferage of one's cultural heritage.

Within Rodd's book this basic principle is ignored or humored. In the summary to his first chapter we are informed "a good patina is a great treasure," but that "an ugly patina should be removed . . ." Now one either has a patina or one doesn't. And one is either concerned with it as part of the intrinsic value and history of an artifact, or one isn't. If all we should be interested in is appearance, then let's throw out the whole concept of conservation or restoration and call it "fixing old furniture." He also states it has never been his practice to label new pieces put into a piece of antique furniture. But I think is is mandatory that any new piece placed into an artifact be marked and identifiable as such by the reasonably trained eye. Concealment does the future no favors, and the conservator must not be party to this type of fraud . . .

On page 51 Rodd recommends dipping furniture into a tank of solvent to remove a finish. It is one sure way to destroy forever any patina. It is economical, but the cost to the artifact may be overwhelming.

On page 117, a very disturbing practice reminds me of Vietnam, where a city is destroyed to save it. We find a tabletop planed down to 3/8 in. in places and new wood glued on the other side, all in the name of flattening the top. The new wood is shown glued across the width of the top; this arrangement is bound to cause cracking and splitting. And where is the antique he started out with? A good part of it will be swept up and tossed out with the trash . . .

Furniture restorers and conservators must start protecting the artifacts they love most—antique furniture. It is a quickly diminishing commodity, and sadly much of its demise has been at our own hands.

—Richard O. Byrne, Ste-Foy, Quebec

As an engineer for a furniture company, I can shed some light on John Selock's question (Fall '76, p. 9) on finishing cherry. Almost all the finishes one sees in stores are applied in the step method, in order to maintain quality and consistency from one cutting to the next. Sanding and polishing must be perfect. Finish in this order: Spray transparent stain with a touch of pink, let dry; spray transparent stain with a touch of green, let dry; wipe stain with a touch of red; spray with

brown glaze, let set awhile, wipe to desired grain effect; spray sealer, let dry (sand lightly if necessary); apply speckle and rag glaze distressing if desired; spray as many coats of lacquer as desired (usually two); rub with 4-0 steel wool and oil.

—James Heuer, Holland, Mich.

In the Fall '76 issue of *Fine Woodworking*, Tage Frid describes a workbench and advises how to construct one. He states that he and his students construct such workbenches every two or three years and that "This year each bench cost us about $100, half for wood and half for hardware." This seemed too good to be true, so following his advice, I ordered the hardware from Woodcraft Supply, Woburn, Mass., and did pay about $50. However, after submitting the cutting list to a lumber company, you can imagine my shock to learn that instead of $50, the lumber would cost more than $200.

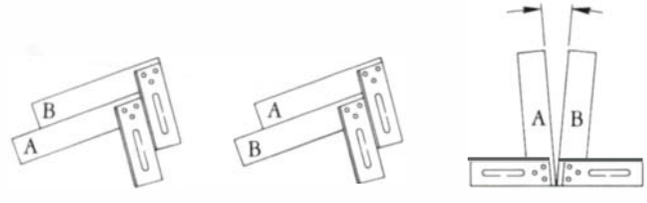
I would like to know where Mr. Frid got his lumber in 1976 for $50 when it costs four times that much today?

—Joseph T. Greenwood, Paterson, N.J.

[Editor's note: Tage Frid replies, "We used 8/4 maple of random widths and lengths for our benches, and in 1975 we paid about $0.68 per board foot. The price today would be between $0.76 and $0.80 a board foot.

"The mistake Mr. Greenwood made was to submit a cutting list to a lumber company. This means the lumber company has to cut the lumber to size, and thickness-plane it to dimension. The material would cost about $50, the rest would be handling and labor. Of course, when buying small quantities, the price per board foot is a little higher."]

Duane Waskow's "A Square Square" (Fall '77, p. 23) did not go far enough. It was proven that we have two identical



squares but not necessarily square. Reversing the squares on a flat surface will prove if the two identical squares are square.

"Wooden Clamps" by Richard Showalter (Fall '77, p. 64) is an excellent article, unfortunately not read by your technical illustrator. Note the direction of the wood grain in the exploded illustration of the bar clamp and the photograph above it (p. 69). The author points out the problem of tapping into end grain. If someone made a clamp as shown it would break in the highly stressed area on a center line between the two retaining pins.

—Clinton W. Bostock, W. Suffield, Conn.

After reading two articles (Spring '77, Fall '77) related to thread construction and use, I see no mention of hickory (shagbark) as a wood for threads.

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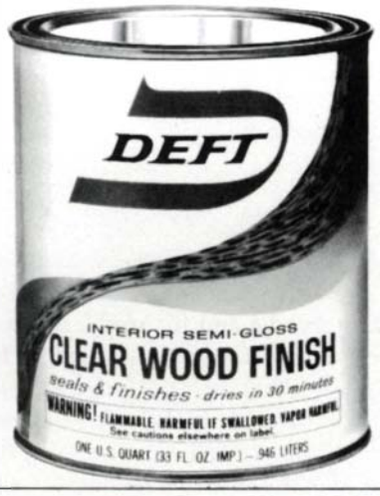

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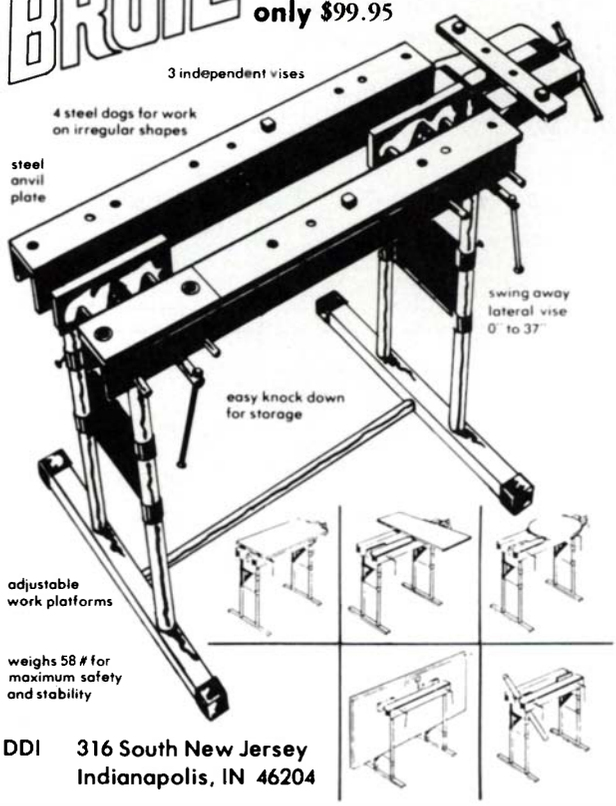

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LETTERS (continued)

Richard Showalter's identification of the wood used in his "antique clamp" was probably incorrect, as hickory looks similar to ash.

—Gary Randall, Sussex, N. J.

Regarding Timothy Ellsworth's article on hand planes (Winter '75): He intimates through illustration that adjustments may be made by tapping the body of the wooden plane with an iron hammer. This is a definite NO NO. Use of the iron hammer will over a period of time destroy the plane body. Use a wooden mallet or a block. Tapping the blade to get a deeper cut should also be done only with a wooden mallet or block. The hammer burrs over the top end of the blade. This same erroneous recommendation is made in many books published as long as 50 to 75 years ago.

—John W. Olson, Kensington, Md.

Bob Sutter's "Plane Speaking" (Summer '76, p. 28) implies that the block plane is advantageous for planing end grain...If the bevel is ground to an angle of 25°, the top edge of the cutting iron would have an angle of 47° on ordinary block planes. Since other planes (smooth, jack, fore, etc.) have the plane irons resting on a seat of 45°, there is no advantage of the block plane producing a smoother cut on end grain simply because block planes have irons angled at about one-half that of a bench plane. Only low-angle block planes have an advantage in planing end grain.

—Lyle Terrell, New Orleans, La.

Since Granberg Industries introduced their chain-saw mills in 1963, there has been a continuous debate on the need of special ripping chain for cutting roots, logs, and burlwoods. We manufacture George's Chain-saw Mills, and more than three years of crosscutting and ripping of tree roots, logs or burls (estimated over 5000 slabs) have shown me that any chain properly sharpened as I'm suggesting here will do the job satisfactorily. All of our chain is currently being sharpened at 20° top plate angle, instead of the 30° to 35° of new chain. All depth rakers are filed or ground to .040. We use chipper chain sharpened this way for all types of general woodworking of slabs, root burl, and log ripping. All chain is sharpened this way regardless of the size of our power heads, or the type of chain, using electric sharpeners. We use saw bars to 6 ft. long, and build mill frames to 10 ft. long (our exclusive feature). Our slant mill is the most versatile piece of equipment in the world for slabbing roots, logs, or burls.

When the top plate angle of the tooth is reduced, the size of the wood chip is smaller and so is the drag on the chain, as the sawdust must be drawn completely across the cutting area before it is ejected outside the cut. The result is higher chain speed, essential to successful cutting. It seems to us that the smaller angle on the tooth stays sharper longer. Also, reducing the cutting angle tends to eliminate the grabbing action and clutch slip when ripping logs. Less vibration reduces operator fatigue. Changing the angle to 10° or 0° gives a smoother surface and a little slower cutting, but is easier to sandpaper later on. We gradually change the tooth plate angle as we resharpen new chains, 5° to 10° at a time. Chains are discarded when two-thirds of the tooth is gone, because the drive links are worn down, and the chain has a tendency to gallop while cutting. Never cut with dull chain: Sharp

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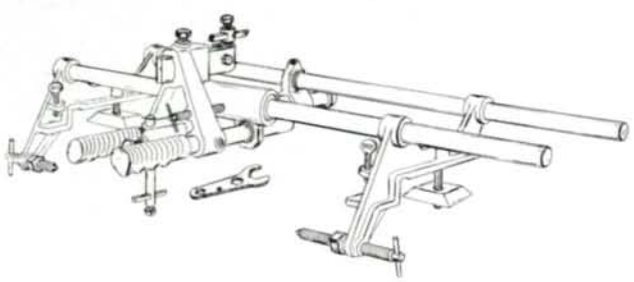

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Special skip-tooth chain simply eliminates some chain teeth to reduce the amount of wood chips traveling along the cut. It costs more money and is not readily available.

Special ripping chain is designed to break up the chips into irregular sizes so they offer less resistance as they are carried through the cut. It costs even more money, is not easily available and takes great care in sharpening, although it gives a fairly smooth cut. . .Some saws come equipped with power sharp top cutters and cannot be changed. The balance of the little saws are mostly a chain that is a marriage of the chisel chain and the chipper, and when filed or sharpened to 20° angle or less, offer good ripping features—less vibration when crosscutting—a little slower, but—less operator weariness.

—George Grube, El Cajon, Calif.

[Editor's note: George Grube manufactures a variety of chain-saw mills of his own design, ranging from a $20 "Mighty Mini" device that attaches to a small chain saw, up to a 4-ft. by 10-ft. slant mill that costs $650. His address is 14135 Old Highway 80, El Cajon, Calif. 92021, tel. (714) 443-2911.]

As a charter subscriber I have greatly enjoyed your magazine. It has filled a long-existing void in world publications and I have commended it to my friends around the world with almost paternal pride.

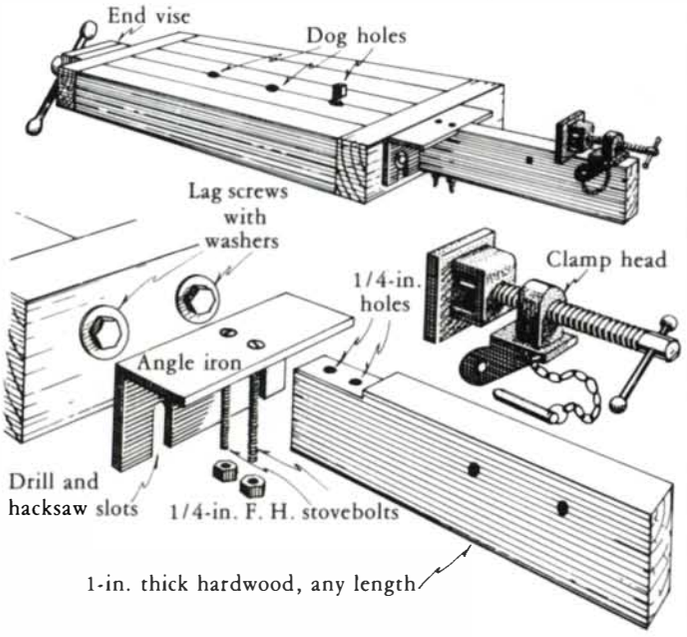
With this sentiment, perhaps you can appreciate my disappointment when I tell you that the articles on chain-saw milling and rip chain in your Fall '77 issue are highly misleading as to the development of the techniques and the equipment with which to perform them. From their presentation the reader must infer the equipment, the procedure and the technique sprang full-blown from the fertile brain of the writer of these articles, Robert Sperber. I assure you, nothing could be farther from the truth.

The portable chain-saw mill, as pictured and described in that article, was invented in the late 1950s by Ernest Hayden of Callahan, Calif., and John Tanner of Douglas, Alaska. This company, as Granberg Industries, Inc., and under the earlier name of Nygran Industries, has been manufacturing that device under license from the inventors since November of 1960 and during the past 17 years this device has become internationally known as the "Alaskan Chain Saw Mill." It is the rare country, island or region where it is not in use today. . . .While imitation is said to be the most sincere form of flattery, we can take no comfort in such a bromide. . .Since he is making his equipment for sale, our attorneys are in the process of reminding Mr. Sperber of his legal responsibilities to the property of others. We have filed suit in federal court to prevent this continuing infringement of our U. S. patents. . . .Our disappointment, therefore, is with you as this lack of skeptical curiosity on the part of your staff is most unprofessional and irresponsible. We trust this incident resulted from a momentary lapse of diligence and that cloak of competence you wear isn't concealing clay feet.

—F. D. Schrupp, Granberg Industries, Richmond, Calif.

Bench clamp

My clamping device extends the top (for holding and clamping) of a small workbench in limited-floorspace workshops. It can be used in conjunction with a tail vise on the opposite end of the bench or alone with dog holes drilled on



line with the clamp head device.

The Record brand clamp head can be bought from Silvo Hardware for $5.89.

My unit was constructed with 3-in. angle iron 6 in. long with the slots drilled and hacksawed 1 in. from either end. The 3/8 x 4-in. lag screws were driven through the slots into the end of my workbench so that the angle iron is flush with the top. Tightening and loosening the lag screws facilitates rapid installation and removal. Wooden bars of various lengths are handy for different projects.

—Robert Bessmer, Averill Park, N. Y.

Testing finishes

After turning wooden bowls, several of my eighth-grade students asked if they could use them for eating cereal. I was surprised and intrigued by the question, so I set out to test the water resistance of various nontoxic finishes, hoping that one would be good enough for such wet food.

I tested Deft, Benjamin Moore Urethane Varnish and constantine's Wood Bowl Seal on basswood, Philippine mahogany and pine—the woods used in our school shop. I also tested three oil finishes—Watco Danish oil, salad oil and mineral oil—on pine only.

The test pieces (which I called "concaves") were turned on the lathe from 3-1/2-in. discs of 1-3/4-in. stock. The outside was merely trued, the inside cut to a bowl contour. I made a concave of each wood for each finish, plus two extras—one to test unfinished, and a control (finished but not tested). The test liquid was water; to obtain a permanent record I added a powdered red stain.

I finished the concaves according to the labels on the cans, filled each with stain, and enclosed them in plastic bags to eliminate evaporation as a variable. I arbitrarily decided to let the basswood samples soak for a week, the pine for two weeks,

Bandsawn pine samples around unfinished control are (clockwise from top left) bowl seal, urethane varnish, salad oil, Watco.

the mahogany for three weeks. Since the unfinished samples quickly soaked up stain and were completely red within a day, I stopped this series after 24 hours. Every day the rest of the concaves were emptied, dried, examined and refilled with stain. At the end of the test periods I let them dry for two days before bandsawing into halves, to avoid the distortion that cutting wet wood might cause.

In every case the biggest changes occurred during the first few days. All the Deft samples stained in 24 hours—basswood the most and mahogany the least. The concaves finished with urethane and Wood Bowl Seal stained primarily on torn end grain, which had not been sanded perfectly smooth, and (in pine) along cracks in knots. The finishes themselves took on a salmon color, but penetration below the finish was minimal.

Mineral oil and salad oil were the least effective finishes, with Watco somewhat better but still not as good as Deft. The sectioned surfaces seemed to indicate that the stain traveled along the oiled surface of the wood, rather than through it. Note that two coats of the oil finishes were wiped on. Certainly the results would be different if the wood had been immersed and soaked in oil.

These tests demonstrated, first, that any finish increases the water resistance of wood, and second, that end grain must be sanded absolutely thoroughly for a finish to be effective. Knots also reduce the overall effectiveness of a finish. I concluded that two coats of urethane or Wood Bowl Seal are durable enough to resist the wetness of cereal, and that Deft and Watco are probably adequate for the usual uses of wooden bowls—salads, nuts, etc.

I don't mean to recommend these finishes or eating wet foods from them. But I do hope my testing method will be useful to others who are trying to

compare the relative merits of the particular finishes they like.

—C. Orentlicher, New York, N. Y.

Carving gouge

Before shelling out a lot of money for carving tools, I always think about what I want to carve and what tools I'll need. Often the tools will cost me nothing if I make them myself.

To make a small carving gouge, I use a hardened steel cut nail. The tapered shape needs very little grinding. I don't

bother grinding off the head; I just grind it down with the rest of the shaft, grinding one side flat and the other three sides into the curve I want. Then, holding the blank in a vise, I file the inside groove with a round (chain-saw) file. I grind a tang and mount the gouge in a hardwood handle, often with the bulge, or palm-grip, up, for easier carving at a shallow angle. Then I sharpen, putting the bevel on the inside, with file and slipstone.

—J. B. Small, Jr., Shippensburg, Pa.

Staining curly maple

Curly maple—fiddleback, tiger-tail, or whatever you may call it—requires a staining technique all its own. Maple with a curl was the favorite wood for the stocks of the muzzle-loading rifles of yesteryear. The staining method described here has come down by word of mouth from the old gunsmiths.

Great-grandpa used two stains and he made both of them. For the first you must find a handful of rusty cut nails—very old and very rusty cut nails are best. Place about a dozen in a soup bowl and cover them with homemade apple-cider vinegar, the stronger the better. Do not use a metal dish and do not substitute synthetic vinegars or white vinegar. Cover to prevent evaporation and let stand for two weeks.

For the second stain dissolve potassium dichromate crystals in water. It need not be a saturated solution but I use it fairly strong. You can buy these

crystals, or you might try begging a few from your high-school chemistry teacher. This stain can be used immediately.

We will assume your curly maple stock is now in the white and you have it sanded dead smooth. Use a rag swab to coat the stock with the vinegar stain. When it dries it should be about the color of a slate roof—not very pretty. This stain will penetrate deeply into the soft spots, but it will only sit on the surface of the hard stripes. Allow an hour for drying, or speed it up a bit with some heat. Now with a good grade of 220 garnet paper, sand this stain off the hard stripes; you will be unable to sand it off the soft spots where it has penetrated deeply. Sand a bit more here and a bit less there to bring out all the figure. Be sure to use a sanding block. The stripes are very hard and the spaces are soft. Sanding without a block can result in a washboard effect.

Now, using a new swab, stain the stock with the potassium dichromate stain. This stain will penetrate those hard, white stripes and color them a rich orange-yellow. It will also change that slate color to a rich dark brown. When the second stain is dry, sand it off with a very fine paper. Now put several drops of boiled linseed oil in the palm of each hand and rub it in lovingly, lean back, and feast your eye. The oil is only to bring out the color. Allow plenty of drying time before you apply your favorite finish.

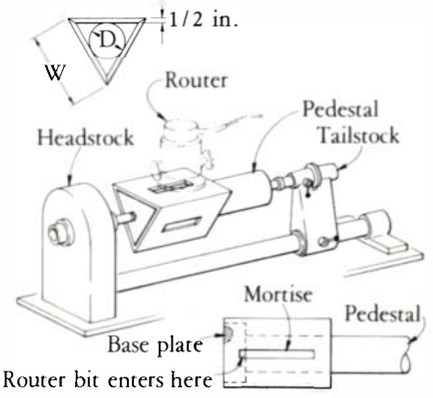
If you prefer to stick to grandpap's methods, give it an oil finish. An old gunsmith put it this way: "...three drops of boiled linseed oil and then three weeks of rub." Use as little oil as possible to cover the stock.

—Bob Winger, Montoursville, Pa.

Tripod jig

With the aid of this homemade jig, mortises for tripod table legs can be routed while the pedestal is on the lathe, after it is turned cylindrical and before it is turned to shape. The jig consists of a triangular box that fits around the cylinder, with mortises in its faces to guide a router bit. To build the jig, first make a full-scale drawing of the pedestal bottom and construct an equilateral triangle around it. Draw another triangle 1/2 in. outside the first one, as shown. Then cut three rectangular pieces of 1/2-in. plywood to

METHODS (*continued*)



the width determined by the drawing and about twice as long as the mortises will be. With table-saw blade set at 60° and plywood held vertically against the fence, cut the long edges at a 30° angle. Then cut mortise templates in the exact center of each piece—a dado blade simplifies the operation; chisel the ends square. The width of the mortises will vary according to the router bit and template follower you plan to use. For the back piece of the jig, bandsaw an equilateral triangle of 1-3/4-in. thick scrap wood to fit. Then glue and nail the four pieces together.

With the pedestal cylinder held by the tailstock of the lathe, position the jig and center the headstock spur on its bottom plate. Triangular spacers may be inserted between the pedestal and jig base to adjust the length of the mortise. Rout the first mortise, turn jig and pedestal 120°, mortise, and repeat.

To cut dovetail housings (p. 68), first remove the bulk of the wood with a straight bit the diameter of the dovetail waists, then rout out the sloping sides with a dovetail bit.

—Lyle Terrell, New Orleans, La.

Rubber clamps

Over the years I have refinished several old pieces with delicate curved surfaces and very hard-to-redo finishes, where normal clamps just won't work well. I tried string tourniquets with not too great results. Aviation bungee cord worked well but is expensive and hard to find. Now I use tire tubes cut in long ribbons. Bound around any surface they conform to shape and apply a very satisfactory even pressure. The more wraps, the more pressure. I cut ribbons about 1-1/2 in. wide, stretch each wrap as tightly as I can and tie off the end with an overlap.

—C. H. Dimmick, Sparta, N. J.

Q & A

Consulting editors Andy Marlow and George Frank invite questions from readers about cabinetmaking and finishing. And we invite readers to join the discussion with their own answers to problems raised in this column, for although Marlow and Frank have about a century of experience in the woodworking arts, there's always more to learn. Write Q/A, Fine Woodworking, *Box 355, Newtown, Conn. 06470.*

First, a number of recent questions concern moisture, warp and shrinkage. Richard O. Phipps of Gilbertsville, Pa., who builds early American furniture of select white pine in a small shop without heavy machinery, summarizes the problem: "To my frustration, almost every piece of wood I pick up is warped either in length or width . . . I see all this beautiful furniture on the market and just toss up my hands in disgust—it seems impossible to obtain a perfectly straight board."

Marlow replies: "The major cause of cupping is improper seasoning—the wood is not in equilibrium with the moisture contained in the air ("Water and Wood," Fall '76, p. 20). Pine is particularly susceptible because of the speed with which it is hurried through its journey from standing tree to the board in your shop. After the tree is felled and sawn it is shoved through a kiln for about half the time it should be. Then the boards are graded and planed and often stacked directly onto a freight car, one board right on top of another with no air in between.

"When you buy pine, take it indoors and sticker it well for several weeks so it can dry and adjust. If you have to use it soon after purchase, cut the lumber to rough length and stand it on end with several inches of air all around. Hold it upright and away from the wall by tacking a thin, pliable strip to the end.

"These are measures for *preventing* cup and warp. *Flattening* cupped boards is another matter, and there are two ways to do it permanently. One, rip each board into a number of strips, joint the sawn edges square, and glue back into a single unit. Two, hand-plane the concave side until a straightedge placed across the board will touch both edges and the center. Then the board may be fed through a thickness planer, first smoothing the convex side, then the hand-planed side. This will do

Q & A (continued)

a perfect job, if enough wood thickness remains.

"If a large power jointer is available, it may be used to flatten the concave side. But do not even hope to remove a warp with the thickness planer alone. The pressure of the feed rolls will flatten it, but on leaving the planer it will spring back to the original warp. Both measures are worthless if the wood isn't thoroughly seasoned first.

"Longitudinal bow can be solved only by making up a panel width from two pieces with about the same bow. Edge-glue the two pieces together with one bow facing up, the other down. Use slow-setting glue and start clamping in the center. Work toward each end, using a block and a heavy hammer to pull the joint even. Good luck."

To Dennis S. Kinnel, whose resawn stock cups: Marlow explains that although the board may have seemed dry, the interior must have been wetter than the surface. The newly sawn surfaces therefore dry until they are in equilibrium with the original surface, shrink, and pull the board concave. One solution is to season the wood thoroughly before resawing, thereby eliminating these stresses. Reader Guy Bradt of San Carlos, Calif., suggests an opposite approach: "Store the lumber in a damp place for several days before resawing to equalize the moisture in the middle and outside." In either case, after resawing sticker the wood on a flat place to allow it to stabilize.

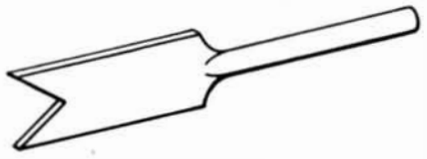
Reader Marcella Hudek, of Platte, S. D., writes: "I'm making a large, rolltop bread box. My problem is finding a sealer for the wood that won't retain an odor, so it doesn't contaminate my breads."

Frank replies: "Buy a good brand of shellac, white for light wood, orange for dark. Make sure it is fresh since old shellac won't dry properly, and keep it in a glass container. Cut it one measure of shellac to three of alcohol, and apply two or three even coats with a soft brush. Let each coat dry thoroughly and sandpaper with a fine grit between coats. When the third coat is dry, cut the finish with 4/0 or 5/0 steel wool—rub until it is very smooth to the touch. Then apply a thin coat of paste wax, let it dry and rub clean with an old wool sock. The secret is to use very little

Q & A (continued)

finishing materials and a lot of rubbing and sanding."

To Daniel Milano, who needs a tool to make the slots for *fiche* hinges: Trevor Robinson of Amherst, Mass., says the tool is called a *Fischbandeisen* in German. "It is used in Europe to make slots for the hinges used in casement windows. There are several designs; the simplest is sketched below. The thickness of the blade is equal to the thickness of the hinge leaf."



To Van Wagner, who needs a nontoxic finish for a butcher-block countertop: George Frank replies: "I finished my butcher block with polyurethane varnish. Cut the first coat three parts to one of thinner, apply it generously to all sides of the block, let sit for about ten minutes and rub off vigorously with a cloth. Let it dry overnight. Then brush on two coats of varnish diluted about two parts to one of thinner, without rubbing it off. This produces a thin coating but still a solid protection, and no smell whatsoever. Or, mix two parts of boiled linseed oil with one of turpentine and one of some good brand of spar varnish, apply three or four coatings and energetically rub off the excess each time."

Eric Rasmussen of Berkeley, Calif., says butchers use melted paraffin. "Paint the surface of the block, and scrape off the excess wax with a cabinet scraper. Repeat three or four times. Then rub a little mineral oil into the surface from time to time to keep it looking beautiful. To clean it, scrape it lightly and wash with hot water and ammonia."

To Kenneth Carl, who wants to finish birds carved in vermilion wood without darkening its bright color: Although Frank is not familiar with vermilion wood, he suggests you try an old method for finishing bright-colored woods without darkening them. "The answer lies not with the finish material, but with the tricky way of applying it. My choice would be fresh white shellac, but you can use picture varnish or

water-white lacquer. The trick is to get the finishing material to contact the wood and dry at the same time, so the carrying agent (alcohol, thinner or turpentine) has no time to enter the pores of the wood and darken it. I would use an air brush of the type commercial artists use, or a mouth sprayer, which you can buy for a couple of dollars at an art-supply store. Regulate it to spray as much air and as little finish as possible, and hold it far from the work. The first coat must be infinitely light and thin. Succeeding applications can be a little heavier, but you must not rush. It will take a certain amount of skill and a great deal of patience. You could also try two coats of a dilute, lukewarm solution of bleached hide glue, well sanded, under any clear finish."

To Harold Kauffman, who makes clock cases of pine and is plagued by pitch streaks breaking through his walnut stain and varnish: George Frank replies, "This is an age-old problem and the easiest way to deal with it is to select a better grade of pine with less pitch. The second solution, which I learned in school but have never tried, is to wash down the pine before finishing with a fairly strong solution of lye, rinse with clear water, let dry and sand. The lye should remove most of the pitch, and it would increase the contrast between the hard and soft grain, making the pine more attractive. A third way, which I have done, is to set a match to the pitch and burn it out, then clean the hole and fill with tinted plaster or stick shellac. The difficulty is, you can do it only when a teardrop of pitch is visible on the wood."

Guy Bradt of San Carlos, Calif., believes the problem is caused by improper seasoning, "since it takes a minimum of 138° F to crystallize pitch in ponderosa and sugar pine. I suggest putting the blanks for the case parts in the oven at 150° F for half an hour. This seems to eliminate bleeding."

Reader Jonathan Wagman of Ulster Park, N. Y., asks: "How shall I finish my redwood picnic table and benches? The store advised a redwood stain, which turned out to be mostly paint and flaked off. We've sanded it down to the bare wood."

Frank replies: "Redwood is so beautiful it doesn't need any stain to en-

Q & A (continued)

hance it. It also resists fungus and weather quite well. Mix equal amounts of boiled linseed oil and any good brand of varnish. Spread this mixture generously on the furniture, but before it dries—about 15 minutes to a half-hour later—wipe off all that you possibly can. Use a burlap-type rag, and plenty of elbow grease. The very thin coating that remains in the wood will offer surprisingly good protection and it can be still improved by repetition. Give each application a week to dry and put the emphasis on the rubbing—that is what makes it beautiful."

To W. H. Baldwin, who is looking for bulk abrasives: Charles Haber of Huntington Beach, Calif., notes that hobby shops catering to rock hounds sell bulk carborundum in a variety of grits.

More about earlier questions: Several readers warn that vegetable oils used to finish salad bowls eventually turn rancid in the wood and taint the food. Although mineral oil in large quantities may rob the body of vitamins, the tiny amount that might enter the salad is harmless. Marty Sweet of Fairfax, Calif., adds: "One can also use coconut oil or lemon oil, neither of which will decay. Of course any oil finish will be far better if it is applied hot and rubbed with 600-grit paper soaked with the oil of choice."

Re the difficulty of bonding veneer to particle board: Henry Kramer of Somerville, N. J., says, "Give it up. Don't try to put nice veneer on particle board." Marlow agrees: "I wouldn't use the stuff on a doghouse. Bond veneer to a good grade of plywood."

But George Kahn of Potsdam, N.Y., writes that tight finances have forced him to experiment with particle board. He has concluded that the critical problem is moisture—veneer lifts because the wood chips in the board weren't dry at the time of manufacture. His answer is, "First make sure your particle board is dry—air dry it for at least a month at room temperature. Second, seal it with shellac sealer or lacquer cut 50% with thinner, and add a tablespoon of Japan dryer per half-gallon of mixture. Three light coats make a superb gluing surface; roughen the lacquer with 220-grit paper before applying contact cement."

BOOKS

Manual of Wood Carving and Wood Sculpture by Frederick A. Brunner. *Frederick Brunner, Westwood, Mass. 02090. 1972. $10.00 paper, 148 pp.*

Frederick Brunner, who was born in Germany and completed an apprenticeship and journeywork there, learned to carve before he learned to read and write. Yet he believes it is never too late to learn to carve, and labels his own carving experience a "never-ending apprenticeship." Brunner came to America in his twenties in 1923; since then he has completed countless ambitious commissions, specializing in ecclesiastical architecture and figures. He has furnished cathedrals, churches and universities.

Brunner's book is structured much the way a teacher would train a novice. After an absorbing history of carving, he starts the reader off on a series of drawing exercises, believing, "the better drawer the better carver." And drawing skills are necessary if one ever hopes to create designs.

Brunner's skillful drawings explain every phase of the carving lessons, usually better than the text does. They are so well conceived that one feels as though Brunner's hands were demonstrating each step.

Next Brunner discusses types and care of tools, bench equipment, methods of holding the work, woods to use and most important—sharpening. Six pages of illustrations are devoted to sharpening and honing tools. Brunner illustrates a suggested basic carving set and shows how to achieve proper cutting edges. He insists that sharpening tools properly is half of carving success.

A section on carving fundamentals covers how to control tools for different cuts and in different directions. He outlines good carving habits that will help avoid tearing the wood, misusing the tool and turning a joyful occupation into frustration.

Next low-relief, high-relief and in-the-round carving are introduced. Two full-size working patterns are supplemented with step-by-step drawings that explain what tool to use where, and how to achieve the desired forms. In this section are some of the most useful lessons in the book. The reader learns the steps of roughing out, setting in and finishing, using only a few tools.

The last project is a well-detailed se-

quence on making a French Provincial tea-table leg with a scroll ornament. This section is particularly useful to furniture makers as well as carvers. Brunner also shows several clever ways to secure the work through all the form changes the leg takes. The book finishes with several patterns for three-dimensional sculptures with instruction on how to saw out waste to save time.

Brunner's manual is not a slick book destined for the coffee table. It is a self-published, unpretentious book in a plastic spiral binder designed to lie flat on the workbench. Brunner makes carving so alive that one has the urge to put down the book and start working. Almost a substitute for an apprenticeship, it is Brunner's invitation to come carve.

—Rosanne Somerson

How to Build Shaker Furniture by Thomas Moser. *Drake Publishers, Inc., 801 Second Ave., New York, N. Y. 10017, 1977. $6.95 paper, 209 pp.*

The title of this book is somewhat misleading. What Moser, a cabinetmaker in New Gloucester, Maine, has done is take fifty pieces from the collection offered in his catalog and provide a photograph and measured drawings with construction details for each. The pieces themselves are not Shaker reproductions but "adaptations which have a genesis in the 'mood' of the Shaker style." And as far as the rather murky, poorly reproduced photographs allow one to see, the furniture is perfectly reasonable stuff, although quite a bit closer to contemporary in its construction details and general appearance than many moody lovers of Shaker furniture might like.

Preceding the drawings is "a short course on tools and woodworking methods" that includes a discussion of wood structure, drawings of circular saw blades, instructions on drilling holes, and so on. Most of this seemingly obligatory filler material has been covered many times and more thoroughly by some of the books listed in Moser's own bibliography, and it seems unnecessary to have it repeated in this and every other how-to-build book. The section on joinery and casework techniques is more pertinent because it deals directly with the pieces Moser produces, and the drawings that accompany the text here are very informative. Curiously,

BOOKS (continued)

chairmaking is not mentioned, even though several chairs and benches are shown in the measured drawings.

Moser's comments and the photographs of the tools and machines in his shop make the book more interesting, if only because most woodworkers love poking around other people's shops.

Chris Becksvoort's drawings are excellent, providing the kind of details one needs to reproduce these pieces.

—David Landen

Classic Furniture Projects by A. W. Marlow. *Stein and Day, Scarborough House, Briarcliff Manor, N. Y. 10510, 1977. $12.95 cloth, 210 pp.*

Classic Furniture Projects is Marlow's latest book on fine cabinetmaking. This celebrated author and experienced craftsman attempts to take the mystery out of making fine classic inlaid furniture and, for the most part, succeeds.

Marlow details 13 separate projects ranging from small boxes to folding-top tables to a chest of drawers. The dominant style is American Federal. He follows his earlier formula, using plan drawings and photographs keyed to a step-by step text. Marlow focuses on inlay, including banding, inlay ovals and miscellaneous decoration. He pays less attention to basic cabinetry than in his earlier books. He concludes with an excellent chapter on dovetail joints and a brief discussion of finishing.

I have always had great admiration for Marlow's earlier book *Fine Furniture for the Amateur Cabinetmaker* and find it impossible not to make comparisons. (Years ago I found *Fine Furniture* to be a *tour de force* as a teaching text in the sophisticated aspects of basic cabinetry for the serious amateur woodworker.) By my estimate, *Classic Furniture Projects* uses somewhat less than half the text and photographs than *Fine Furniture* might for a comparable project. It seems the author is assuming more knowledge of basic cabinetmaking and the fine points of hand tools. Further, I found the sectional drawings not quite as thorough as those in *Fine Furniture*. These are minor problems, however, since *Classic Furniture Projects* is a fine book and brings inlay work, which has always puzzled me, into the realm of the possible for the average cabinetmaker.

—Garretson W. Chinn

ADDENDA, ERRATA

Our *Questions/Answers* column acquires a new format in this issue, now that cabinetmaker Andy Marlow and furniture finisher George Frank have joined us as consulting editors. In the past, we have published readers' questions, leaving the answers to the next issue. Now we forward all the questions to Marlow and Frank for answering; then the editors select those of general interest for publication. As always, we encourage readers to expand on or take issue with the advice provided by our experts, and we'll pass on reader experiences in subsequent columns. We're grateful to all the woodworkers who have responded to the column so far; often, we receive a letter containing not just one answer but a detailed response to a whole list of questions. We hope readers will continue to take time out from their own work to share their knowledge with others.

Every quarter, we receive several hundred letters to the editor. The ones that comment on magazine articles and the woodworking arts in general are excerpted for the *Letters* columns; those asking and answering questions to the *Q/A* columns, and those offering tips and techniques go to *Methods of Work.*

Many letters suggest topics for future articles, information about craftsmen who might be the subject of an article, or are from readers offering to write an article. We are particularly grateful for all of these, and we follow up on them, because they are our primary source of editorial material. Finally, our favorite letters come from readers who pungently criticize the magazine itself or who simply want to say they enjoy it, and which articles they found most useful. We don't publish these letters, because they don't add to the store of knowledge of woodworking. Instead, we pass them around the office and savor them.

With this issue, John Makepeace joins Colin Tipping as editorial correspondent in England. Makepeace is one of Britain's foremost furniture designers and proprietor of a workshop and school at Parnham House, Beaminster, Dorset.

As Christmas looms, so grows the stack of new fall catalogs from the mail-order tool merchants. The many new firms that have entered the market in recent years vastly increase the range

ADDENDA (continued)

and quality of available tools and supplies. Those catalogs that have reached this office, and their prices, include: Barap Specialties, $.50; Bimex, $2; Brookstone, $.50; Conover Woodcraft, $1; Constantine, $.50; Craftsman Wood Service, $.50; Frog Tool, $.50; Garrett Wade, $1; Leichtung, $1; Minnesota Woodworkers Supply, $1; Princeton, free; Sculpture House, $1; Silvo Hardware, $1; U. S. General Supply, $1; Wood Carver's Supply, $.75; Woodcraft Supply, $.50; Woodworker's Supply, $1. Most refund the catalog price with the first order; their addresses can be found in their advertisements elsewhere in this issue.

After a brief flirtation with volume numbers for each issue of *Fine Woodworking*, the contents page of this issue sensibly switches to sequential whole numbers. Thus our first issue, Winter '75, is No. 1, and this issue, Winter '77, is No. 9. Back issues may be ordered by date or by whole number, and life in our subscription department will be much simpler.

* * *

In Fall '77, p. 33, grain raised by water in refinishing should be sanded with 220-grit paper or finer, not with 80 or 100 grit.

In Fall '76, p. 22, the legend under the graph showing seasonal variations in moisture content slips out of phase at the third summer. It should continue to alternate winter-summer.

Gerald R. Ward, assistant curator of the Yale University Art Gallery, notes that in "Painted Furniture," (Fall '77, p. 48) we neglected to credit the Empire-style couch to Yale's collection. We also take this occasion to note that in the same article, the small sewing box belongs to the Greenfield Village and Henry Ford Museum of Dearborn, Mich.; the blanket chest came from the Metropolitan Museum of Art, New York; the music cabinet was lent by Gary Moody of St. Paul, Minn.; "Face Chair" was lent by Nancy Hoffman Gallery, New York; "Maple Mable" was lent by the artist; the painted cupboard came from the Minneapolis Institute of Arts; and the Boston rocker was lent by the Museum of Fine Arts, Boston.

* * *

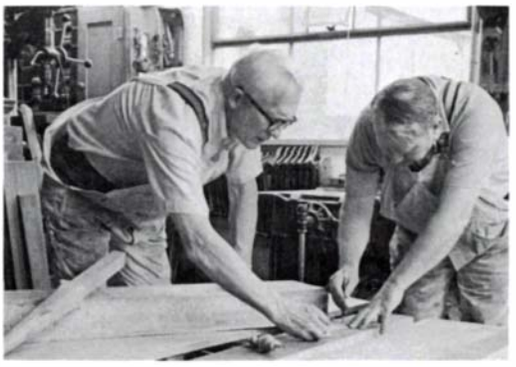
Art credits: 12, 21, 24, 35-37, 41-43, 49-51, 59, 61, 66, Stan Tkaczuk, Image Area; 17, 19, 45-48, 64-65, 70-71, Joe Esposito; 73-74, Roger Barnes.

Photo credits: 32, Providence Sunday Journal; 38, Philadelphia Museum of Art; 39, Museum of Art, Rhode Island School of Design; 44, 46, Ben Davies; 49-51, Bengt Carlen; 52, Rob Ely; 52-53, Richard Starr; 58-60, John Meyers; 62, Ann Pappert; 63, Canadian National Exhibition; 64-65, W. Kaphaem, Jr.; 66-67, Peter Britton; 68, J. Kassay, Derek Balmer; 72-74, W. Smith.

Repair and Restoration

A visit with Ek and Tucker

by Richard E. Preiss



Ek, left, and Tucker

Knut L. Ek and Kenneth R. Tucker rebuild and refinish antique furniture. The sign outside their door in Rumford, R. I., simply reads "Ek Antiques." Ek and Tucker have worked together here since 1938, restoring many Newport, Goddard and Townsend pieces as well as unique items such as John Brown's chair and table. Their methods are not complex or secretive, just practiced with the patience, honesty and know-how that only time can perfect.

Most of their work is furniture that has been acquired by Ek, sold as is and then brought back to stylish life. The buyer knows exactly what he is starting with, before any repairs are made. "We could look across the room and date a piece of furniture," says Tucker. Subtle variations in curves, moldings and finish colorations are quick clues to the age of a piece. The hardware, joinery and drawer construction give further information about an object's history.

Appraising a Windsor chair, Tucker first twists his hand rapidly around the turned legs. "We love to feel something like this," he says, noting the out-of-roundness that has developed over the years. The extent of shaping that went into the seat is checked, the bent back is admired and a date and value are affixed. "Shows are filled with phonied stuff because the sellers don't know what they have," says Tucker.

After an item has been sold, the first step usually is removing the old finish. Tucker mixes varnish and shellac remover, partly out of habit and partly because it costs less than commercial preparations. To mix 10 gal., he adds 1-1/4 lb. of paraffin wax to 5 gal. of benzol (benzene), mixes it well, and adds this solution to 5 gal. of denatured alcohol. The wax keeps the mixture from drying up. After disassembling the major elements of the piece of furniture, he applies remover with a brush, keeping the surfaces wet until the finish comes away. On flat areas he carefully removes the sludge with a putty knife. He wipes off carved and turned sections with a rag. No scrapers are used, so as not to damage the oxidized surface patina of the wood itself. The wood is then rubbed with denatured alcohol and 3-0 steel wool until no trace of old finish remains. This remover will not work on most finishes used after 1925; newer finishes are generally lacquer-based and are therefore removed with acetone.

Reconditioning, which sometimes means starting with a spindle or a seat and reconstructing a chair, requires a feel for the "tolerable variances" that must be incorporated into a period piece to make it look and feel old. Rebuilt furniture must look as authentic as possible, not only in styling and design, but also in style of workmanship.

To simulate a period look, Tucker must first find a suitable piece of wood to replace a missing part. This is often difficult, because wood like the dark, dense Santo Domingan mahogany, preferred in American Queen Anne, is virtually gone. Often, collected segments from similar period objects are recut and incorporated into a restoration. For a drawer bottom in an old chest, only a piece of wood with an accent of rubbed-in dirt would appear proper. Other markings that give an antique its flavor are overrun scribe lines and saw kerfs, edges worn down by sanding, and carefully developed stress marks.

When extensive refinishing is needed, such as to match lighter and darker pieces of wood within one cabinet, the whole unit is scraped and sanded quite thoroughly. There is less concern at this point with retaining the patina colors, because one way or another a complete coloring and blending of tones will be required. Tucker fills holes and dents with stick shellac, melted with a small soldering gun. He prefers shellac to linseed-based putty fillers because "it sticks better." After the shellac hardens, he pares the surface flush with a chisel before moving on to the next hole. Where a special color of filler is required, the stick is dipped in liquid shellac and then into a powdered pigment before being melted in place. Tucker and Ek use Lansco dry powdered pigments, which they buy at the local paint store.

To blend the color of a dark patch or a newly added piece of wood to the original, Tucker first lightens the darker area with Spe-De-Way bleach, a two-part liquid made especially for bleaching wood. Then he mixes his powdered colors with water or alcohol and rubs the color into the surface until it matches the surrounding areas. Jars of color fill the finishing area; the correct blending results from practice and "just knowing the way it's supposed to be," says Tucker. He also uses liquid penetrating stains to return a piece to its correct stylistic era. A little bit of alcohol applied to a rag used for staining and then rubbed on the work is a fast way to cover a small light spot.

A very light sanding prepares the freshly cleaned surface for its new finish. With the old finish removed and the surfaces dry, the wood is completely hand-sanded with 220-grit paper, with care not to penetrate the existing patina unevenly. No sanding blocks are used, although Ek switches to a slightly coarser grit paper to smooth out stubborn areas. Rust or ink stains are removed with oxalic acid, which usually can be bought from the drugstore in crystal form. To mix the acid solution, Ek puts a 2-in. layer of crystals into a quart jar, stands the jar in a hot water bath, and fills it three-quarters full with water. He spills a little solution onto the stain, rubs

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Rich Preiss, 25, is resident instructor at Leeds Design Workshops in Easthampton, Mass.

it in and wipes it off. Then he rubs the area with a cloth dampened in vinegar (borax will do the same job) to neutralize it and prevent shellac from bubbling up later on.

For a protective finish, Ek uses either varnish or shellac; his rule is, "If you can set a glass of water on it, use varnish." He mixes shellac from flakes because its color is more consistent than prepared shellac, and the viscosity can be controlled. Also, following the final rubbing, bought shellac tends to retain an undesirable gloss, whereas shellac mixed from flakes will remain flat. Ek uses only orange shellac, never white, because it has less tendency to turn milky in high humidity, and because he contends that white often doesn't dry properly. He applies three or four brush coats of shellac, generally proceeding from a dilute to a heavier mixture. Each application is allowed to dry thoroughly—at least 24 hours—and then sanded evenly with 220-grit silicon-carbide paper. After the final coat has been sanded, he rubs the surfaces uniformly with a mixture of pumice and oil until the gloss is taken off and the piece has an even glow. This is the finished surface—no wax or polish.

On horizontal surfaces that may suffer glasses of water, Tucker and Ek spray two coats of Behlen's Rock Hard Varnish, with a light fine sanding between coats. When the first application is completely dry, pimples are rubbed out with 400-grit wet/dry sandpaper used with water. They are careful not to sand through to the previous layer. The surface is then wiped off and allowed to dry before proceeding. Following the second coat, the wood is rubbed with 3-0 steel wool in long, sweeping strokes until the sheen is gone. Rubbing with pumice and light oil completes the work.

After I left Tucker and Ek, the relaxed feeling of the shop stayed with me for hours. Eight dollars an hour is not much to charge for such painstaking work and timeless techniques by two master artisans.

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Rockwell power block plane kit: model 9167, includes 167 plane, sharpening attachment and case. Used, $75. C. Brooks, Box 323, Selah, WA 98942.

Will exchange Honduras Rosewood pieces for Zebrawood—pound for pound. T. Desler, Box 40, Dolton, IL 60419.

Stanley 55 with cutters, all in good condition. Will trade for two-man crown molding plane. J. Hamilton, 1 Bates Road, Morgantown, WV 26505.

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Designing for Dining

Dutch pull-out extends table for guests

by Tage Frid

There are several different systems to choose from when making an extension dining table. Some you can purchase ready-made; they are usually quite expensive. Of the ones you can make yourself, I prefer the "Dutch pull-out" dining table. It is both simple and fast to make.

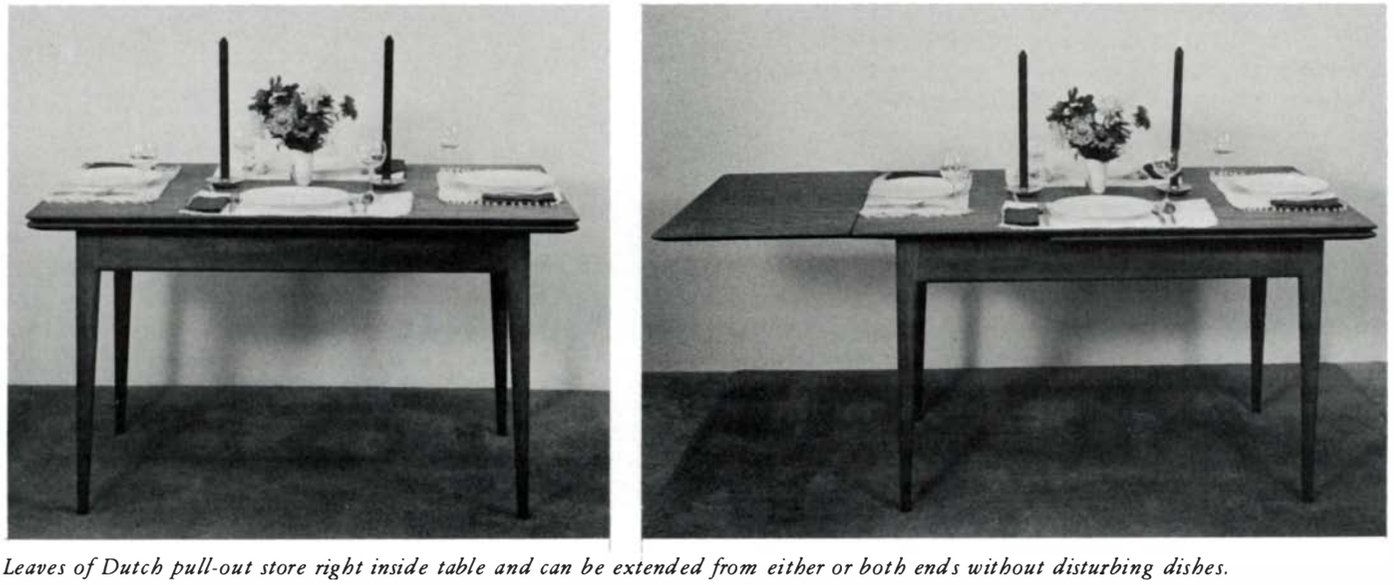
The tabletop consists of two pieces of plywood, both the same size, one mounted right above the other on the base. The lower piece is cut into three sections—two of them are the leaves, and the third is a fixed center piece. The top rests on the center piece and the leaves and is held there by two vertical dowels sitting loosely in guide holes. Thus it is free to move up and down but not from side to side. The leaves are mounted on long tapered slides that allow them to be pulled out from the ends. The slides travel in grooves in the end aprons and in a supporting rail across the center of the table base. As a leaf is extended, the taper makes it rise slowly throughout its travel to the level of the top. As the leaf rises, so does the top, until the leaf is fully extended and clear of the top. Then the top drops down again, flush with the leaf. Before the leaf can be pushed back in the top has to be lifted high enough to clear, then the top settles back down onto the center piece as the leaf travels back to its original position.

I made the table illustrated here 25 years ago, and it took four or five days, including veneering and edging plywood for the top. Once you understand the system, the work is easy and should go very quickly. You'll have to make four slides and only eight mortise-and-tenon joints. Other than wood for the base and the slides, you need hardwood-veneered plywood, two 3/4-in. dowels and edging for the top.

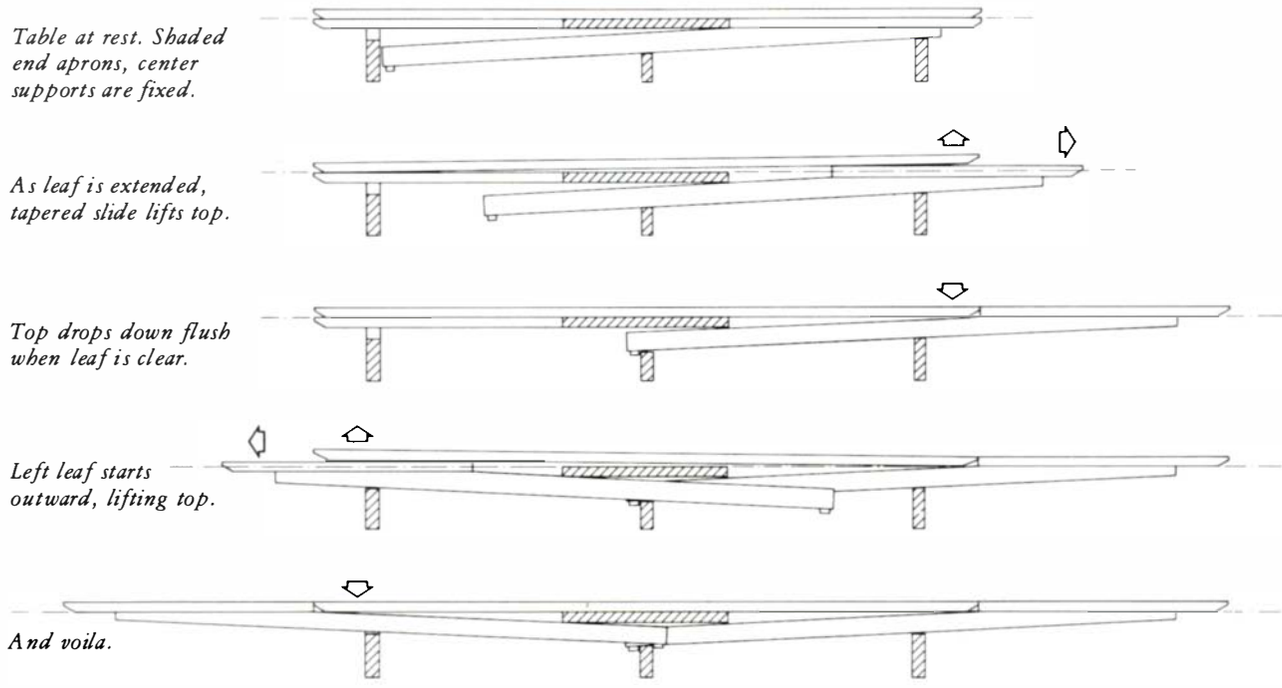
In addition to being easy to make, the leaves store right inside the table and are easy to pull out, even with the table set. If uninvited guests show up just when the food is on the table and you are ready to sit down, and they apologize for interrupting your meal but hint that they haven't eaten yet themselves, before you know it they are invited to join you. With most extension systems you would have to clear the table before you could enlarge it. But with the Dutch pull-out you can pull out the leaves without disturbing the setting at all.

There are several important dimensions you must consider when designing a dining table. Since the seat height of a dining chair is usually about 18 in., the height of the table should be between 29 in. and 31 in. I usually use 30 in.—this seems to be most comfortable for the average person. And since people differ in height more from the hip down than from the seat up, the distance from the floor to the bottom of the table apron should be at least 24 in., so that someone's long legs or fat legs aren't the legs holding up the table. In the length, I like to allow 24 in. for each person, so no one feels squeezed in. I try to place the legs so that no one ends up with a table leg between his or her own. (The easiest way to avoid that situation is to make a pedestal or trestle table.)

A place setting—dishes, glasses, and so on—is about 14 in. deep. So the minimum width of the table must be 30 in., or else you may drink the wine of the person across from you. Whenever possible, I make dining tables 42 in. wide, to leave space in the center for food, wine, flowers and condiments.



Leaves of Dutch pull-out store right inside table and can be extended from either or both ends without disturbing dishes.



The table shown here was designed for a very small room and is only 32-1/4 in. wide, about the minimum.

For the last 12 years I have belonged to a gourmet club made up of seven men who cook for each other once a month during the winter. We have five good meals for ourselves, and at the last dinner of the season, two of us cook and the wives are invited. I feel that half the success of a meal is a result of how it is presented, and how comfortable each person is.

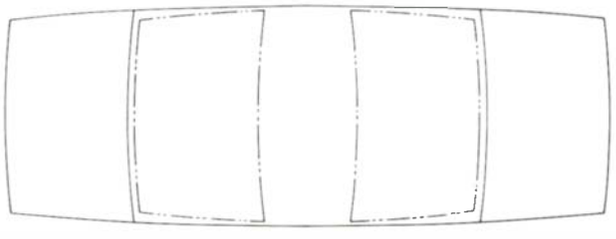
There is nothing worse than being seated near one end of a long, straight table and trying to talk with someone on the same side at the other end. If you want to see the person, you have to lean in so far that you might get gravy on your ear. The most logical shape for a table is round or oval, so everyone can see each other. And with a round table, each person uses less space because the chairs and elbows are out in a bigger circumference. A simple Dutch pull-out cannot be used on a round table, although complex systems using the same idea have been thought of. But a Dutch pull-out will work for a table with curved sides, though the overhang between the top and the leaf will not be the same all the way around (which I don't mind). I prefer to curve the sides slightly.

In designing a Dutch pull-out, remember that the less overhang there is between base and top, the bigger the leaves can be. This is because each leaf must travel its full length outward before it can clear the top. The tail end of the slide to which the leaf is attached of course travels the exact same distance. But the slide can't go any further than the inside length between the apron and the center support, less about an inch for the stop. Therefore, when you have chosen the length of the closed table, you can decide how much the top will overhang the base and calculate the length of the leaves. Or you can decide the length of the leaves and figure the overhang. One determines the other.

The measurements given in the drawings were taken from the old table in the photographs, and I will use these dimensions to explain the system. But you will want to use your own dimensions and make the table to suit your own dining area.

When my table is closed it is 50-1/2 in. long. I decided the top should overhang the base by 4 in. all around. Since the apron is 7/8 in. thick, the aprons and overhangs at both ends

Partly open view from below shows system of slides, stops.



System works with curved sides, although overhang is uneven.

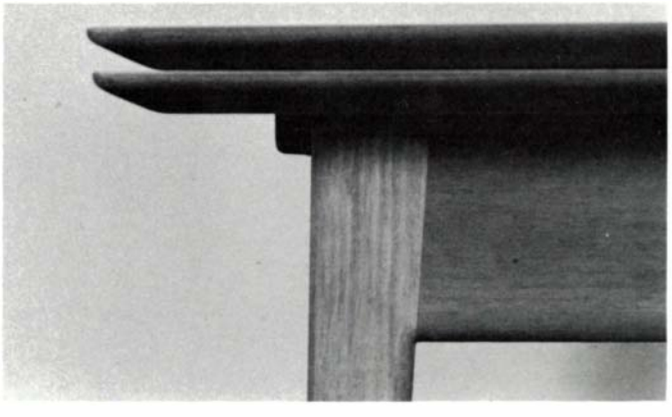
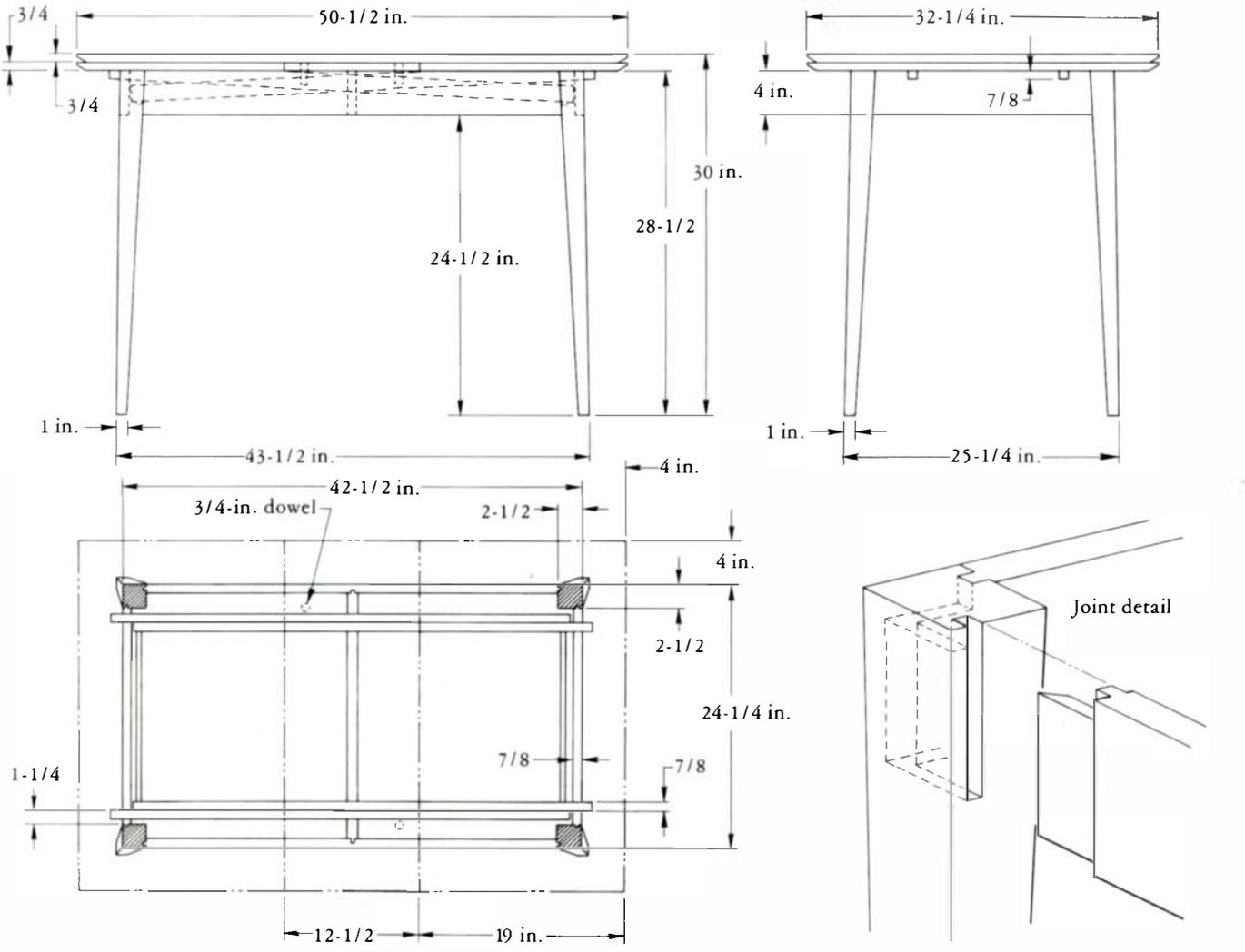


Table has beveled edge and careful rounding where leg joins apron.



add up to 9-3/4 in. Deduct that from 50-1/2 in. and you get 40-3/4 in., the inside length of the base. Divide that in half (20-3/8 in.) and deduct 1-3/8 in. for the stop and half the thickness of the center support, and you get 19 in. for each leaf. Thus the table will extend 38 in., its open length will be the sum of the leaves and top, or 88-1/2 in., and the width of the center piece will be the difference between the leaves and the top, or 12-1/2 in.

If I had started with both the open and closed lengths, I would follow the same calculation in reverse to find the overhang. Since my table measures 50-1/2 in. closed and 88-1/2 in. open, simple subtraction gives 38 in. for the combined length of the leaves. Add the thickness of the two aprons (1-3/4 in.), both stops and the center support (2-3/4 in.) and you get 42-1/2 in. Deducting this from the length of the top gives 8 in. So the top would be allowed to overhang the base by 4 in. at each end.

The table base consists of four tapered legs joined to an apron that is 4 in. deep. I used haunched tenon joints in the legs. If the tenon came up through the leg in a slip joint, you would have to clamp across the cheeks when you glue the pieces together. By leaving the leg solid on top this is not necessary; you need clamps only in the direction that will pull the tenon into the mortise. To get as much strength as possible, I let the two mortises meet and cut the ends of the tenons to 45°, but left a 1/8-in. space between them for expansion. Use a tongue and groove to join the center support across the base. This piece will guide the slides and serve as a place to run the stops against to keep the leaves from falling out.

Because the tabletop is loose and the slides are glued and screwed to the leaves, the top and leaves must either be made out of plywood or be made using frame-and-panel construction. If you use plywood, you should get a top grade. You can buy it already veneered, or veneer it yourself, or you can paint it, stencil it or finish it however you like. I veneered the top and leaves together, so the grain would follow when the table is open, applied solid wood edging and beveled it. There are two reasons to bevel it. First, if the table gets used a lot, there might be a little play in the dowels and the beveled edge will help to hide discrepancies; second, when the leaves slide down, they will slide more easily.

The success of your table will depend on your accuracy in laying out and cutting the four slides. Be sure that the wood you use is straight. I usually cut the slides oversize and leave them for a few days to give them a chance to warp. Then I joint and thickness-plane them to size, in this case 7/8 in. thick and 1-1/2 in. wide. Their length is the inside measurement of the base (40-3/4 in.) plus the 7/8-in. thickness of the apron plus the 4-in. overhang, or 45-5/8 in. The slides will be trimmed shorter later, for looks, but they have to be full length now, for measuring.

The ends of the slides that hold the leaves must be cut at an angle so that they will wedge the leaves up to the level of the tabletop as they are being extended. On this table, the top and leaves are 3/4 in. thick. Thus each leaf must rise 3/4 in. when it has traveled 19 in., its full extension. From one end of one of the slides, measure down 19 in. and square the line off. Then make a point 3/4 in. over on the same end. A line

connecting this point with the edge of the 19-in. mark will give the angle at which to cut the slides.

To be sure that all the slides will have the same angle and be cut exactly the same, you should construct a jig. Square a piece of plywood about 6 in. wide and a foot longer than the angled portion. Place the slide over the plywood with both marks (the ends of the line you have drawn) just touching the bottom edge of the plywood. Then trace the end and the other side of the slide and bandsaw out the shape.

With the table-saw fence still at the same setting you used to cut the plywood jig to width, insert the slide into the jig and make the cut. Use the same setup for all four slides and you can be sure they will all turn out the same.

The slides run in slots in the end aprons and the parallel center support. One pair of slides travels inside the other pair, and the two run side by side in the slots in the center support. To lay out these grooves, mark lines on top of the apron at both ends, 1-1/4 in. from the inside edge of all four legs. With a long straightedge, transfer these lines to the center support. Mark the thickness of the slide to the *outside* of the table from these lines on one apron, and to the *inside* of the table from the lines on the other. On the center support, mark the thickness of a slide to *both* sides of the center line.

The grooves on the end aprons must be the same depth as the slide at that point, so that the leaf will clear the apron as it is extended. To find this depth, measure in 4 in. from the tapered end of the slide and cut the groove to the exact depth of the slide at this point, in this case 7/8 in.

To find the depth of the grooves in the center support, first mark its location onto the slides, in this case 25-1/4 in. from the tapered end, or half of the length of the closed table. Then push the tapered side down flat and measure the depth at the marked point, in this case 1-7/8 in. This is the minimum depth that will allow the leaf to rise 3/4 in. in its travel; the grooves may be cut a little deeper if you wish.

Now that all the measurements and cuts have been made, the tapered ends of the slides can be trimmed. I wanted the closed slides to extend 1 in. beyond the apron, so I cut off 3 in.

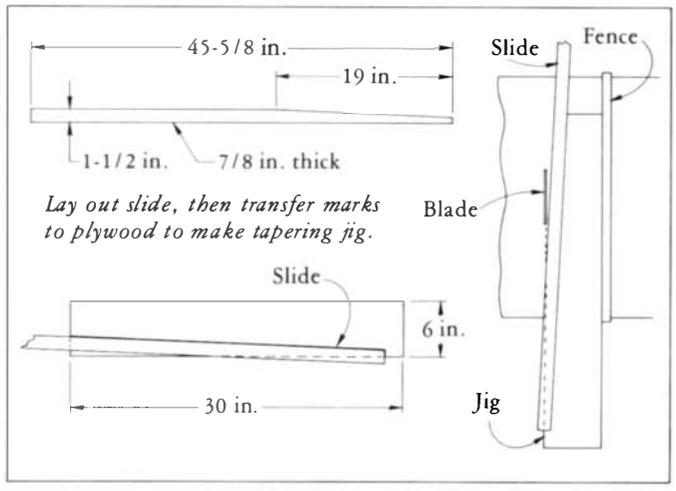
To assemble the table, place the slides in the grooves with the angled sides up. Put the leaves in position (don't forget that you just trimmed 3 in. off the end of each slide), and glue and screw the slides to the leaves. To locate the stops, extend the leaves 19 in. and mark where the slides pass through the center support. Then screw on the stops at this point.

The central plywood piece is screwed to the base above the central support. It prevents the leaves from falling down when they are pulled out and locates the tabletop. Drill two 3/4-in. holes in the central plywood piece between the slides and the apron; these are the guide holes for the top.

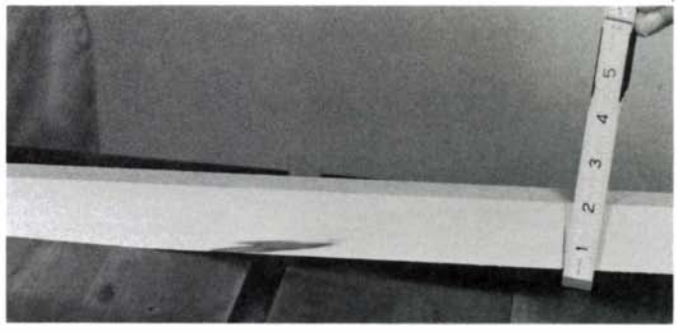
Now push the leaves in and locate the top in its correct position. Clamp it down to the leaves and mark the location of the guide holes on the underside of the top. Then drill and glue two 3/4-in. dowels into these holes. The dowels should be about 2-1/4 in. long, since the top has to move up a full 3/4 in. while the leaves are being extended.

When you push the leaves back in you have to lift the tabletop. To prevent scratches that would result from the tabletop sliding on the leaves, I glued two strips of felt to the bottom of the top. Use hot hide glue or rubber cement.

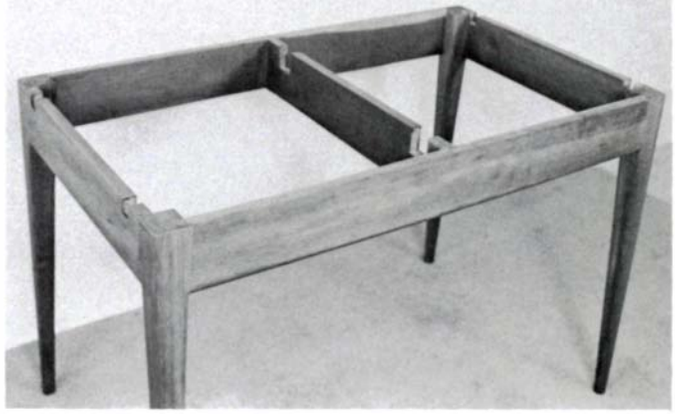
Contributing Editor Tage Frid is professor of woodworking and industrial design at Rhode Island School of Design.



Ripping the taper: Jig guarantees four identical slides.



Push taper flat to measure depth of slot at center support line.



Slots for slides are cut in aprons, center support.

Tall Chests

An appreciation

by Lester Margon

It is remarkable that so many cabinetmakers from various sections of the Colonies gathered in Philadelphia during the latter part of the 18th century. The roster includes such famous names as Thomas Affleck, William Savery, John Gillingham, Benjamin Randolph, Jonathan Shoemaker, Jonathan Gostelowe and a long list of equally skilled artisans. These men worked independently, but produced furniture of similar design and tremendous proportions. The result was a Chippendale-inspired school that was so firmly knit it seems as if they worked together. They made tall cabinets, secretaries, desks, mirrors and dining and living room furniture. But their greatest achievement was the highboy and tall chest of drawers, pinnacles in the history of cabinetmaking.

This extraordinary explosion of talent began around 1680 when William Penn squired a group of craftsmen from the Rhine Valley who settled near Philadelphia. These artisans were not willing merely to copy the European prototypes. They considered them too detailed with many intricacies that were foreign to the free-thinking conceptions of the colonists. Their work was of highest quality, even surpassing their contemporaries in England, and Philadelphia became one of the world's principal centers of cabinetmaking.

One of the foremost Philadelphia cabinetmakers was Thomas Affleck, a Scott, who was trained in England and emigrated to America in 1763. He made furniture for many wealthy and important people, among them the governor, who bought Affleck's beautiful Chinese Chippendale furniture. Affleck was the paramount figure in the cabinet and chair-making crafts and the leader of the Philadelphia Chippendale school.

Dozens of pieces of furniture have been attributed to Affleck. Today his work is considered the finest example of the Philadelphia Chippendale style. During the Revolution he sympathized with the Royalists, but this did not seem to affect the continued demand for his furniture. The important thing was his ability to produce elegant furniture for the stately manor houses then being built.

After Affleck's death in 1795, his son Lewis advertised in the Philadelphia papers that he would carry on in his father's shop. However, Lewis was not successful and soon gave up.

In the latter part of the 18th century, as people became affluent, the manor house found favor in the cities. This stately classical form of architecture featured living-room ceilings that reached a height of 10 ft. or more. The cabinetmakers of the day tried to satisfy the increasing demand for elegant furniture to fit into these interiors. One result was the high chest, which often reached 9 ft. tall, including the carved center ornaments. These cabinets contained many drawers to hold the necessary service articles for gracious entertaining. The demand for these highboys was tremendous and as they became the center of attention in the fashionable living room, their prices became astronomical. This trend continues today: A highboy recently brought $40,000 at auction. The appraised value of the original Kittinger high chest, which some experts attribute to Affleck and now part of the Yale University collection, is $100,000.

Each part of these Philadelphia highboys was expertly made. Aprons were fashioned in cyma curves; stretchers flowed in graceful lineation. Flowers, rosettes, urns and principal pinnacles were exquisitely turned and often included graceful cartouches. Featured at the top of the crown were

This impressive Chippendale-style chest-on-chest, now part of the Philadelphia Museum of Art collection, is attributed to Thomas Affleck, c. 1775. The bonnet top features a double scroll with pierced fretwork. At the center, an arrangement of oak leaves and acorns grows out of a basket. The flamelike pattern of the mahogany veneer is particularly elegant.

pediments perforated at the center to receive flaming torches, turned finials, baskets of flowers or perhaps the bust of a fair lady. Chippendale fretwork was often applied around the upper portion along with carved festoons, drapery effects and stalactites. Pilasters were fluted and corners chamfered or decorated with carved flowers and leaves.

Caribbean mahogany was perfect for carving and the Philadelphia cabinetmakers were masterful carvers. The precise scale and placement of the carving was a matter that received careful study. Restraint was mandatory. Carving is like the icing on a cake: It must be just right or it will appear superfluous.

Lester Margon, 85, is the author of five books on American furniture. His More American Furniture Treasures, *Architectural Book Publishing Co., New York, 1971, contains measured drawings of the tall chests pictured here.*

This high chest from the collection of the Museum of the Rhode Island School of Design is also attributed to Thomas Affleck, c. 1765. The two applied carved panels on the drawers at top and bottom contain concave shell carvings for depth. Convex shell carvings appear at the knees of the cabriole legs.

Tall Chests

The art of proportioning

by Timothy Philbrick

As colors can evoke emotions within us, or combinations of notes and tempos suggest joy or sorrow, so can proportions in furniture produce a desired effect on viewers. Objects built to the same proportions, although different in period, style and composition, can still evoke similar reactions. Proportions set up and define the framework within which the furniture maker expresses himself. The very selection of proportions, or lack of selection, affects the success of the maker's intention as perhaps no other single factor can. In furniture studies, the often-used term "integration of design" must be explained in proportional terms, as well as in terms of structure and decoration.

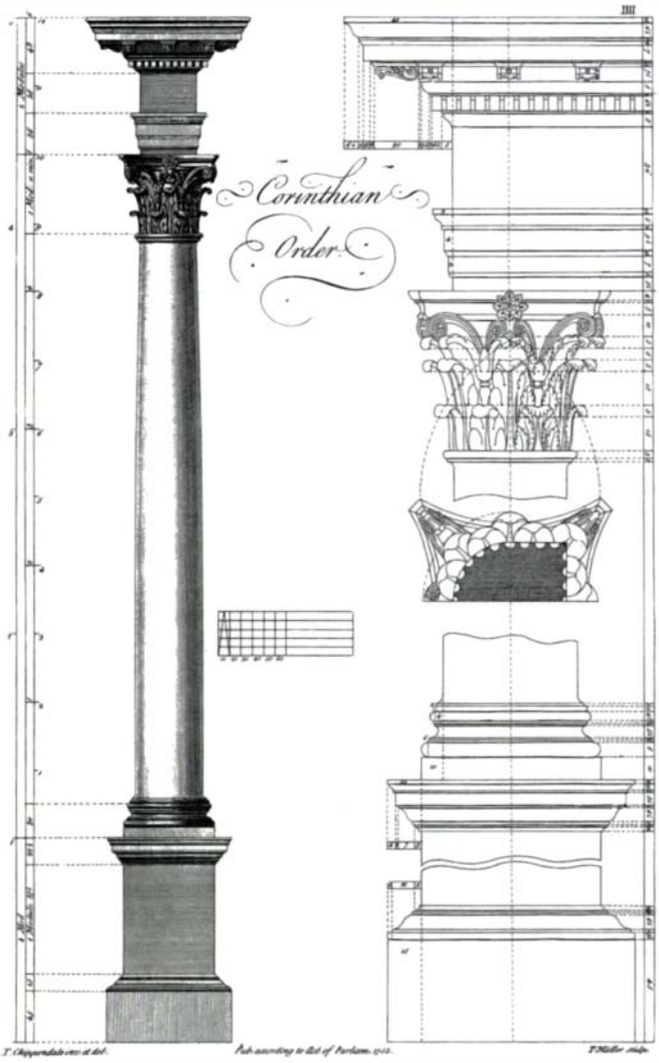
The esthetics of proportion is today a lost, or at best a well-hidden, science because of the current clinical separation of science from art. The following investigation is an attempt to uncover proportioning systems used by 18th-century cabinetmakers. It should be of use to designers and connoisseurs today.

Most texts on 18th-century furniture contain comments such as, "The old workmen had an instinct for good design." Their authors assume that master cabinetmakers and craftsmen had some mysterious, built-in instinct for proportioning. While this may be true of some country cabinetmakers, great design is not just a "feeling," but a carefully planned and consciously applied system of relationships, learned in a rigorous apprenticeship to an old tradition.

Proving that a system of proportions has been deliberately applied in a piece of furniture is no easy task. In studying a piece of furniture, one can easily be misled into finding those ratios one sets out to find. Unfortunately, little research has been done on the subject and few written records of proportioning systems exist. Ratios were passed on verbally during the cabinetmaker's seven-year apprenticeship. The phrase "Art and Mystery of the trade," seen in the apprenticeship contracts of the period, refers to the study of proportions and geometry, together with skills and techniques. Unfortunately, the "Arts and Mysteries" were a verbal tradition and are now extinct.

Naturally, all furniture has some proportions in common for it must conform to the proportions of the human body. If furniture is to be functional sculpture, its height must relate to its purpose and this measurement will serve as a starting point in calculating proportions. The Danish furniture de-

Timothy Philbrick, 25, is studying furniture design for a certificate of mastery at Boston University. He has served a five-year apprenticeship restoring and reproducing 18th-century furniture and owns a cabinet shop in Narragansett, R. I.



The Corinthian order, from Chippendale (Dover reprint, 1966). Column is scaled in 'modules' that equal its diameter, moldings at right are dimensioned in sixtieths of a module.

signer Kaare Klint has defined optimum chair height at 16 to 18 in., table height 28 to 30 in., standing working height 40 to 42 in., maximum vision height 54 to 56 in., and maximum reach 76 to 84 in. These measurements are not new; they served the 18th century as well as modern society.

Great American high-style furniture designers also used traditional proportions long known in buildings, paintings and furniture. Whole numbers have been important since classical times: Whole numbers and their simple relationships (1:2, 2:3, 3:4, 4:5, 5:6, 6:7, etc, and 3:5 etc) were the expression of perfection and, therefore, the divine. These simple relationships have been the framework for a vast amount of artistic creation. The medieval artist had little mathematical knowledge, but knew well how to use his compass, so the basic division of the square and circle naturally was his proportioning vocabulary.

As Arabic geometry began to permeate the decorative arts of the 13th century, the tools for the Renaissance were provided. A reverence for geometry and mathematics as the ultimate expression of perfection was even more pronounced. The basis of the Renaissance desire for simple, measurable relationships was the concept of universal proportions. These concepts from Renaissance Italy first began to affect American furniture in the late 17th century in the William and Mary style. The major dimensions are made divisible by a common integer, 5 or 6 usually, in the basic combinations of 2:3, 3:4, and 4:5. Press cupboards for example, tend to be in the ratio of 4:5, width to height (e.g., if the width is 48 in., the height is 60 in.). In the early 18th century, with the advent of the Queen Anne style, visual proportion and geometric ratio are expressed in both furniture and architecture. In Queen Anne chairs, for example, heights to widths of backs, and heights of legs to widths of seats are directly proportional.

The Chippendale style

In the second half of the 18th century, an increasingly pervasive emphasis was placed on the importance of classicism. From James Gibb's *Rules for Drawing the Several Orders* (1731), Chippendale's *Director* (1754) and *The Carpenter's Co. of Philadelphia 1786 Rule Book*, to the work of Thomas Sheraton (1791-1794), the proportions of the five classical orders of columns became one of the most widely written-about topics. Thomas Chippendale, in his introduction to the first edition (1754) of his *Gentleman and Cabinet-maker's Director*, says: "I have prefixed to the following designs a short explanation of the five orders. These ought to be carefully studied by everyone who would excel in this branch, since they are the very soul and basis of his art."

Chippendale felt these orders and their proportions important enough to devote the first eight plates of his book to drawings and descriptions of their proportioning. Throughout Chippendale's work, emphasis is constantly placed on the ratio of height to width. Even the contours and form of moldings are worked out by a specific system. In Chippendale's drawings Rococo decoration and ornament are united with disciplined geometrical principles.

In the work of Thomas Sheraton, classical proportion is given an even more elaborate role. His drawings, like Chippendale's, are presented in a precisely proportioned framework. His introduction informs us that the first part of his book "provides the workman with geometrical lines applied to various purposes in the cabinet branch, (which) can not be subject to alteration any more than the principles of reason itself." The first 146 pages of Sheraton's *Drawing Book* are devoted to geometry, including 30 pages on the five orders; the remainder are studies of perspective, showing how to obtain working measurements from perspective drawings.

The importance of the five orders to these men is hard for us to understand today. Sheraton explained it this way: "Many cabinetmakers are found desirous of having a knowledge of the five orders, and the proportions of the several frontispieces...I believe that the orders are now brought to such perfection in their proportions as will bear the strictest mathematical examination...I consider them incapable of improvement." He also wrote that nothing more worthy can appear in a drawing book and that a knowledge of these moldings and proportionings is necessary to any man of culture and to all craftsmen.

The golden section is probably the most ancient and widely revered proportional system. It has been used for such diverse purposes as establishing the date of Easter and proportioning Jacques Villon's paintings and Le Corbusier's buildings. In antiquity, Egyptian and Druid builders alike used the golden section to plan their temples and to proportion other artwork. The golden section represents the division of a line into two parts such that the smaller part is to the larger as the larger is

to the whole. In the diagram below, BC:AB = AB:AC. The geometrical division of a line into these proportions is fairly

straightforward with compass and rule. But if the length BC = 1, algebraic determination of the length AB requires solution of a quadratic equation and produces an endless decimal whose first few terms are 1.61803. A rectangle with sides 1 and 1.618 is known as the golden rectangle. Among its many interesting properties is the fact that if a square is cut off one end, the smaller rectangle that remains is the same shape as the original, that is its short side is still related to its long side as 1 is to 1.618. For most practical purposes, the golden section may be expressed as the ratio 5:8.

Great mysticism surrounded this proportion until recent times. Described as being like God because it is unique, and like the Trinity in that it is one proportion in three terms, the construction of the golden section has always been among the secrets of the Masonic Guilds. Gibbs, Hogarth, Burlington, Thornhill, Washington, Jefferson, Harrison and many other famous men of the 18th century were Freemasons, an order which still claims to have preserved through the ages the secrets of perfect and ideal proportions.

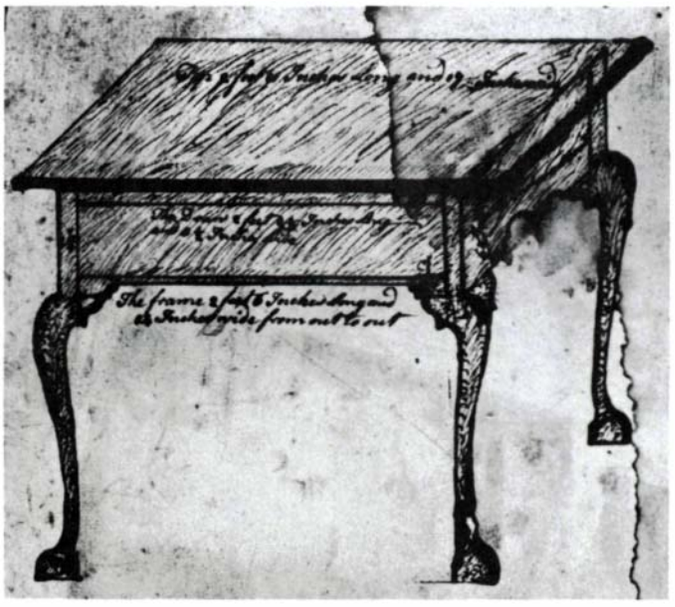
One of the few surviving records of an American cabinetmaker's predetermination of proportions is found on an unclear sketch by Samuel Mickle, who was apprenticed to Philadelphia cabinetmaker Shoemaker in 1765. On the sketch is the notation, "The Heighth of ye Book Case is 3:6 inclusive of ye top, ye width of ye Book Case is 3:5." It is difficult to know just where and how the cabinetmaker is applying these proportions from this cryptic bit of information. However, this sketch stands as a major document, for it conclusively proves the consideration of proportion in the design of a piece of furniture.

Examples of proportioning

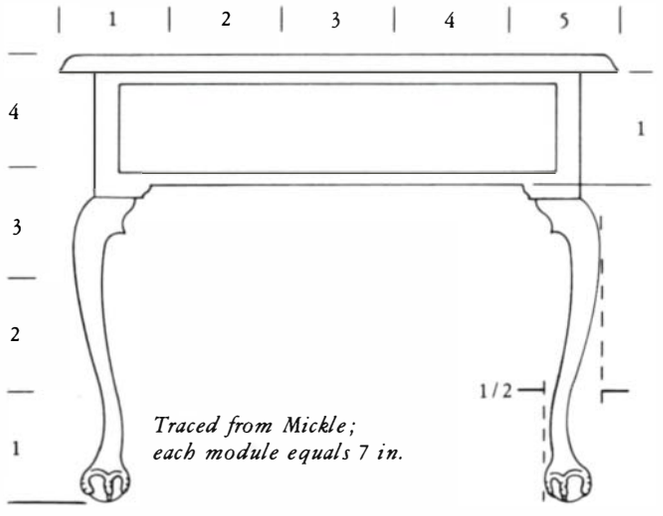
In the following study, two drawings from Mickle's sketchbooks and three 18th-century American highboys are examined for proportional relationships. In looking for such relationships, one should not expect to find absolute mathematical precision: A drawing is flat and a pencil line has no thickness, while wooden furniture exists in three dimensions and every piece of wood has thickness. Thus a proportional scheme worked out on paper, no matter how elegant, can't be exactly translated to solid wood. In sketching a piece of furniture, the cabinetmaker would first set up a proportional framework, then detail the drawing within the grid. Once the cabinetmaker has chosen his proportions, nothing compels him to follow them rigidly. Variations would be made for esthetic reasons, and to solve mechanical problems.

Confusion also occurs because immigrant cabinetmakers trained in different national traditions would have used different reference points to set out their proportions, and the style of furniture made in 18th-century Philadelphia would not be exactly the same as that made far away in Newport, R. I. It is nonetheless remarkable that so many definite relationships that reduce to small, whole-number ratios can be found within each piece, and can be found in common among several fine antiques.

I believe the examples on this page and the following two pages demonstrate that 18th-century artisans were well aware of proportions, and provide sufficient evidence for serious



Chippendale dressing table, from Mickle sketchbook, 1765. Handwritten notes are transcribed in the text below.

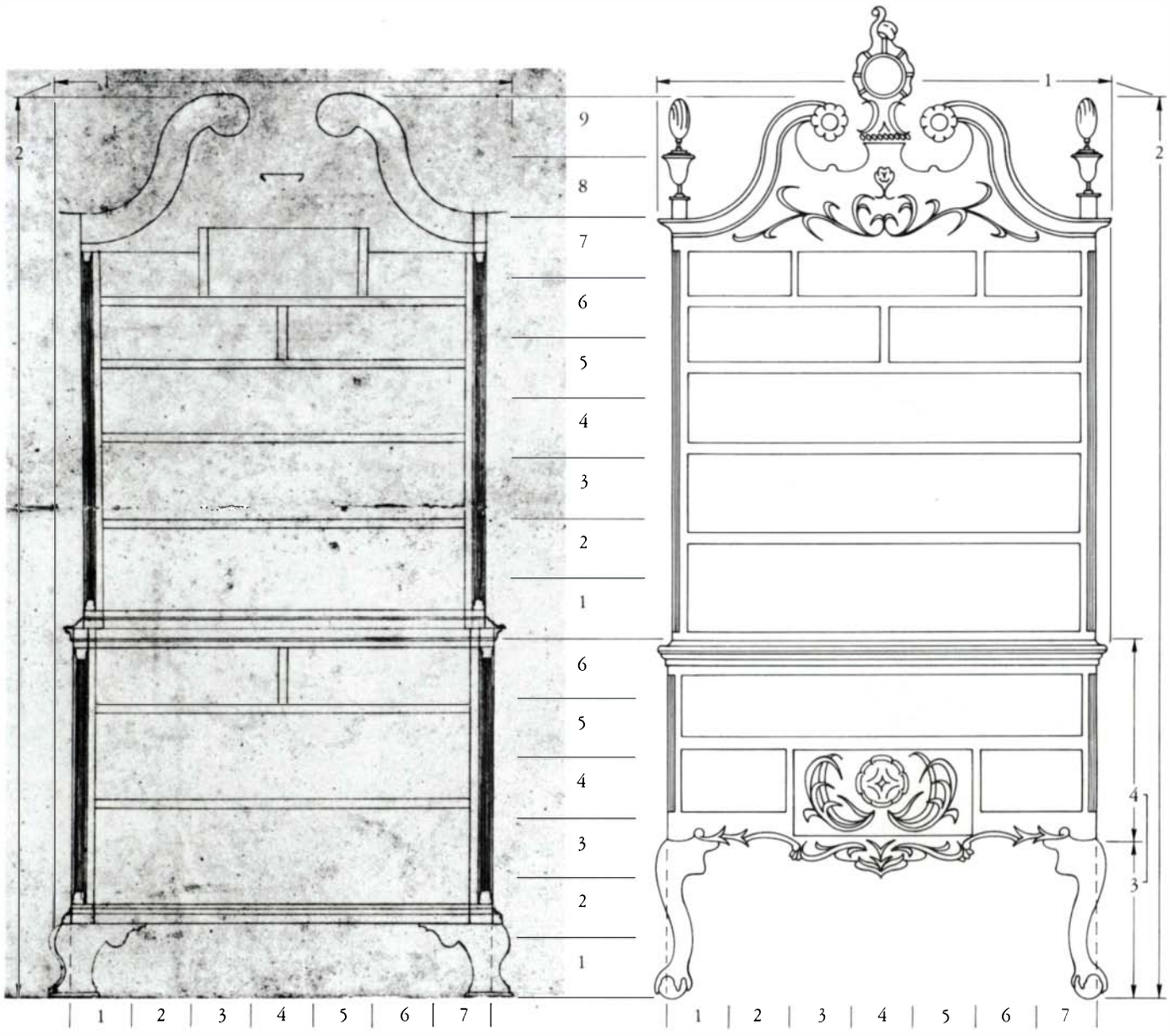


contemporary study. I cannot describe my own excitement, after studying an antique for several hours and measuring from many points, upon suddenly seeing a relationship.

The photograph above, of a page in Mickle's sketchbook (Philadelphia Museum of Art, gift of Walter M. Jeffords), shows a Chippendale dressing table. The front elevation has been traced from the original to display the proportions. Mickle's notes say, "Top 2 feet 11 inches long and 17-1/2 inches wide; the draw 2 feet 3-1/2 inches long and 5-1/2 inches wide; the frame 2 feet 6 inches long and 24 inches wide from out to out."

The drawer width, 5-1/2 in. added to the 3/4-in. thickness of the rails above and below it, produces a module of 7 in. The principal dimensions of the table may be expressed in terms of this module.

The top is 35 in. by 17-1/2 in., or 5 modules by 2-1/2 modules, a 2:1 ratio. The table is 28 in. high (4 modules); its height to its width is as 4 is to 5. The legs are 3-1/2 in. wide, half a module, and thus the height of the table is to the width of the leg as 8 is to 1, exactly the same as the classical Corinthian column pictured on the opposite page.

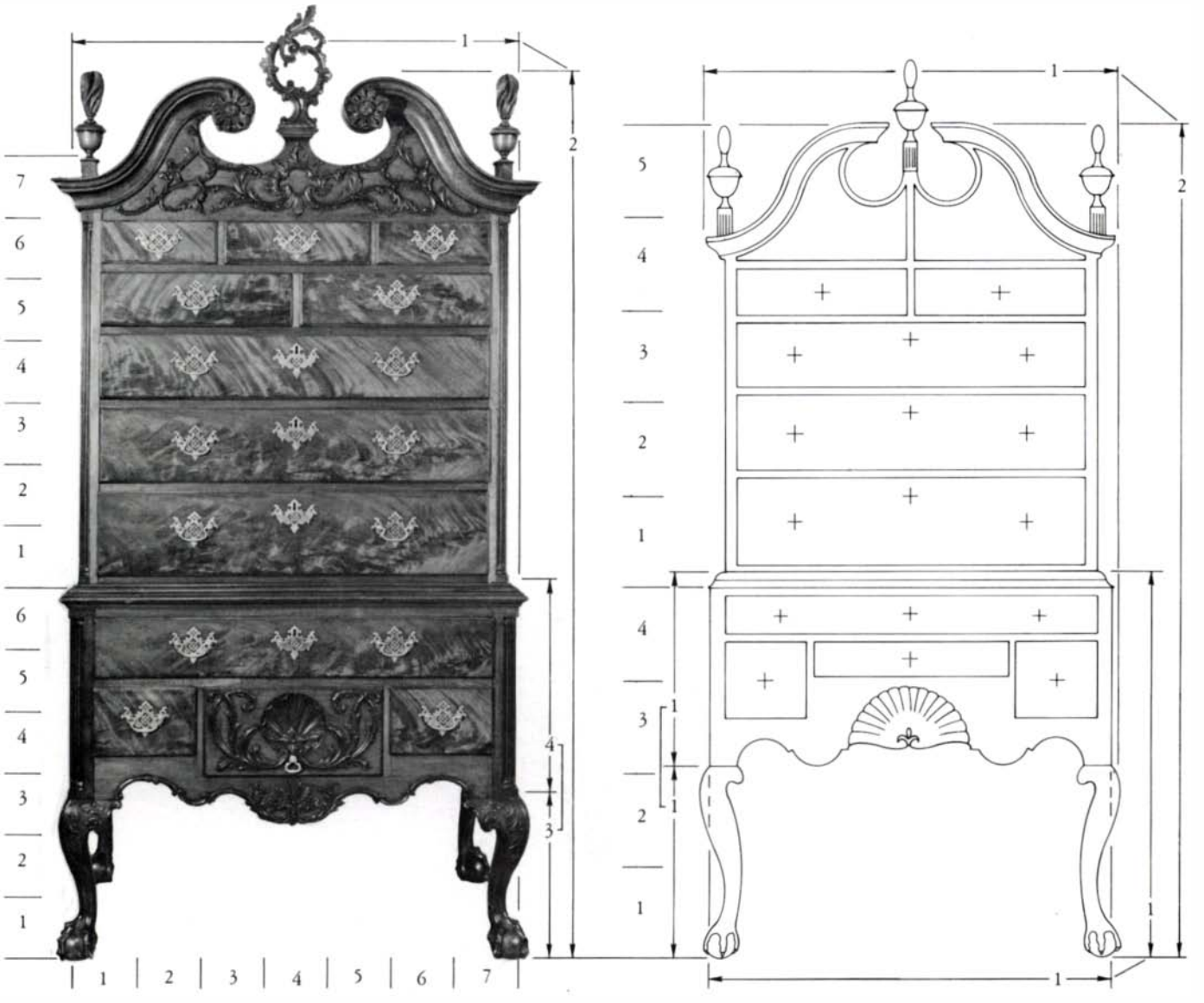


The exactly proportioned front view of a handsome chest-on-chest above is also taken from Mickle's sketchbook (Philadelphia Museum of Art). The original was drawn at 3/32 in. to the inch. The overall height of the chest (from the floor to the top of the pediment) is 90 in.; the overall width (measured at the knees) is 45 in.—a 2:1 ratio. Within this rectangle are two boxes, defined by the mid-molding. The lower chest is 36 in. high, 42 in. wide (from the sides) and 21 in. deep (from an auxiliary view). The upper chest is 42 in. high from molding to cornice, 54 in. high to the top of the pediment, and 40 in. wide. Thus the lower chest is twice as wide as it is deep, and its height is related to its width as 6 is to 7. The upper chest is exactly as high as the lower chest is wide, which is to say the height of the upper is to the height of the lower as 7 is to 6. The height of the upper chest, including pediment, is related to the height of the lower chest to the mid-molding as 9 is to 6, or 3:2. The width of the chest has been divided into seven equal parts (a module of 6 in.) and the height has been stepped off in the same increments.

This drawing, because of its authenticity and lack of confusing detail, is an excellent subject for speculative exploration with a pair of dividers and a scale. For example, the height of the legs is just half the height of the curved braces that form the pediment, and very close to twice the height of the cluster of moldings and rails that divides the chest. The height of the feet plus the bottom moldings is the same as the height of the bottom drawer front. And each drawer front, plus the rail on which it sits, is just as high as the drawer front below it, without rail, except at the mid-molding itself.

The front-view drawing above is a photo tracing of the majestic Philadelphia highboy pictured on the magazine's front cover (Yale University Art Gallery, Mabel Brady Garvan collection). It is the original of the well-known Kittinger reproduction and has been appraised at $100,000. Its dimensions and basic proportions are virtually identical to those found in the Mickle drawing: overall 90 in. high and 45 in. wide, a 2:1 ratio. The lower chest is 43 in. wide, 21-1/2 in. deep (2:1) and 36 in. high (width-to-height is almost 7:6); the upper chest is 42 in. high to the cornice and 42 in. wide (1:1), and the upper chest is exactly as high as the lower is wide. The upper chest from mid-molding to the top of the pediment is 54 in., as in the Mickle drawing, a 3:2 ratio to the height of the lower chest. Each increment along the bottom and left side represents a 6-in. module.

Furthermore, the legs are 15-1/2 in. high and the lower case is 20-1/2 in. high, a ratio of 3:4. The small lower side drawers are each one-quarter of the total width between the corner posts, and the central carved drawer is just as wide as the engaged fluted quarter-columns are high. The drawers in the upper case progress as before: Each drawer front, plus the rail on which it sits, is as high as the drawer below it.



The photograph above is of yet another revolutionary-era Philadelphia highboy (Museum of Fine Arts, Boston). At first glance this antique chest appears identical to the previous one, but close examination reveals that not only does it differ in details of ornamentation, but also it is a full 4-1/2 in. shorter. Yet if the overall measurements are taken at the sides of the base rather than at the mid-molding, the proportional scheme is virtually identical. For while the chest is only 85-1/2 in. high, the base is 43 in. wide (2:1) and 21-1/2 in. deep (also 2:1). The height of the base is 36 in., as before a ratio of almost 6:7 to its width, and the height of the leg is related to the height of the lower case as 3 is to 4. The upper chest is 41 in. high to the cornice and 41-1/2 in. wide, a virtual square; its height measures 49-1/2 in. from the mid-molding to the top of the pediment, very close to a 4:3 ratio to the height of the lower chest. If the width of the lower chest is swung up vertically from the mid-molding, it lands at the base of the finials and at the bottom of the pediment cut-outs, while before it landed at the cornice itself.

The central carved drawer is 16-3/4 in. wide and the fluted quarter-columns are 16-3/4 in. high. And once again the drawer fronts seem to progress: Each front, plus the rail on which it sits, is as high as the drawer front below it.

Finally, the photograph of a 1760 Newport highboy at right (Museum of Fine Arts, Boston) has been converted to a photo tracing, above. While this chest is quite different from the Philadelphia examples, and at 81 in. high is smaller, proportional relationships can still be found. Its overall width at the knees is 40-3/4 in., the usual 1:2 ratio to overall height. But here the similarities end. On one hand, the mid-molding can be considered part of the base, as in the Philadelphia chests, giving a base height of 37-1/2 in. The lower case is 39 in. wide, a height-to-width ratio very close to square, and the leg height, 18-1/2 in., is about half the base height. On the other hand, the mid-molding is actually fastened to the upper case and therefore may be considered a part of it. This assumption makes the base the usual 36 in. high, and the upper case 45 in. high, a 4:5 ratio.

Furthermore, notice that the pediment is three times as wide as it is high, the lower drawers are as wide as the upper case, the small square drawers are a fifth as wide as the case, and the upper drawers follow the familiar progression.

Entry Doors

Frame-and-panel construction is sturdy, handsome

by Ben Davies

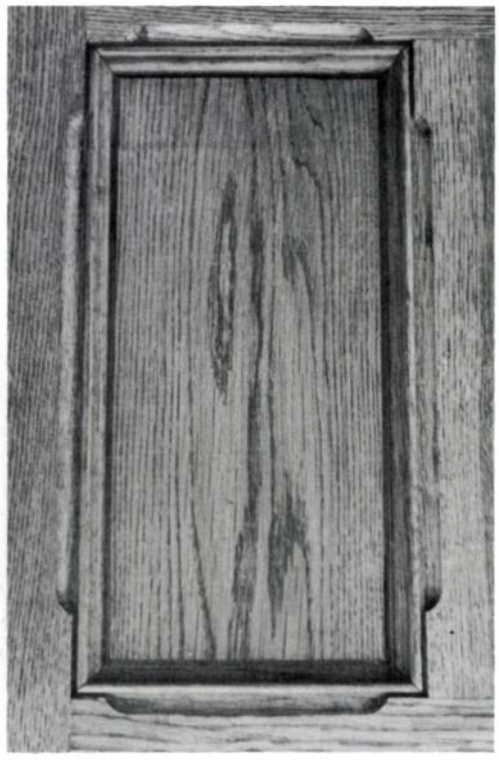
Exterior doors are the problem child of architectural design. They are required to perform three functions: seal off an opening from the exterior air, open to allow passage and then reseal, and be attractive. All this from wood, a material that can change in size as much as an inch over the width of a typical opening. While each of these functions might be separately accomplished with ease, their combination into one design creates problems.

Single-panel board-and-batten constructions of edge-glued lumber are generally too unstable for exterior doors. They cast or wind unless great care is taken in the selection and seasoning of the lumber. They also expand and contract so much with the seasons that sealing against the weather is impossible. These shortcomings can be overcome by using frame-and-panel construction and, in fact, most doors are made this way. The style is relatively stable and offers great flexibility of design. Even the familiar commercial veneered doors are a variation of the frame and panel—the panel is reduced in thickness to veneer and glued over the frame rather than inserted into grooves, and cardboard honeycomb or wood cores support the veneer. These doors succeed admirably in the first two functions a door must perform, but fail miserably at being attractive.

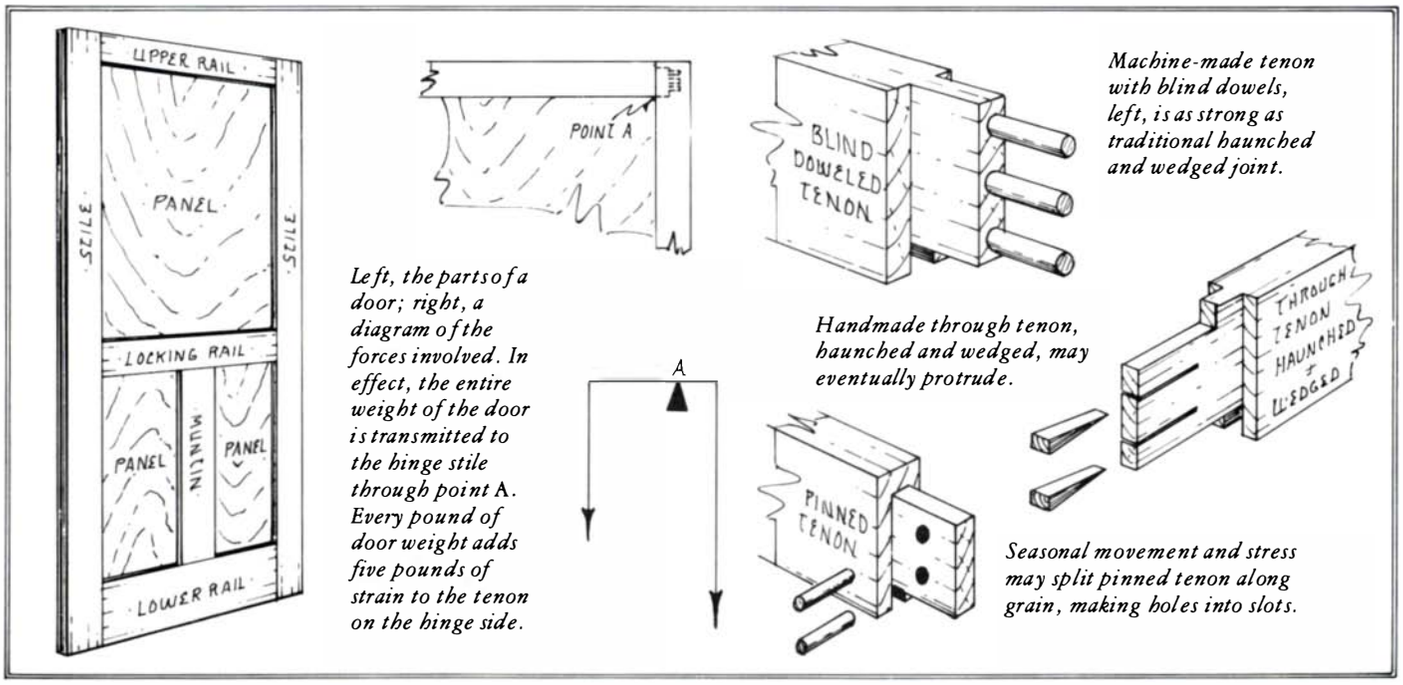
The frame-and-panel door has been in use for so long that its construction is well understood, and variations on its designs have been thoroughly explored. When any construction method remains dominant for hundreds of years it can mean only that it works quite well.

The standard size for entrance doors of new construction in the United States is 3 ft. wide by 6 ft. 8 in. high. A walnut door of this size can weigh 80 lb. to 100 lb. or more, depending on the thickness of the panels and the amount of glass. This is considerably heavier than a softwood or hollow-core door of the same size, and great care must be taken to ensure that the joints are well designed and well constructed.

I have seen a number of doors fail that were constructed



Routed sticking stops short of corners in raised-panel door, left, but continues around corners of flat-panel door, center. Both are Honduras mahogany. Detail from oak door, above, shows routed sticking combined with molding.



Left, the parts of a door; right, a diagram of the forces involved. In effect, the entire weight of the door is transmitted to the hinge stile through point A. *Every pound of door weight adds five pounds of strain to the tenon on the hinge side.*

Machine-made tenon with blind dowels, left, is as strong as traditional haunched and wedged joint.

Handmade through tenon, haunched and wedged, may eventually protrude.

Seasonal movement and stress may split pinned tenon along grain, making holes into slots.

with a mortise-and-tenon joint pinned through the cheek with dowels. A stronger joint is one with blind dowels inserted into the end of the tenon and bottom of the mortise. I use a 3-in. deep mortise and tenon with three or more 1/2-in. diameter blind dowels to join the stiles with the rails. Interior parts of the frame, such as muntins, are joined to the rails with smaller tenons, usually made to fit the groove cut for the panels, and are also blind-doweled. For flat panels I ordinarily use a 1/2-in. deep groove in the rails and a 3/4-in. deep groove in the stiles. This difference is to compensate for the greater shrinkage that occurs across the grain of the panels.

Several factors make blind dowel pins preferable to through-the-cheek pins. The first is visual. Dowels through the cheek are often chosen because they give the same sense of rigidity to frames as dovetails give to casework. While they do make a door look sturdy, the time will surely come when that particular effect is not wanted.

More importantly, I believe the blind-doweled tenon to be stronger than one pinned through the cheek. A tenon with blind dowels need not be haunched because the dowel pins not only make the tenon effectively longer, but also transform a stub tenon into a haunched tenon. Thus the glue area of the tenon becomes about one-third greater. And a stub tenon can be made more quickly than a haunched tenon.

Dowels perform two main functions. One is to prevent the tenon from sliding out of the mortise and the other is to counteract the bending moment of the weight of the door about the point where the tenon enters the stile. The lever arm through which the through-the-cheek dowel must act is necessarily about 3/4 in. shorter than that of the blind dowels. In a 3-in. tenon this difference translates into 25% greater strain on the pins. It is very important to understand that on a 36-in. door with stiles 6 in. wide, every pound of door weight adds about 5 lb. of strain to the dowels on the hinge side of the door. The wider the door and the narrower the stiles, the more intense the leverage. The maximum length of a through-the-cheek dowel is the thickness of the door, while the blind dowel can be twice as long as the width of the stile minus the tenon length. The extra dowel length is significant because part of the glue line between the dowels and their holes is end grain joined to long grain.

I have not discussed the through wedged tenon because this joint must be made by hand, a relatively time-consuming operation. However, the joint is strong, although in the long run the tenon will protrude slightly from the stile.

The total strength of a blind doweled mortise-and-tenon depends on two factors: the shear strength of the glue line that joins the cheek of the tenon to the wall of the mortise, and the lesser of the tensile strength of the wood in the dowels and the shear strength of the glue line around the dowels. The dowel joint is strongest when the outside dowels are as far apart as possible without getting so close to the end that the tenon is split by hydraulic pressure from the glue.

A mortise and tenon can be strengthened by increasing the size of the tenon, thereby increasing the glue area. The thinness of the glue line is also quite important—the thinner the better. The smoother the walls of the mortise and the sides of the tenons, the better the adhesion of glue to wood. I use a chain mortiser to make the mortise, and for the tenons, either a tenoning jig on the table saw or a single-end tenoner, which cuts with a cylindrical head like a jointer. But the tools used are not as important as getting a close fit.

While the decline and fall of Western civilization is widely anticipated, these things do take time, and until the event actually occurs there are few circumstances in which a door will be exposed to moisture other than that which is in the air. Therefore I generally use aliphatic resin (yellow) glue on doors that will be protected by a porch. This glue has worked out well in practice. In order to be classified "waterproof," a glue joint must withstand boiling water for some hours without losing strength. If you plan to boil your doors, phenol resorcinol glue is what you want. No matter what glue is used, be sure to seal both ends of the door with polyurethane varnish, even if the door is to be delivered unfinished. This is often neglected by the painter.

Wooden panels for a door can be flat or raised. Raised panels are somewhat easier to fit, because with flat panels the fit

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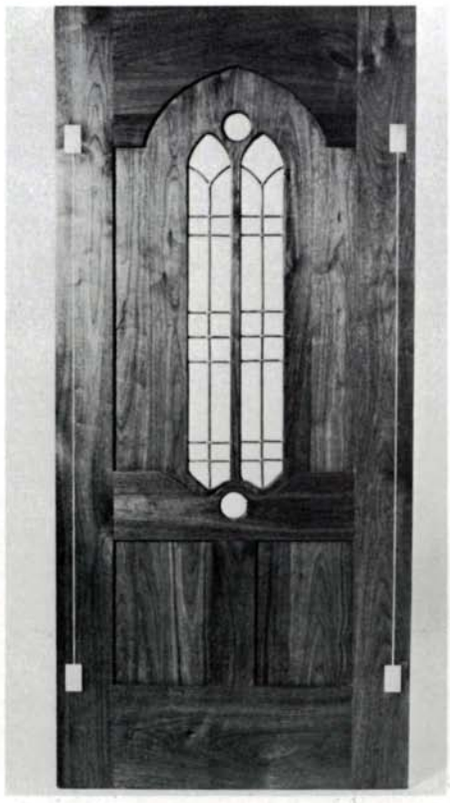
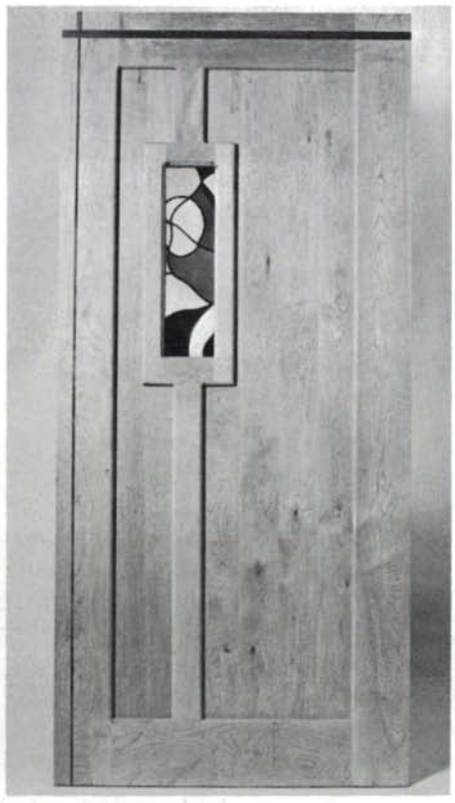
Ben Davies makes doors and furniture at Muntin Woodworks in Chattanooga, Tenn. He has taught philosophy.

Federal law requires manufacturers to use tempered glass, but permits leaded glass panels as long as no single piece of glass is larger than 30 sq. in. and no opening is large enough to pass a baseball. Beveled octagonal glass, left, is a framed panel within a panel.

must be precise—very nearly tight enough to split the stile or rail but not so tight as to actually do it. Something can be gained by slightly tapering the edge of a panel by a hand plane or belt sander but this requires a very light touch. Any irregularity or dip left by the plane will show up distinctly where the panel enters the frame. When using panels of glued-up stock, it is a good idea to design the door so that no panel is wider than about 12 in. This is particularly true where there is a cutout in the center for glass. If the panel and glass fit tightly, the wood of the panel may split at its narrow point when contracting, rather than moving in its grooves. Of course, don't fragment a design just to obtain narrow panels.

If a wide panel is necessary, flat-cut veneer over plywood will give great stability. Or large panels themselves can be made up as another frame within the frame of the rails and stiles, if the changing grain directions do not do violence to the design. A number of coats of polyurethane varnish on the door will inhibit the transfer of moisture from wood to air and reduce the shrinkage-expansion oscillations.

Often an integral part of the doors I design is a piece of stained glass that is curved or in some other way not rectangular. Installing the glass in the irregular opening can be a problem. The easiest solution is to let the glass into a groove when gluing up the door, in the same manner as for a wooden panel. This is quick and convenient, but impossible to repair. It is best to avoid this method unless the door is going to lead a quiet life in the interior of a mausoleum. Gentle curves can be glazed with moldings of steamed wood. First, a rabbet is cut with the router, then the glass is bedded in glazing compound, and finally the molding is steamed and put into place. I sometimes make a virtue of the necessity for fasteners to hold the molding and work brass screws into the design. Silicone caulk is excellent and long lasting, but it is also a glue and the window will have to be cut loose with a razor blade if it has to be removed. If curves are too acute for steam-bent wood, an extremely flexible brown plastic panel retainer can be used. It is available from Minnesota Woodworkers Supply, Rogers, Minn. 55374.

If neither steam bending nor plastics is appealing, you can use the band saw or sabre saw to cut a molding out of solid stock to fit the line exactly where glass and wood meet. This works well, but is time-consuming. Leave the stock 1/2 in. or more thick, make the cutout, then fashion some detail on the edge complementary to the sticking (the shape cut into the inside edge of the frame) on the door.

The sticking on all commercial doors is done so that the detail runs the full length of the stile. Its mirror image, called the cope cut, is then made on the shoulder of the tenon. The corner resulting when the door is assembled is a crisp line, much like that made by mitered molding.

The most economical way for a small shop to make these cuts is with matched coping and sticking cutters for the shaper. Knives can be purchased with standard copes and stickings already ground and many companies will grind a set to your specifications. I use a single-end tenoner with cope heads, which is somewhat more cumbersome to set up than the shaper but has the advantage of easily cutting a tenon as long as 3 in. and making the cope at the same time. Also, matching beading and coping bits are available for the router, and one could fashion a set of wooden hand planes to do the job. Skill and patience with hand tools can make a joint as well as a ton of machinery can, and also will lead one in the direction of simpler, less cluttered designs.

Relying on sticking to provide the detail on the inside edge

of the frame works well if the panel design is rectangular and raised panels are used. However, when the design includes curved or flat panels, it is often better to eliminate crisp corners by cutting the sticking with a router after the frame is clamped up without the panels. The effect is to soften the corner, draw the eye away from the frame and emphasize the shape of the panels. Although subtle, the difference is important to the overall feeling of the door. Attention is diverted from the outline to the interior, for the most part unconsciously. Generally, soft corners are best suited to less formal designs, although this is not a hard-and-fast rule. Making use of this detail can be a powerful tool for the designer in trying to achieve a desired effect.

Moldings around the panels give a similar effect to conventionally cut sticking, but far more depth and detail are possible. The door can be made up with everything square and the moldings then glued into place. There is a problem here of wood movement, best solved by fastening the molding to the frame, leaving the panels free to expand and contract. Silicone-type glues will stretch a great deal while still holding their bond. Better yet, put the molding around the panel like a picture frame, with a channel or a tongue on its outer edge to fit to the door frame. No glue is needed to hold the panel or the molding in place.

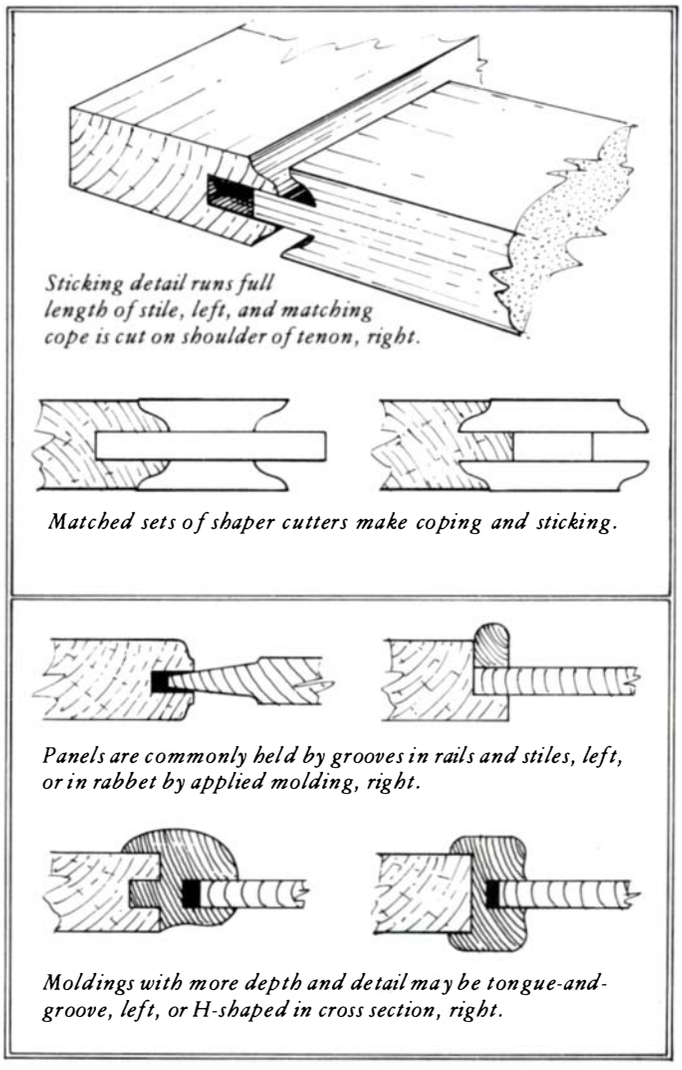
Lately I have been experimenting with a molding that is H-shaped in cross section, with excellent results. The open ends of the H are cut to fit the stiles and rails on one side, and to fit the thickness of the panel on the other.

It is difficult for me to say anything really useful about design because only its superficial aspects can be discussed meaningfully. Much nonsense is spoken and written in an attempt to intellectualize style and lump it together with technique. More often than not, good design is a matter of trial and error combined with the designer's ability to recognize those combinations of color and form that succeed and, just as important, those that do not.

A number of design techniques, although they will not generate successful designs all by themselves, are nonetheless helpful from time to time. One of these techniques is to use a geometric form where possible rather than a free form.

Beveled glass takes on a multifaceted gemlike appearance when used in openings that are regular or irregular polygons. These same polygons around a free-flowing piece of stained glass give a visual reference that controls the curves on its interior. I suspect this explains why Art Nouveau was less successful in architecture than it was on a smaller scale. Its paintings were bounded by rectangular frames and its small objects and furniture by rectangular walls. Its architecture had no regular boundary and consequently appeared grotesque. Descriptions of space will go where they will but the human mind is Euclidean. And why should these geometric devices not succeed? Much of the diversity and beauty found in nature has as its foundation the geometric, crystalline structure of inorganic materials. A designer can do a lot worse than to mimic nature. At least it helps avoid appearing contrived.

Another interesting tool comes from the arithmetic series 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, and so on. These are called Fibonacci numbers and each number in the series is the sum of the two preceding numbers. After the series has progressed for a while, the ratio between any two adjacent numbers stabilizes at 1.618. All this would be only of academic interest if someone had not noticed that the Parthenon fits neatly into a rectangle whose width is 1.62 times its height; that the exquisite, logarithmically spiralled shell of the chambered nautilus can be generated with this ratio; that the proportions of some of Leonardo da Vinci's paintings, as well as those of Mondrian, seem to be determined by this ratio. A rectangle of this proportion, known as the golden rectangle, is frequently used in art and architecture. It has obvious applications to both doors and casework. Of course we do not want every rectangle to have these proportions, but it can be helpful to know the relationship.



Sticking detail runs full length of stile, left, and matching cope is cut on shoulder of tenon, right.

Matched sets of shaper cutters make coping and sticking.

Panels are commonly held by grooves in rails and stiles, left, or in rabbet by applied molding, right.

Moldings with more depth and detail may be tongue-and-groove, left, or H-shaped in cross section, right.

These examples do not begin to scratch the surface. They are from one category of one mode of our awareness. That is, they are visual and oriented toward form. Within the visual mode there are also techniques for generating color and texture. And most often neglected are the other senses: smell, touch and hearing. The interplay and blending of techniques with a material as diverse in its nature as wood allows limitless possibilities for design.

And yet, when a door or piece of furniture succeeds, it is due to the designer's sensitivity rather than to manipulation and awareness of techniques. In much of the work where the golden rectangle has been found, the designer was unaware of the mathematics involved; the proportion just *looked* right. No doubt it is very easy to do a perfectly hideous piece based on the golden rectangle, or on any geometric figure for that matter. Techniques are just toys with which to play—they do not guarantee good design. Good design is simply done, not generated by formula.

The Right Way to Hang a Door

by Tage Frid

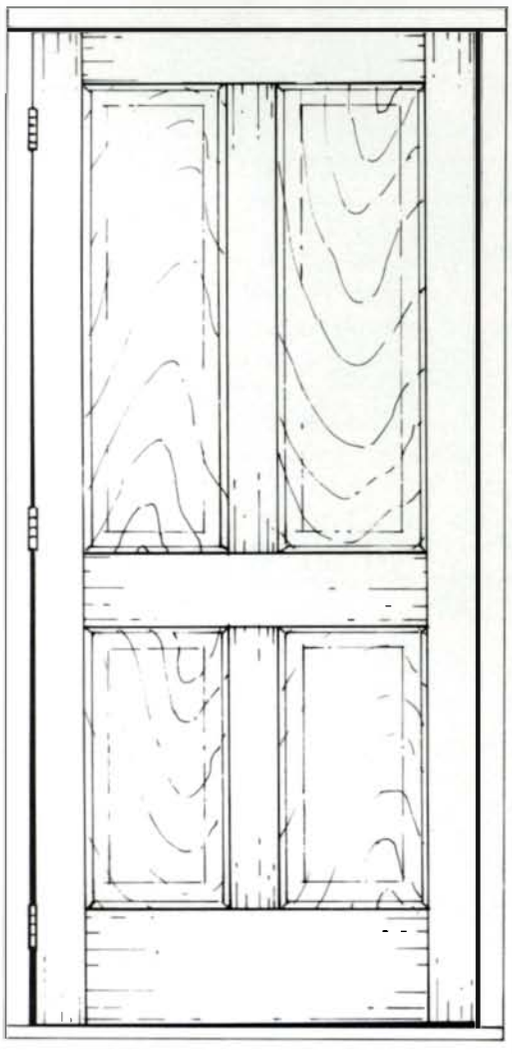
When I make a door I first make the doorcase (frame). I make the inside of the doorcase 3/16 in. larger in height and width than the door itself. If the door is to be painted, I allow a little more for the paint. I bevel the edges of the door a little toward the closing side, so that if dirt or paint should fill up the corners of the frame, the door will still close tightly.

If I am using two hinges, I place them approximately one-sixth of the height of the door in to the center of the hinge. With three hinges, I center one and move the other two out closer to the top and bottom. The hinges should be mortised half into the door and half into the frame. Here is where the mortising plane (*Fine Woodworking*, Fall '77, p. 18) comes in handy, as it will fit into the lip of the frame.

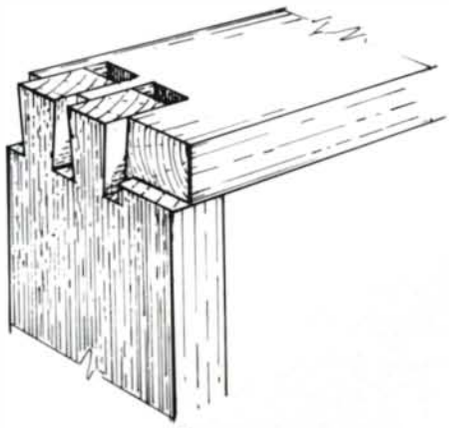
When fitting the hinges to the jamb, inlay the top hinge so that the door will fit tightly against the jamb when it is closed. But inlay the bottom hinge a little less, so there will be a gap of 1/8 in. or so in the back. Setting the hinges this way will leave the whole door cocked at a slight angle, which is much exaggerated in the drawing. The space will not be the same the whole way around. I do this because as a hinge starts wearing the door will begin to droop down. Hinges set as described will allow for this droop and the door will fit much better throughout the life of the hinge. It is especially necessary to do this with modern stamped and rolled hinges. You can see in old doors that haven't been hung this way the extent to which drooping occurs.

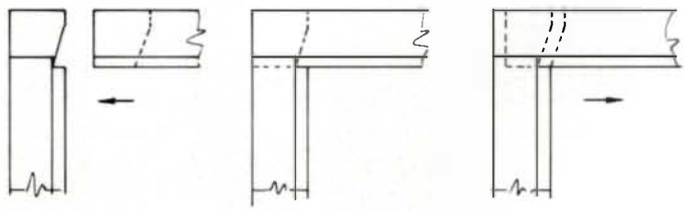
When I install the door frame I have all the hardware—hinges, locks, latches—already installed in the frame. I use wood shingles as shims to level the frame and fasten the hinge side first. Then I hang the door into the frame, close it and shim it until I get the spacing I want all the way around the door. Then I fasten the rest of the frame to the studs on the wall.

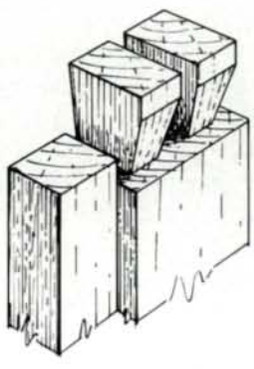
If I really want to do it right, I use a door-frame dovetail on all four corners, with the pins in the horizontal pieces. The joint is designed so that when you fit the door you can make the frame narrower or wider without a gap showing. Also, if the door should shrink or expand, I can take the outside molding off and wedge in or shim out the door frame to fit the door without getting a gap and without having to plane the door and refit the hardware. And this joint is much stronger than the usual method of nailing the corners together.

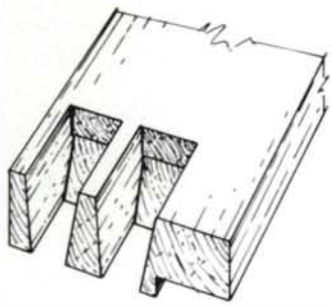


Door hung askew, here exaggerated for clarity, allows for droop as hinges wear. Door-frame dovetail makes opening adjustable without ugly gaps. Drawing at right shows joint in widest position; three sections below show joint going together, fully closed and fully open. Bottom sketch shows how sloping tails on vertical pieces fit undercut between pins.









Drawer Bottoms

Six variations on a theme

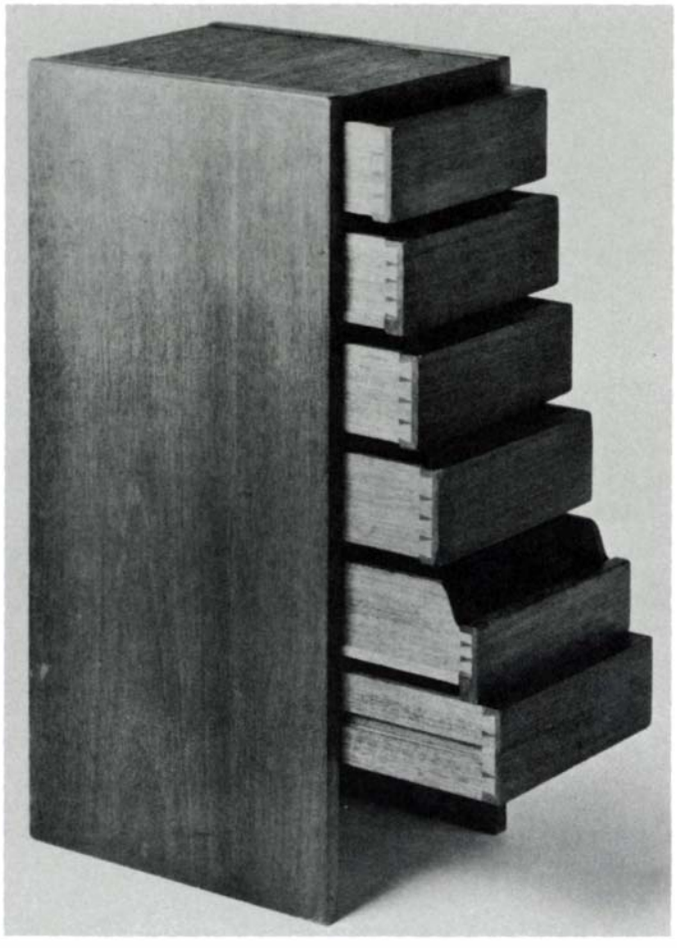
by Alan Marks

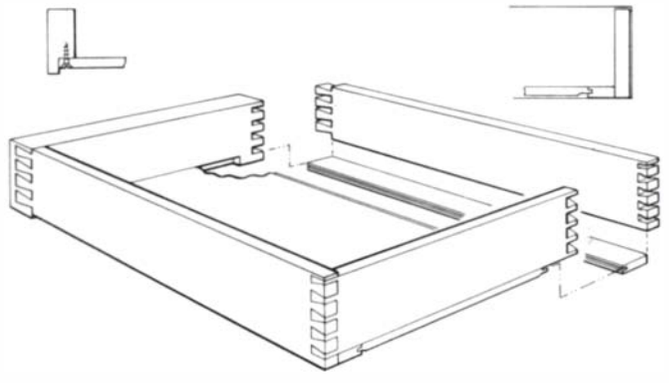
Drawers have long been considered one of the most difficult elements in cabinetry, probably with justification. Done in traditional fashion, they are time-consuming and require exacting work if they are to operate properly. This accounts on the one hand for industry's preference for stapled particle board, hot-melt glues, and ball-bearing steel suspension glides; and on the other hand for the tendency of today's craftsmen to avoid traditional drawers in favor of compartments, shelves or pigeon holes. Dovetailed construction, however, remains the strongest way of making a drawer, and also the most attractive.

The many types of construction possible using dovetails allow for innovation and flexibility, as witnessed by these six examples from Malmstens Verkstadsskola in Stockholm. Although the Swedes agree that the dovetailed drawer is the sturdiest, they often consider the decorative aspect incidental. All of the front dovetail joints shown here are half-blind. The conservative Swedes generally eschew through dovetails in drawer fronts because they interfere with the design requirements and overall style of traditional pieces. Drawer fronts on such cabinets often are delicately inlaid with veneers or carved or profiled around their edges, all unsuitable situations for through dovetails. Also, problems of uneven swelling and shrinkage can occur with through dovetails, when the wood of the solid drawer front shrinks while the end grain of the tails does not. Through dovetails are, however, used in the backs of drawers, where the unevenness ordinarily remains unnoticed.

French bottom

The traditional drawer bottom is made of solid wood, as opposed to Masonite or plywood. Thought to have originated in France, the so-called "French" drawer bottom floats with its grain running parallel to the drawer

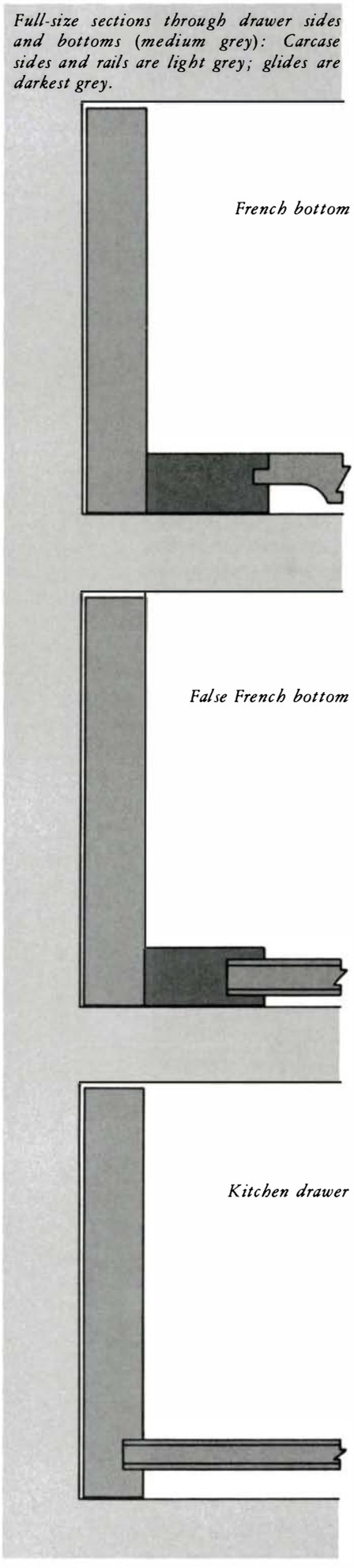




Exploded view from rear, with side and glide removed, shows how French-bottom drawer is put together. Section at left shows bottom screwed to front rabbet; right, section shows side, glide and bottom.

The little chest shown here is used to teach drawer construction at Malmstens Verkstadsskola (workshop and school) in Stockholm, Sweden. It was made in 1960 by master cabinetmaker Artur Jonerōt, from drawings by guitarmaker Georg Bolin, then rector of the school. Of mahogany, it stands 65 cm (25 in.) high, 25 cm (10 in.) wide and 31 cm (12 in.) deep. From the top, the drawers are kitchen, NK, false French, French, NK with ply bottom, and side-hung. The work of Carl Malmsten, who died in 1972 at age 83, was an inspirational source for the commercial furniture style now known as Scandinavian or Danish modern. Many of his designs are still in production; his school, which he founded in 1930, is now state-owned. In preparing drawings for manufacturers, he usually offered alternative constructions and indicated the one he thought superior. The second would be accompanied by a comment such as, 'This construction probably won't even last a hundred years.'

Full-size sections through drawer sides and bottoms (medium grey): Carcase sides and rails are light grey; glides are darkest grey.



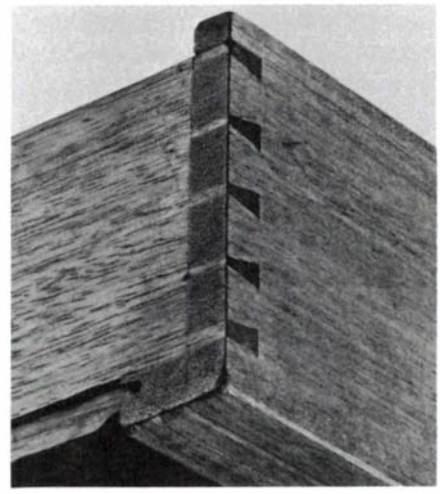
front, grooved into a two-piece frame formed by the glides. The drawer front is rabbeted to receive the bottom, which is slid home after glides have been glued to the drawer sides. Then the bottom is secured at the front with screws or a few brads, thus allowing later removal for cleaning, refinishing or repair, or else it is simply glued at the front edge. Either way, the wood bottom is free to expand and contract in its grooves. On a drawer this small, the bottom need be only 8 mm (5/16 in.) thick; it is raised 1-1/2 or 2 mm (1/16 in.) above the bottom of the glides to get around problems of sagging and scraping. The tongues should be made about 2 mm (3/32 in.) thick and 3 mm (1/8 in.) long.

The back of this drawer—and all the drawers discussed here—is made 5 mm (5/16 in.) lower than the sides; this keeps the back from scraping as the drawer is pulled out.

The bottom edge of the drawer front protrudes about 4 mm (5/32 in.) below the drawer side to act as a stop. This overhang slides into a corresponding rabbet in the carcase rail; the drawer may be made to close flush or to recess by varying the depth of the rabbet.

False French bottom

Because the French bottom is somewhat complicated to make and not compatible with large series production, the obvious shortcut is to take advantage of such dimensionally stable materials as plywood and Masonite. The resulting false French bottom simplifies construction and saves time. It looks the same at the front, but from the back the scalloped profile of the genuine French bottom is missing and three plies, two of veneer and one of Masonite or plywood, show up. This procedure creates a problem: The bottom might warp upward or become uneven if it is not restrained in some way; a tongue cut in Masonite or plywood would be much too weak. The solution is a glide with a groove wide enough to accommodate the whole thickness of the bottom, glued to the sides and butted against the front, as before. This creates a ledge inside the drawer, like the edge of the frame in conventional panel construction, which can be rounded. The final fitting of the glides is left until sides, front and back have been assembled. Then the glides are held in place at the front, marked at



French bottom, back view.

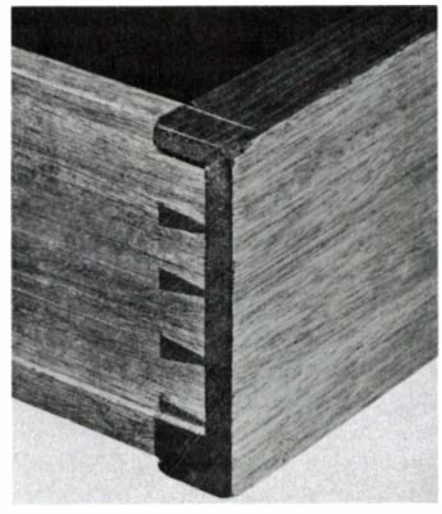
the back, and rabbeted with a chisel the small amount needed to make the bottom of the glide flush with the bottom of the side, enabling the bottom to be slid home. The drawer bottom projects into a rabbet in the drawer front and is fastened there with brads or screws and a bit of glue.

Kitchen drawer

The kitchen drawer bottom carries the cheapening of quality construction to its extreme. It is nothing more than a veneered plywood or Masonite bottom held by grooves in the sides and front and glued in place. There are disadvantages: rubbing on sides, little torsional strength, a small gluing surface, sides weakened by the groove, and a tiny gliding surface that eventually wears grooves in the rails.

NK drawer

The traditional French bottom and its counterfeit version share a weakness with most drawers made ever since



NK glide; pins are pared flush with side.

chests of drawers replaced lidded chests: the sides present a large scraping surface. This is noisy and can make the drawer difficult to extract. A solution is found in the so-called NK (pronounced enco) drawer.

NK is the abbreviation for a large store with several branches, Nordiska Kompaniet. Founded in Stockholm in 1902, a time of revolution against cluttered overdecoration in Swedish interiors, NK set up its own furniture factory. It was able to design, build and market tasteful contemporary pieces more in keeping with the timeless advice of William Morris: "If you want a golden rule that will fit everybody, here it is: Have nothing in your homes that you do not know to be useful, or believe to be beautiful."

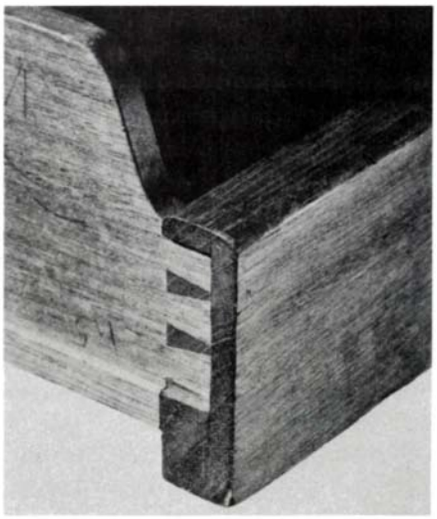
The glides, usually 10 to 12 mm (1/2 in.) thick, are glued to the bottom of the sides and protrude about 3 mm (1/8 in.) beyond them. This is done by cutting the pins on the drawer front about 3 mm deeper than the thickness of the sides. Thus the drawer is steered by the narrow side surfaces of the glides alone. After assembly, the protruding full pins are pared flush with the sides, while the half-pins at the top and bottom of the front are trimmed to horizontal. A solid bottom is screwed or glued into a groove in the drawer front.

This construction gives ultimate ease in sliding, especially when used for high drawers, and is quite strong because of the bracing the glides provide by being glued across the corner.

NK ply bottom

The one drawer that provides all possible strengths is the NK style with a veneered Masonite or plywood bottom, although it may offend those who insist upon solid wood. The version shown here has a half-open front, intended for use inside large cabinets with doors or within secretaries with drop leaves. Since it needs no pull, the cabinet door can close quite close to the drawer front, an optimal use of space. The bottom of the front entirely overlaps its supporting rail.

In construction, the veneered bottom is cut to width such that its edges on either side lap the drawer sides by half their thickness. It is then glued into a rabbet in the glides. The glides butt against the front, where the bottom enters a rabbet. This assembly, if squared properly, automatically ensures

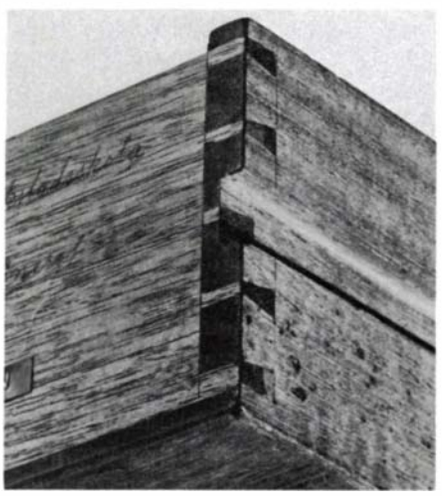


NK glide with low front, recessed side.

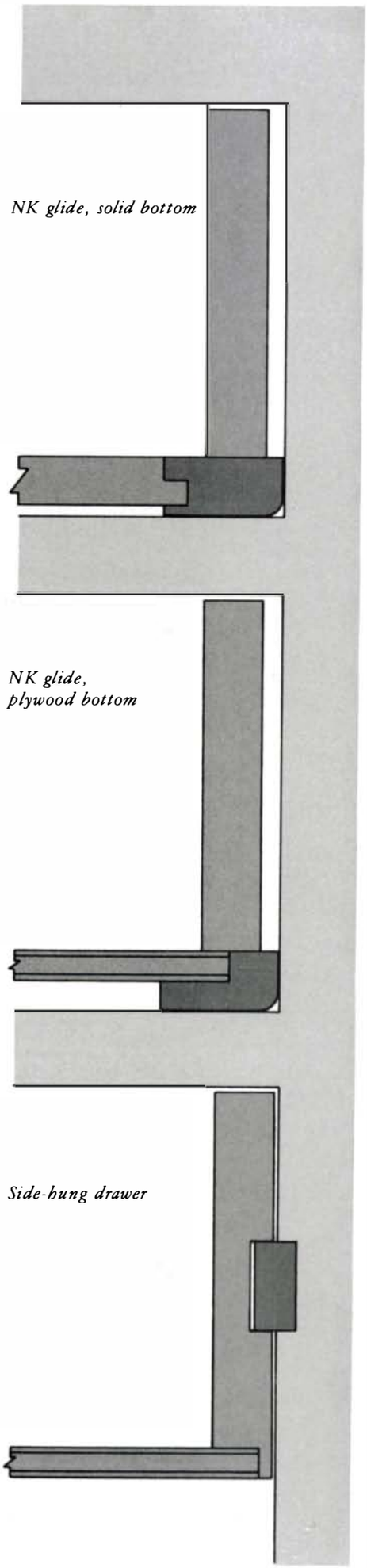
that the drawer front closes parallel to the cabinet. Excellent fits are easily made possible if the bottom and glide assembly is first fitted to the drawer opening before it is glued to the front, sides and back.

Side-hung

The side-hung drawer slides on runners inset into the cabinet sides and screwed in place. These runners also butt the end of the groove in which they ride and act as stops for the drawer. Thus the drawer front need have no overhang. The grooves may be made with a router, shaper or dado head, and squared up with a chisel. The veneered Masonite or plywood bottom acts as a cross brace for the front, back and sides. The sides are rabbeted, leaving a lip of about 3 mm (1/8 in.), and the bottom is glued, or glued and screwed, to them. At the same time it is glued to the back and let into a rabbet in the drawer front.



Side-hung drawer, back view.



School Shop

Teaching far more than manual skills

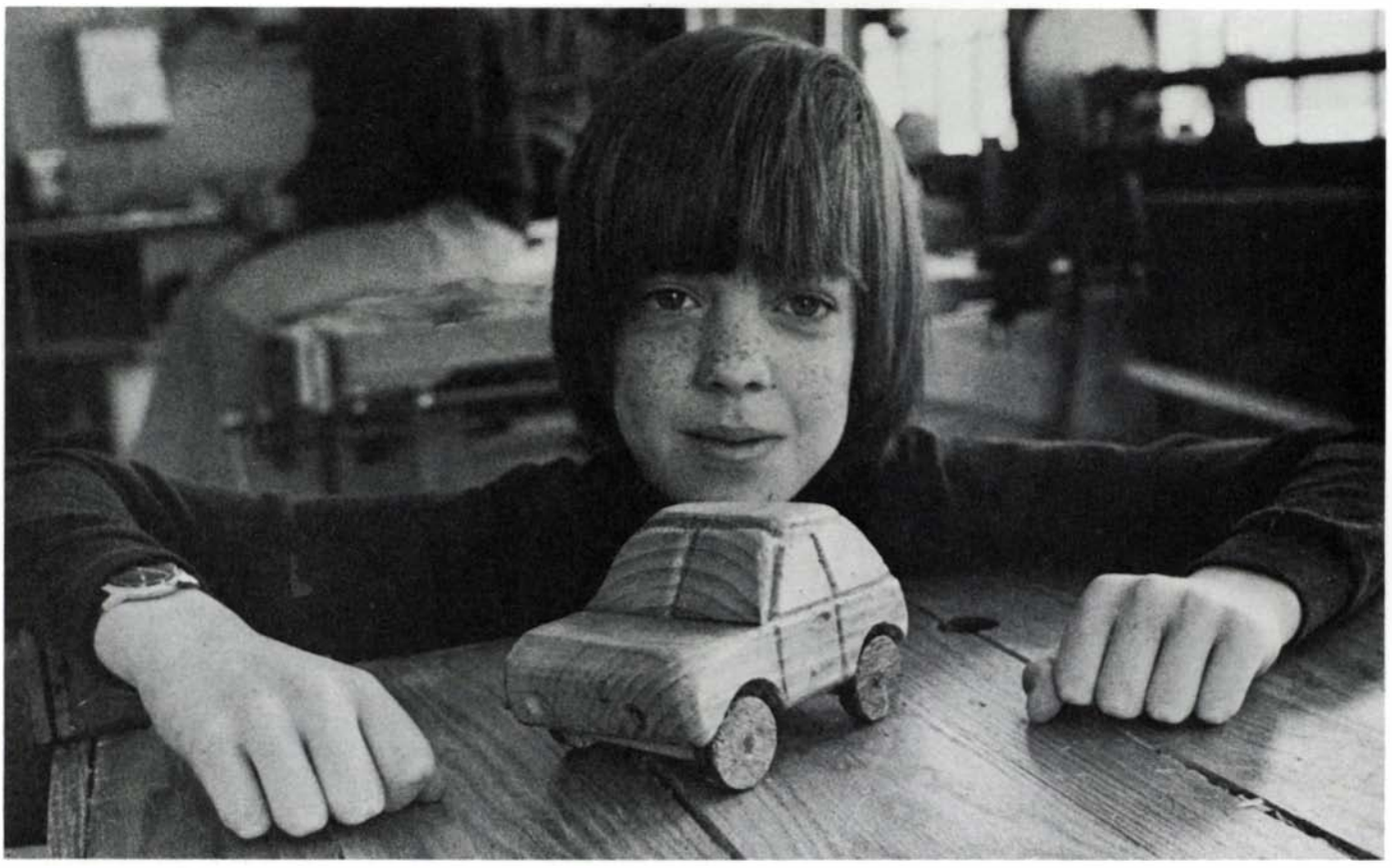
by Richard Starr

'Dovetails are very hard joints and you need a lot of practice to get them just right. My mother really likes it.' —Scott King, 8th grade.

I like to think that we teach woodworking in school for the same reasons we teach music. We try to help students develop an appreciation and love for the craft, though we expect few of them to become professional musicians or cabinetmakers. If attractive to children, woodworking can be a vehicle for teaching far more than basic manual skills. We can help them learn how to make intelligent choices, to work with care, integrity and pleasure, and to deal constructively with mistakes and frustration.

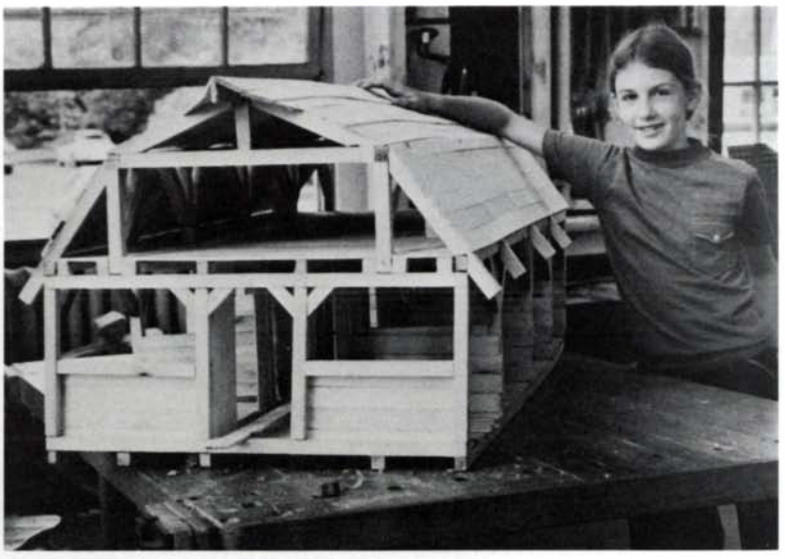
Our quiet shop reflects my preference for the old methods. Students use only hand tools, including a large variety of planes, drawknives and spokeshaves, carving tools and a foot-powered lathe. Children who might be intimidated by power tools are comfortable and productive here. Our major concern is to support their efforts to make projects of their own design, not to teach them specific skills. The skills they learn are a by-product; their reward is enjoyment of the work and satisfaction with the finished object.

Author discusses chair construction with Breena Brodsky, 8th grade. Starr, 33, teaches woodworking to grades 6 through 8 at Richmond (public) School, Hanover, N. H. These photos span several years.



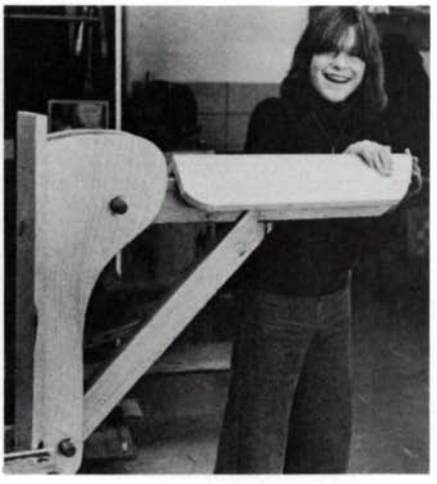
'Make the shape. Make four wheels, put them on. Make windows and doors with a gouge. Then oil it.' —Bobby Officer, 5th grade.

'I still don't know why I made this thing. What am I supposed to do with it?' —Michael Holland, 7th grade.



'It's a barn for model horses. It's constructed like an old barn and pegged together.' —Cathy McFadden, 7th grade.

'I finally finished it!'—Nita Pacillo, 6th grade.



'It's a saddle rack. It folds.' —Carolyn Strohbehn, 8th grade.

'I enjoyed building the guitar. The only bad part was all the sanding I had to do. I haven't learned to play it yet.' —Scott Baughman, 7th grade.

'It's a press. You turn the large round wheel to make the board go up and down.' —Adam Tucker, 7th grade.

Health Hazards in Woodworking

Simple precautions minimize risks

by Stanley N. Wellborn

Industrial woodworkers have long recognized the risks of their trade. But it has been only in the past few years that artists and craftsmen have become concerned about—or even aware of— the many hidden dangers in woodworking.

Of course everyone recognizes those hazards that cause immediate and traumatic injury—blades that cut fingers and limbs, wood chips and fragments that fly into eyes, loose clothing or long hair that catches in whirling machinery, smashed fingers and toes, muscle strains from heavy lifting. But now medical authorities in the United States, Canada and England cite a number of insidious causes of disease that can be directly attributed to woodworking. Their list includes wood dust, sap and oils, mold and fungus, chemical additives, toxic solvents and adhesives, vibration and noise.

A diligent search of medical literature, or a chat with an industrial hygiene specialist, will turn up dozens of horror stories about the health hazards of woodworking. For example, the 43-year-old woodworker who had operated a lathe for more than 25 years and became worried about a persistent sinus irritation and sore throat. His doctor prescribed a standard treatment, yet the condition did not improve. Finally, lab tests revealed cancer of the nasal passages. Or the art student who broke out in a rash, with blisters resembling second-degree burns, shortly after she began to sculpt wood. When she stopped woodworking, her skin healed.

The mere existence of a medical case history doesn't mean every woodworker will succumb to serious disease; the biggest unknown is often the size of the risk. In most cases, woodworkers can take adequate precautions for relatively little cost. Common protective measures are described in the box on page 56. Woodworkers who notice something wrong with their health would be wise to suspect something in the shop; some potential problems are discussed below.

Respiratory ailments

Health authorities warn that woodworkers should be most on guard against inhaling foreign substances.

To most woodworkers, concern about the cancer-causing potential of wood dust overrides all other health worries. Indeed, this concern appears justified, at least on the surface. Woodworkers are 500 times more likely to have certain types of nasal cancer than non-woodworkers. However, the risk of developing cancer solely through exposure to wood dust is quite low.

"The statistics on cancer in woodworkers can be made to sound quite alarming," says Dr. Julian A. Waller of the University of Vermont Medical School and an authority on health hazards in the arts. "But the actual risk advances only from 'extremely rare' to 'rare.' Only one woodworker in 1,400 will get this cancer, and at that after an average of 40 years of exposure."

Nevertheless, in various health hazard evaluations conducted by the National Institute of Occupational Health and Safety (NIOSH) in Cincinnati, Ohio, investigators have concluded that wood dust is at least a contributing factor in the development of some other types of cancer. In a report prepared after an evaluation of the Cooper Union School of Art in New York City, the Institute cites studies pointing out that "cancers of the larynx, tonsils, tongue and lung have been reported to have resulted from inhalation of wood dust" among furniture workers in England and Sweden.

In addition, the NIOSH report mentions that many researchers have found that the normal functions of the mucous membranes in the nose, throat and lungs were impaired in workers exposed to wood dust for more than ten years.

Among the most recent and thorough research on this problem is a study done by Dr. Samuel Milham, Jr., of the State Department of Social and Health Services in Olympia, Wash. He reviewed the death records of more than 16,000 members of the United Brotherhood of Carpenters and Joiners of America, and found that the results supported the hypothesis that wood contains carcinogens. The study also found an above-average incidence of leukemia and lymphoma among millwrights, lumber workers and cabinetmakers.

Although risk of cancer from exposure to wood does appear to be low for most woodcrafters, the incidence of other forms of respiratory illness is high. At one time or another, virtually all woodworkers have suffered irritation of the upper respiratory tract after breathing sawdust. The condition is usually transient and produces coughing, wheezing and tightness in the chest. Frequently, however, long-term exposure produces "fogged lungs" on X-rays and a type of occupational asthma that can become virtually permanent.

Redwood dust, for example, is the cause of sequoiosis, an acute illness that resembles pneumonia. It usually appears within a few hours after exposure, and its symptoms are shortness of breath, bronchio-constriction, dry coughing, chills, sweating, fever and general malaise. Repeated episodes of this ailment can cause permanent scarring of lung tissue.

Wood dust from another tree, the Western or Canadian red cedar, causes similar symptoms that can develop into asthma or rhinitis, an inflammation of the nasal passages.

Stan Wellborn, who writes on educational and social trends for a national news magazine, is Washington correspondent for Fine Woodworking.

Medical researchers believe the causative agent in red cedar is plicatic acid, which is thought to give the wood its characteristic fragrance. Lumber workers in the Pacific Northwest are frequently affected by cedar dust. One medical case history tells of a 30-year-old worker who could breathe at night only by kneeling on his hands and knees. When he left the woodworking industry, he regained his health.

Another source of respiratory difficulties is the mold and fungus that grow in damp areas of the shop, particularly in piles of sawdust. Mold has also been known to cause serious reactions in skin and fingernails after continuous exposure.

Occupational health experts agree that the obvious and best way to prevent respiratory problems is to cut down the amount of airborne dust in the shop. Although no specific environmental standards for allergenic wood dust have been established by the federal Occupational Safety and Health Administration (OSHA), the American Conference of Governmental Industrial Hygienists has set a provisional (and very low) limit on "nuisance dust" of 5 mg per cubic meter of air space. A few minutes of steady hand-sanding normally produce about 15 mg per cubic meter in the immediate work area; a portable or stationary belt sander will generate about 150 mg per cubic meter. Without ventilation, the dust will remain airborne for hours and spread through the shop.

Skin irritations and allergies

A large number of wood species will produce skin irritation or glandular swelling in sensitive individuals who are directly exposed to their dust, oil or sap. Some woods, such as West Indian satinwood and mansonia, are classified as "primary irritants" because they are highly toxic and are likely to produce skin eruptions or blisters in most people on first contact. Others, such as cocobolo, are "sensitizers" that may cause allergic dermatitis only after repeated exposure.

A number of domestic U. S. woods have been mentioned in medical literature as causing skin irritations, such as hives and rashes, but such skin reactions are actually quite infrequent, occurring in less than 2% of the population. However, the problem becomes much more serious with tropical or exotic woods. A partial list of toxic timbers is given in the box on this page.

Dermatologists who have investigated wood allergies note several common characteristics. Allergic reactions are more pronounced during the summer, or when a person's skin is moist from perspiration, or when the wood dust itself is damp. Reactions are more frequent among persons older than 40. Freshly cut wood is much more likely to be an irritant than older, seasoned wood. Occasionally, a wood species from one geographic area will not affect a woodworker, while the same species grown somewhere else will.

In most cases, it is the heartwood rather than the sapwood that is responsible for skin allergies, and it is the accessory substances, or "extractives," from the heartwood that produce the toxic effects. Extractives are whatever can be leached out of the wood (with water or other solvents) without changing its structure. These powerful chemical components—resins, alkaloids, tannins, acids, salts and gums—vary widely from species to species and even from log to log. In some trees they make up as much as 20% of the wood structure. Most woods contain about 4% to 10% extractives. The effect of extractives can be devastating. One report cited a serious outbreak of dermatitis among workers at an English

Toxic Woods

This list includes woods that are known to cause allergic, toxic, infectious or respiratory reactions. Although researchers point out that not everyone is sensitive to these woods, they warn that woodworkers should be particularly cautious when sanding or milling them. The category "respiratory ailments" includes bronchial disorders, asthma, rhinitis and mucosal irritations; "skin and eye allergies" includes contact dermatitis, conjunctivitis, itching and rashes.

—*S. N. W.*

Respiratory ailments	Skin and eye allergies	
•		Arbor vitae (*Thuja standishii*)
	•	Ayan (*Distemonanthus benthamianus*)
	•	Blackwood, African (*Dalbergia melanoxylon*)
•	•	Boxwood, Knysna (*Gonioma kamassi*)
	•	Cashew (*Anacardium occidentale*)
•	•	Cedar, Western red (*Thuja plicata*)
	•	Coco bolo (*Dalbergia retusa*)
	•	Cocus (*Brya ebenus*)
•		Dahoma (*Piptadeniastrum africanum*)
•	•	Ebony (*Diospyros*)
•	•	Greenheart (*Ocotea rodiaei*)
•		Guarea (*Guarea thompsonii*)
•	•	Ipe [lapacho] (*Tabebuia ipe*)
•	•	Iroko (*Chlorophora excelsa*)
•		Katon (*Sandoricum indicum*)
•	•	Mahogany, African (*Khaya ivorensis*)
	•	Mahogany, American (*Swietenia macrophylla*)
•	•	Makore (*Tieghemella heckelii*)
•	•	Mansonia (*Mansonia altissima*)
•	•	Obeche (*Triplochiton scleroxylon*)
•	•	Opepe (*Nauclea trillesii*)
•	•	Peroba rosa (*Aspidosperma peroba*)
•	•	Peroba, white (*Paratecoma peroba*)
	•	Ramin (*Gonystylus bancanus*)
	•	Rosewood, Brazilian (*Dalbergia nigra*)
	•	Rosewood, East Indian (*Dalbergia latifolia*)
	•	Satinwood, Ceylon (*Chloroxylon swietenia*)
	•	Satinwood, West Indian (*Fagara flava*)
•		Sequoia Redwood (*Sequoia sempervirens*)
•		Sneezewood (*Ptaeroxylon obliquum*)
•		Stavewood (*Dysoxylum muelleri*)
	•	Sucupira (*Bowdichia nitida*)
	•	Teak (*Tectona grandis*)
•	•	Wenge (*Millettia laurentii*)

This information has been taken from:

National Institute of Occupational Safety and Health

International Labor Organization *Encyclopedia of Occupational Safety and Health*

Sculpture in Wood by Jack C. Rich, Da Capo Press, New York, 1977.

"Toxic Woods" by Brian Woods and C. D. Calnan, *British Journal of Dermatology*, Vol. 95, Supplement 13, 1976 (an excellent source on skin reactions to woods, with case histories and an inclusive list of toxic species).

furniture plant that used mansonia wood. The entire operation had to be shut down for weeks.

Obviously, the occasional case of dermatitis won't discourage woodworkers from continuing to use exotic woods. The best path to follow is one of prevention, including dust control, protective clothing, washing and shower facilities and barrier creams, such as DuPont's Pro-Tek. Persons who suspect they are sensitive to certain woods should have a doctor do a skin-patch test to find the cause of the allergy.

Pesticides and preservatives introduced to wood while it is being timbered, processed and shipped may also cause dermatitis. These include everything from the highly toxic pentachlorophenol to the relatively innocuous polyethylene glycol (PEG) and denatured alcohol. Other chemicals often used in domestic wood processing are potassium dichromate, ethyl triethanol amine, glycol humectant, naphthenic acid, copper hydrate and zinc naphthenate. Standard threshold limit values (TLV's) based on current medical knowledge have been established for many of these chemicals, with the intention of protecting people whose jobs expose them constantly to these substances. But many chemicals banned in this country are routinely used by foreign loggers and shipping companies to prevent insect infestation, mold growth and dry rot in transit.

It is almost impossible for a woodworker to ascertain which additives have been used. Michael McCann, an industrial hygienist and chemist with the Center for Occupational Hazards in New York City, says, "The best procedure to follow is to assume that the wood being used has been processed with dangerous chemicals and take the necessary precautions. It is also important to remember that it is not uncommon for woodworkers to toil 12 or more hours a day for weeks on end when preparing for a show or fair, or just plain getting caught up with a work order. Under these conditions, it becomes doubtful that established TLV's for an eight-hour work day are applicable."

Dr. Bertram W. Carnow, professor of occupational and environmental medicine at the University of Illinois, points out that the key factor in determining toxic levels for an individual is what he calls "total body burden"—the sum that each person's metabolism and general health will accommodate. "Liquid or solid particles such as fumes or vapors in aerosol form, cigarette smoke and other exposures in addition to those from materials used at work all contribute to the burden on the lungs, skin and other organs, and should be minimized," says Dr. Carnow.

Many skin irritations are caused by contact with adhesives and solvents that dry the skin and make it more subject to infection. In addition, fumes from such chemicals often are not only toxic if inhaled or swallowed, but also highly flammable.

Epoxies, for example, can cause severe blistering and scaling. Liquid, uncured epoxy resin and hardener will cause adverse reactions in more than 40% of all workers who come in contact with it. Synthetic adhesives, such as urea-formalde-

Preventive Measures

Few occupational health experts would advocate giving up one's craft unless there were overwhelming evidence that a person's health was being seriously impaired, or that an irreversible allergy to materials had developed. In virtually all cases, simple modifications of the working environment and a few changes in work habits will resolve any hazards to health.

Dr. Julian A. Waller believes that "a reasonably good margin of protection" can be obtained in most shops for under $100. He and other authorities in the field suggest the following preventive measures for woodworkers:

Adequate ventilation is the basic, and probably most important, requirement of a safe shop. The exhaust system should begin as close as possible to the source of dust or fumes, so they cannot accumulate and will flow rapidly away from the worker's face. The exhaust should be vented to the outside whenever possible, and dust should be collected in a bag or bin. A shop vacuum with a homemade clamp that holds the nozzle near the source of dust and chips is a relatively inexpensive way to remove particles from the air. Fresh air should be allowed to enter the working area freely.

Shop cleanliness is another fundamental. A general cleanup is recommended at the end of each working day. When not in use, jars, cans and bags should be sealed, and spills should be wiped up promptly. For fine sawdust and sanding dust, the best cleanup methods are wet cloths, wet mopping or industrial-type wet vacuuming. Dry sweeping or blowing with an air hose only stirs up the dust.

Personal hygiene also plays an important role. Dirty clothes, long fingernails and unwashed skin and hair can trap dust, solids and dried liquids, and thus exposure continues even when the woodworker leaves the shop. Plastic disposable coveralls, gloves and hats can help reduce these hazards. Work clothes and equipment should be washed separately from other household items.

Protective equipment such as face masks, respirators, eye goggles, ear plugs or muffs, and plastic or rubber gloves are essential for certain operations. Many safety devices, such as respirators and ear protectors, are rated for effectiveness by the federal government or the American National Standards Institute in New York City. A simple filter-type respirator will keep exotic dusts out of your lungs.

Recent workshops on health hazards in the arts have placed heavy responsibility on craftsmen for maintaining awareness about medical matters related to their work. Most doctors are not well informed about occupational hazards associated with the crafts, and many of the cumulative diseases do not become apparent until their damage is fairly extensive. Symptoms of slow-developing occupational diseases are often attributed to another cause or dismissed as psychosomatic.

For these reasons, health authorities suggest four guidelines for woodworkers:

—Know as much as possible about the woods and other materials you use, what diseases they can cause, and what the danger signs are.

—Suspect that a health problem may be related to woodworking if it improves after a layoff of a few days and gets worse when work is resumed.

—Have a physician arrange a pulmonary-function test every two or three years. This test detects lung problems much sooner than X-rays can.

—If a doctor's diagnosis or treatment does not seem satisfactory, consult specialists on particular problems.

—S. N. W.

hyde and phenol-formaldehyde resin, are other irritants with which woodworkers commonly come in contact. Although few woodworkers have occasion to use uncured formaldehyde or phenol resins, they should be aware that "thermal degradation" of these compounds has been reported when heat produced during high-speed machining of wood breaks down glues into separate components, or produces entirely new compounds.

Vibration disease

Another woodworking hazard, well-defined over the years by occupational health specialists, is a disease that develops and spreads slowly through the muscles and circulatory system of the fingers, hands and forearms. Vibration disease is closely related to an affliction known as Raynaud's phenomenon, and is triggered by lengthy use of machinery that vibrates in the 40 to 3,000 cycle-per-second frequency range.

Most woodworkers have experienced a rhythmic tingling in the hands and arms after using such vibrating tools as orbital sanders, chain saws and pneumatic chisels. In most cases, the spasms disappear within an hour. Now, recent medical research among lumbermen in Canada has shown that serious side effects of this reaction may develop, although the process may take from several months to ten years. Smoking and cold weather tend to hasten the onset of the problem. In some cases, tendonitis of the elbow and shoulder may set in. Eventually, numbness and a heightened sensitivity to cold and humidity will occur, and the fingers and palms of the hands will become extremely pale—giving the condition its more common name of "white hand" or "dead fingers." In a few extreme cases, it has been necessary to amputate the fingers.

"We know that vibrations may cause definite lesions to the hands with serious potential consequences," says Dr. Gilles Laroche, a cardiovascular surgeon with the Hotel-Dieu Hospital in Quebec City, in the March 7, 1977, issue of the Canadian periodical *Maclean's*. "Once severe occlusive arterial disease is established, the condition is permanent and little or no improvement will result from cessation of work. In fact, the condition may worsen in a large proportion of patients."

Safety experts advise that cutting down on extensive use of vibrating tools is the best way to prevent this condition, although some authorities have urged tool manufacturers to build shock absorbers into vibrating equipment. Many chain saws now have rubber bumpers between the engine and the handles, and users report them nearly vibration-free. OSHA has not set a vibration standard for tools.

Noise

High levels of noise have long been recognized by industrial safety technicians as unsafe to workers. In a typical wood shop, decibel levels often exceed industry limits and may cause hearing loss.

One study cited by NIOSH found that nearly one shop worker in four had suffered some pemanent damage to hearing because of high noise levels from operating machinery. Other studies have found that excessive noise can also contribute to heart problems and gastrointestinal disorders.

Noise levels are measured in decibels (dB) on a logarithmic scale on which every increase of 10 dB means a tenfold increase in noise intensity. Ordinary conversation averages about 60 dB.

OSHA has set a maximum permissible average noise level of 90 dB per eight-hour working day. The permissible noise exposure rises to a maximum of 115 dB, a level that can be tolerated for only 15 minutes or less per day. A circular saw produces between 100 and 109 dB, a medium-sized woodworking shop in full operation averages about 110 dB, and a chain saw may peak at 130 dB. One report cited by NIOSH states that "operators of saws, planers, routers, molding machines, shapers, jointers and sanders are exposed to average overall sound-pressure levels that exceed 95 dB. For several of these operations, the average may be as high as 115 dB."

Protection from noise involves damping machinery with mufflers and sound-absorbing material, keeping machines in good repair and well-oiled, and mounting machines on rubber bases to reduce vibration and rattling. In addition, OSHA-approved ear muffs and ear plugs—rather than improvised cotton or wax devices—are recommended. In general, industrial hygienists recommend ear muffs as the most effective sound reducer.

Fire hazards

Although most woodworkers are extremely cautious when using flammable materials, the danger persists. The National Fire Protection Association reports that the combination of machinery, wood, volatile fumes and finely dispersed dust in woodworking shops results in scores of fires and explosions annually. Small grains of wood dust, when scattered throughout a confined area, can explode with tremendous force if ignited by a spark or match. If flammable solvents are present, the hazard becomes much greater.

Fire prevention authorities agree that the best way to curb the possibility of fire is adequate ventilation. If dust and fumes are vented by a vacuum or "cyclone" air cleaner, and fresh air is continually available, most fire hazards will be sharply reduced.

Campaign begins

Although many potential hazards have been identified, a great deal remains unknown. Several state and national art and craft groups have begun a campaign to inform their members about occupational risks, and to seek more government assistance in improving the health and safety of the craft community. Gail Barazani of Chicago, editor of "Hazards in the Arts" newsletter, terms these dangers a "silent enemy" that can seriously harm the health of artists, craftsmen, hobbyists and their families. A national conference is being planned for mid-1978 to bring interested persons together for a thorough discussion of the issue.

Most of the hazards that woodworkers encounter in their craft are obvious ones that will be recognized and dealt with immediately. The less obvious ones require more diligence and a determined effort to learn as much as possible about the materials being used. Dr. Waller, a craftsman himself, sums up by observing that the general rule of thumb should be "common sense and simple precautions. That will eliminate virtually all the hazards anyone is likely to experience."

[Author's note: *Clinical Toxicology of Commercial Products* by Gosslin, Hodge, Gleason and Smith is a standard medical reference text. Other sources of more detailed information are *Health Hazards Manual for Artists* by Michael McCann, Center for Occupational Hazards, 56 Pine St., Rm. 1405, New York, N. Y. 10005, $2.75 postpaid; and *Health Hazards in Arts and Crafts* by Bertram W. Carnow, to be published in the spring of 1978 by John Wiley & Sons, 605 3rd Ave., New York, N. Y. 10016.]

Basic Blacksmithing

What a woodworker needs to forge tools

by Ray Larsen

Author files weld on shell auger.

The furniture maker ruins a mahogany table base while trying to cut a deep mortise in it. He is using the wrong chisel because the right one has been out of stock for eight months. The instrument maker applies pressure to the shell auger buried deep in the boxwood clamped in front of him. The bit snaps in his hand. The turner walks from his lathe, shaking his head. A poorly designed gouge has just ripped through the tulipwood bowl he's been working on all day. The sculptor lays down his mallet and puts his work aside in frustration. He can't get the effect he wants, although he's tried every tool in the catalog.

Such incidents, all too common in woodworking, have led to a resurgence of interest in hand forging high-quality tools, at least those special tools unavailable from even the best supply houses. This has developed a number of skilled blacksmiths able to produce special tools of the highest quality, and woodworkers need only avail themselves of their services. In addition, a growing number of serious woodworkers are taking up blacksmithing themselves. They are discovering that with a little perseverance they can forge their own tools.

It takes a substantial investment to set up a forge and a substantial block of time to locate equipment and learn the necessary skills. Each woodworker should ask himself how serious his need is for special, high-quality tools before deciding to make them. The devoted craftsman will quickly resent the time taken from his first love to produce tools he really doesn't need.

Once a woodworker learns blacksmithing, he never again need worry about tools breaking, or not holding an edge, or ruining the work. Less time struggling with tools means more time producing high-quality work. And the most exotic tools are readily available. Need a special shape for turning the inside of a box? It's there for the making. Many woodworkers find that a tool especially designed for a job enables them to produce pieces others can't, or to produce them faster or more economically. The right tool for the job means superior work.

After the initial investment, the blacksmith-woodworker saves time and money; others must wait until special tools become available, or run around searching them out, or pay the relatively high cost of having them made by a specialist. The woodworker who can make tools can also repair and modify them. A chipped screwdriver is reshaped at a fraction of the cost of replacing it; an old parting tool is reworked to turn a special configuration. In addition, the blacksmith-woodworker can also forge special pulls, latches, hinges and other hard-to-find hardware. This ability is especially important to specialists in antique reproductions.

Ray Larsen, 37, of Hanover, Mass., is a professional blacksmith who makes high-quality tools on special order through Woodcraft Supply Corp.

Equipment

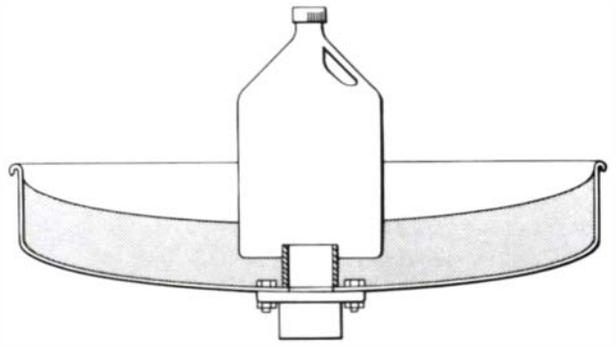
I began blacksmithing with a homemade forge, two borrowed pairs of tongs, a $35 anvil and a beat-up grindstone. Most serious woodworkers already have several pieces of equipment essential to toolmaking, including a good grinding wheel or other sharpening system, high-quality bench honing equipment and a heavy-duty drill press. But additional equipment is required, including a forge, anvil, tongs, hammers, punches and chisels, fullers and hardies, swages, vise and quench tub. Start with a few pieces of equipment and master them before buying more.

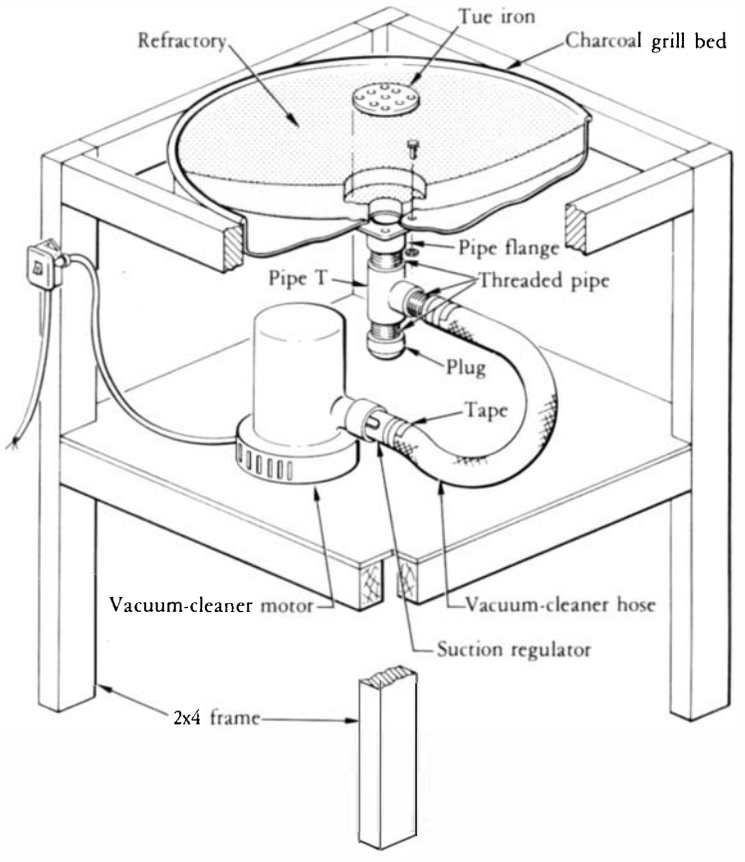
The heart of the blacksmith shop is the forge, in which a blast of air applied to a coal, coke or charcoal fire heats steel to the elevated temperatures required for forging. There are many sizes and styles, from big, permanent types costing well over $1,200 to small, portable types found in junkyards and secondhand shops for $50 to $200 depending on size, quality and the buyer's ability to bargain. The thrifty craftsman can make a forge using a discarded barbecue grill for the bed and the guts of an old vacuum cleaner or hair dryer for the blower.

Forging generates soot, smoke and dust that must be vented away from clean areas of the shop. I recommend buying a hooded, ventable forge over an open type for this reason. Some manufacturers have substituted stamped metal for cast iron in recent years, but cast iron remains best for the job because of its superior fire-resistant properties. Cranking the blower by hand may be romantic, but it isn't as efficient or as easily managed as an electric one. Buffalo Forge Co., Buffalo, N. Y., and Champion Blower & Forge, Inc., Roselle, Ill., are respected forge manufacturers.

Do not use the forge without first lining it with a suitable refractory, a non-metallic, ceramic material with heat-resisting properties that protects the forge bed from burning out. It comes in many forms but a powdered type, Kast-Set, made by A. P. Green Refractories Co., Mexico, Mo., is excellent; it is mixed with water like cement and cast in place. Such refractory will protect the forge and greatly extend its life at minimum cost (less than $20 for approximately a two-year supply).

If the forge is the heart of the blacksmith shop, the anvil is its soul. No other single piece of equipment (save perhaps a favorite hammer) inspires blacksmiths to such heights of enthusiasm and such depths of despair. Like forges, anvils come in a wide variety of types, styles and sizes, from new but





A serviceable forge can be constructed from readily available materials. The bed is built from a new or used stamped-metal outdoor grill. A hooded type (not shown here) makes essential venting easier. Or a hood can be made from sheet metal and a stovepipe. The factory-made tubular legs are discarded in favor of a heavy-duty 2x4 frame with braced 2x4 legs. The bed should be at workbench height. The center hole in the bed is enlarged to accept a 2-in. pipe flange; a T-fitting introduces air blast and a plug is loosely fitted beneath for ash clean-out. A vacuum-cleaner or hair-dryer motor with heating element removed is affixed to the frame; the blower outlet is linked to the T-fitting with vacuum-cleaner or hair-dryer hose. Adjustable clamps and duct tape ensure an airtight fit. A vacuum-cleaner suction regulator or similar device regulates the blast. Refractory is troweled around a suitable form, such as a plastic bleach bottle with 2-in. pipe inserted through its bottom, placed over the center hole (as above). A tue iron cut from heavy-gauge sheet metal and drilled or punched is laid over the 2-in. blast opening in the bed.

expensive all-steel types available from such supply houses as Centaur Forge Ltd., Burlington, Wis., (about $200 for a 125-pound size) to traditional, steel-faced types available from secondhand dealers for $75 and up. The anvil should be mounted on a heavy tree stump.

When selecting an anvil, look for a smooth, flat face and unflawed horn. Use a steel straightedge to spot valleys. The quality of the work depends to a great extent on the condition of the anvil. Don't buy a used one with badly chipped edges on the face, a sure sign of misuse over the years. And don't buy an anvil whose steel face is separating from its cast or wrought-iron base. Improper welding of face to body is a clue to inferior manufacture. Two respected brands are Peter Wright and Hay-Budden; both companies are out of business but their anvils may be purchased through dealers or at junkyards.

Anvils come in many sizes, but the 125 to 150 lb. range is good for toolmaking. Anything smaller is too light to stand up to tool steels, while heavier anvils are too expensive and hard to transport. Before buying, strike the face moderately with a hammer. A good ring and strong bounce are signs of a strong, well-made anvil. Avoid limp clunkers.

Tongs, the long-handled tools used to hold steel while it is heated and forged, come in a bewildering range of sizes and styles. Early trade manuals, such as *Hand Forging* by Thomas F. Googerty (Popular Mechanics Co., Chicago, Ill.), suggest making one's own as a good way to learn the blacksmith's craft. There is a great deal of sense in that. But because tongs are readily available at junk shops and flea markets for as little as 50 cents, it is easier for the woodworker to buy them—at least at the outset. Pick a few simple sizes and shapes and purchase more pairs as needed.

There also are hundreds of new and used blacksmith, mechanic, farrier and other hammers on the market these days and each blacksmith has favorites (my own are an odd, one-pound cross-peen type that I use for delicate finish work and an old electric sharpening hammer that is excellent for hammering in blade edges). Start simply with several ball-peen and mechanic's hammers ranging from one to three pounds and fill in with special types as required. Buy only the highest quality (Sears' Craftsman mechanic's hammers are excellent).

Punches and chisels are special long or handled types which come in hot and cold versions for punching and cutting heated or unheated steel. They are available used from supply houses such as Centaur or manufacturers such as Diamond Tool and Horseshoe Co., Duluth, Minn. Prices vary. As with tongs and hammers, buy a few simple ones and fill in as requirements dictate.

Fullers and hardies fit in the hardie or square hole at the heel of most anvils. Fullers are used to draw steel, hardies to cut it. The metal is heated to forging temperature, then placed over the tool and struck with a hammer. Start with a few simple types from reputable supply houses or manufacturers and supplement as needed. Expect to pay about $10 each.

Swages come in two types. Bottom swages fit into the hardie hole and come in various round, square and other shapes. They permit the toolmaker to hammer hot steel to a desired configuration. Sets consist of matched bottom and top swages. The bottom fits in the hardie hole, and the top is handled like a hammer. Hot steel is held between the two and the top swage is struck with a hammer. This procedure generally requires a helper.

Supply houses stock only a limited number of swages. Secondhand shops, junkyards and tool dealers specializing in

blacksmith equipment are better sources. Expect to pay $5 and up apiece. An alternative to buying a large number of swages is the swage block, a large block of cast steel with a variety of shapes on its four sides. The block is fitted to a special stand or placed on a heavy stump in the same manner as an anvil. Swage blocks, unfortunately, are expensive new and extremely rare used.

A good machinist's vise is satisfactory for the beginning toolmaker but he should consider buying a blacksmith's type as soon as possible. This vise has a steel leg that sets into the floor of the shop. The leg dissipates the shock of hammering steel in the vise. New blacksmith's vises are expensive compared to readily available used ones. Pay about $50 for one with five-inch jaws in very good condition.

Finally, a reservoir of water is essential for quenching tools. A large, galvanized washtub will do. Half a whiskey barrel is better.

Fuel

Some blacksmiths in England prefer coke for forging. Blacksmiths at Old Sturbridge Village in Sturbridge, Mass., use charcoal for authenticity. But the rest of us use "blacksmith coal," a soft, low-sulfur type especially suited for forge work. Blacksmith coal is available from Centaur and other supply houses but these are expensive sources. Try phoning a coal supplier in your area. Most dealers know who sells blacksmith coal and will quickly suggest a source. Buy 200 pounds (less than $10 worth) to start. Pick it up at the yard—it's cheaper that way.

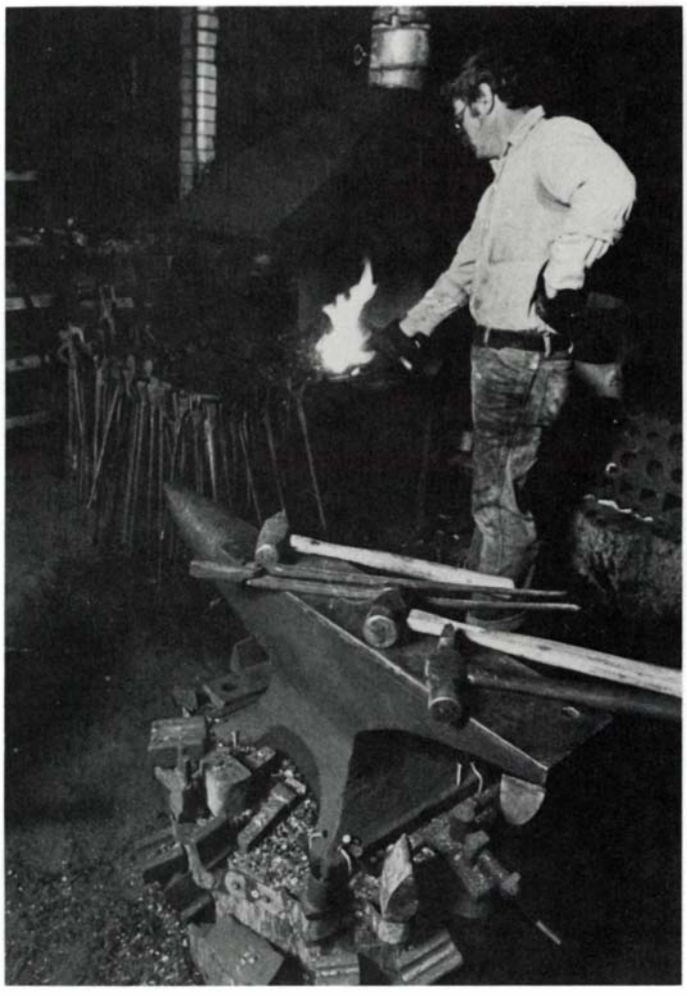
Steel

Domestic and overseas producers make a wide range of steels suitable for woodworking tools. New steel is preferable to used because the toolmaker knows what to expect when working it and can select the right type for the job. No matter how good the smith is at identifying used steel, there is always an element of risk in forging it. Because of producer restrictions on minimum order sizes, woodworkers will have to rely on local service centers or warehouses for the small amounts they require. If in doubt, select a company that advertises itself as a member of the Steel Service Center Institute (SSCI), an organization of highly reputable steel suppliers. Two basic families of steel are used in toolmaking: carbon and specialty.

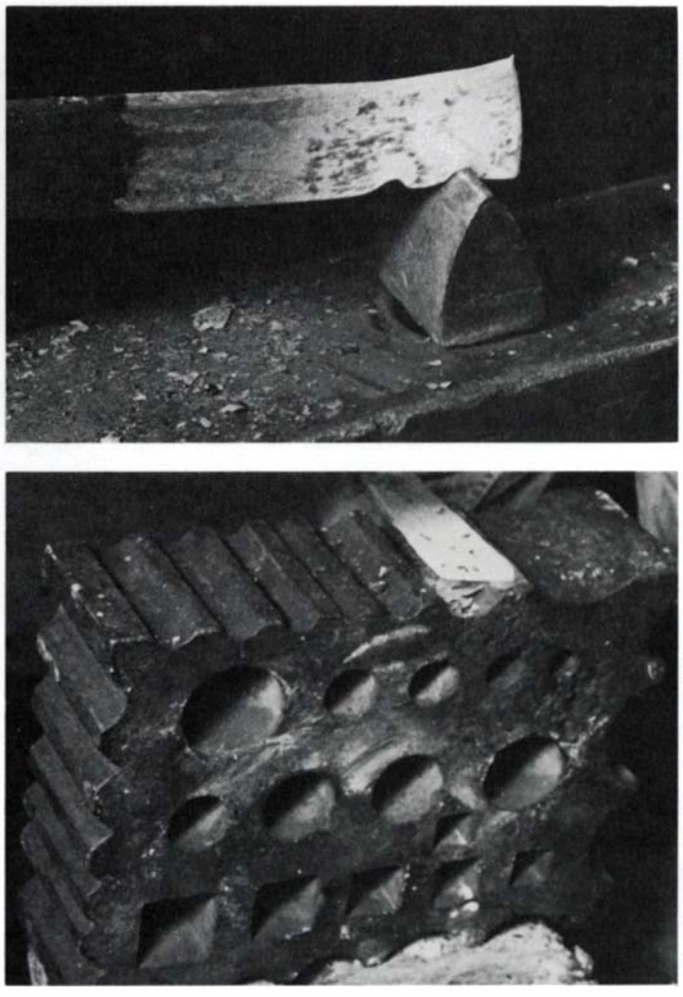
Carbon steel is the single largest type of steel produced in this country and comes in many grades. There are two good reasons for using carbon steel: It costs considerably less than specialty steel, and it comes in many toolmaking shapes not readily available in specialty steels. Prices of carbon steels vary, depending on market conditions.

The amount of carbon determines the steel's hardenability and ability to do work. Only the high-carbon steels are of concern to the woodworker, those types whose carbon content exceeds 0.50%. High-carbon steel ranges from American Iron and Steel Institute (AISI) classification 1055 (containing

Author at work. Note rack of tongs by the forge and hardies mounted in slips around base of anvil, a 350-lb. Hay Budden.



Below, fuller in hardie hole of anvil speeds drawing down steel. Bottom, swage block gives steel round or gouge-like shape.



Spark patterns identify steels

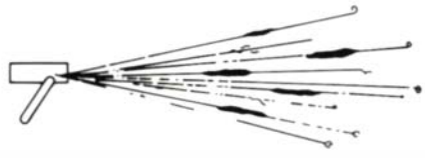
High-carbon steel: Considerable bursting, sparking around wheel. Gold/white color.

Cast iron (not forgeable): Short, thin, brick-red streamers. Very slight sparking.

Medium-carbon steel: Some exploding or bursting sparks. Some sparking around periphery of wheel.

High-speed tool steel: Similar to high-carbon steel but with fine explosions. Reddish streamers. No sparking around wheel.

Low-carbon steel: Streamers thrown from wheel are straight, light straw in color. Some small amount of sparking.



Wrought iron (inappropriate for blades): Very similar to low-carbon steel. Long yellow streamers. Practically no sparking.

0.55% carbon) to AISI classification 1095 (containing 0.95% carbon).

Decent, general-purpose tools can be forged from AISI 1055 steel, but its use is not strongly recommended. A smith forging high-carbon steels should work with the highest grades, 1085 and above. If these are unavailable, move up to a specialty steel rather than down to a lesser grade. High-carbon steel is recommended for screwdrivers, chisels, turning chisels and gouges, plane irons and carving tools.

Most of the specialty steels used in toolmaking are tool steels. They are expensive, some more than $3 a pound. Configuration is limited and finding small quantities can be a problem. They do make excellent tools, however. Commonly used types:

AISI W2 is a high-quality, water-hardening tool steel. As with high-carbon steel, it relies on carbon content (up to 1.40%, depending on producer) for hardness. Use it for tools that must hold an exceptional edge.

AISI O1 is a low-alloy, oil-hardening tool steel. It will not harden to quite the same degree as W2, but is easier to forge, harden and temper. Use it as an alternative to W2 where shape presents heat-treating problems.

AISI D2 is a high-carbon, high-chromium, air-hardening steel. Some cutlers consider it the best material for long, thin blades. It is especially good for bench knives and similar tools.

AISI S5, an oil-quenched, silicon-manganese tool steel specially designed for shock resistance, is difficult to forge but unsurpassed for tools subject to high impact. It makes excellent cold chisels.

AISI M2 is a molybdenum-type tool steel. Smiths report that it makes excellent planer and shaper knives.

AISI 440C Stainless is a high-carbon steel favored by most blade makers where exposure to the elements is a major consideration. It relies on high chromium content for its corrosion resistance. It will not hold as fine an edge as W2.

Used or recycled steel is attractive because it is cheap and some woodworkers may want to try it. Look for a scrap yard specializing in identified grades of high-carbon and specialty steels. These yards charge a premium, but knowing the exact qualities of the steel is worth it. Toolmakers can also rework certain steel implements manufactured from known types of high-carbon steel. Some typical items and the AISI steel they are made from:

Plow discs, plowshares and harrow discs, 1080; hay-rake teeth, 1095; leaf springs, 1085 to 1095; mower blades, 1055 to 1085; clutch discs, 1060 to 1070; and most heavy coil springs, 1095.

Toolmakers can apply the grinding wheel or spark test to steels of unknown composition. Steel is put in contact with a rotating grinding wheel and the resulting spark pattern is studied for clues to the nature of the steel.

Technique

There is no substitute for experience and woodworkers interested in making their own tools should seek training from an experienced smith. Most local smiths are willing to work out arrangements for instruction and forge time. In addition, several colleges and universities offer courses in blacksmithing and farriery (horseshoeing). Reading also is helpful and the following bibliography offers several excellent starting points.

The Making of Tools and *The Modern Blacksmith,* both by Alexander G. Weygers (Van Nostrand Reinhold Co., 450 W. 33rd St., New York; $4.95 each, paperback). Weygers, a sculptor, began making his own tools when he became dissatisfied with available types. His suggestions for setting up shop economically, improvising equipment and using secondary materials are particularly good.

Blacksmithing for the Home Craftsman by Joe Pehoski (Stuhr Museum, Grand Island, Nebr.; $1.75, paperback). Pehoski is a working smith who believes in plain speaking and his book is packed with good advice. His troubleshooting section is especially useful.

Blacksmiths' and Farriers' Tools at Shelburne Museum by H. R. Bradley Smith (Shelburne Museum, Inc., Shelburne, Vt.; $5.00 paperback). To understand blacksmiths' tools is to gain insight into the subtlest techniques for using them. This is the best available book on tools.

The Blacksmith's Craft (Council for Small Industries in Rural Areas [CoSIRA], 11 Cowley Street, London, SWIP 3NA; $3.50 hardcover). Absolutely the finest book available on the techniques of blacksmithing for the beginner.

Drake's Modern Blacksmithing and Horseshoeing by J. G. Holstrom (Drake Publishers, Inc., New York; $4.95 hardcover). Holstrom is disarmingly folksy but his book contains a great deal of down-to-earth advice.

The Art of Blacksmithing by Alex W. Bealer (Funk & Wagnalls Publishing Co., Inc., New York; $12.45 hardcover). This book has come in for criticism in some circles for occasional inaccuracies and oversimplifications but still contains a wealth of good information.

Decorative and Sculptural Ironwork by Dona Z. Meilach (Crown Publishers, Inc., New York; $7.95 paperback). An excellent survey of the latest work and techniques of the country's best smiths.

Blacksmith's Manual Illustrated by J. W. Lillico (The Technical Press Ltd., London; $7.75 hardcover). An excellent advanced course in smithing with special emphasis on large, complex forgings.

Carving Cornucopia

by Ann Pappert and Ray Jenkins

When the First Canadian Agricultural International Wood Carving Exhibition was announced, it seemed certain to be one of the most important carving shows held in North America this year. As part of Toronto's Canadian National Exhibition (the largest annual fair in the world, with over three million visitors) and with $13,000 in prize money, 86 categories for carvers and participation from both the U.S. National Wood Carvers Association and the North American Wild Life Carvers Association, it was a show that promised something for everyone. During its three-week run from August 17 to September 5, the show featured daily carving demonstrations, manufacturers' representatives and 1,800 entries submitted by 475 carvers from all over Canada, the United States and England.

"The Buffalo Hunter," carved by Dixie Lea Muir of Oak Grove, Mo., won Best of Show Prize, $1,000 and first place on the John Matthews Trophy.

British carver Matthews, general adviser and developer of the show, said the Muir figure was chosen for its meticulous detailing and skill in execution.

Mrs. Muir, 35, has been carving professionally for four years. She estimates that she has $8,000 worth of carving tools in her shop, most purchased through the sale of her carvings. She entered eight carvings and seven of them won prizes or judge's mention.

Entries were judged on originality and design, skill and execution in tool techniques, suitability of construction, surface finish and final presentation. The judges were Michael DeNike, director of the American Wood Carving School, Wayne, N.J.; Robert Butler, sculptor and biology professor at Pennsylvania State University; and Benoit Deschenes, a carver from St. Jean, Port Joli, Quebec.

One of the daily demonstrators was Ohio carver Huber King, winner of the Best of Show at the International Wood Carvers Congress four years running (1972-1975). King enjoys the research he does for a piece almost as much as the actual carving. "It's a real rich experience. You run into things you never realized." For his carving "The Young Settlers," the research was minimal—primarily the type of tools and clothing pioneers used. The piece meets one of King's prime criteria: that a carving be interesting from every angle. He does most of his work with a carving knife with different

Top, overall view of roped-off wildlife carving display. All the carvings were similarly displayed. Center, Huber King proudly displays his 'Young Settlers,' carved from laminated 8/4 basswood. It took him 400 hours, including research. Bottom, rear view of 'Young Settlers' shows fine detail and flowing lines.

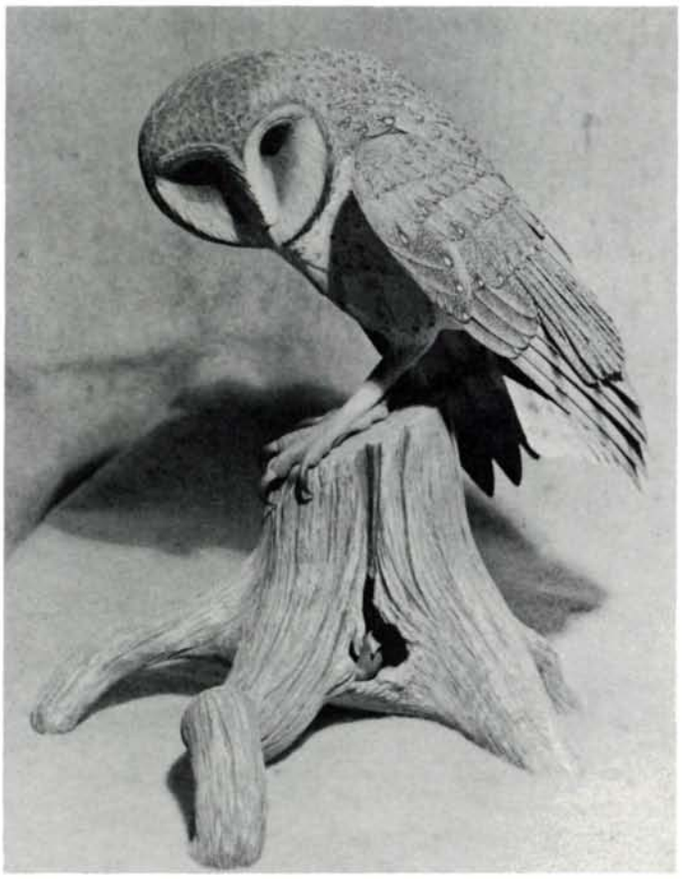
blades and gouges, and never uses power tools. "I'm just chicken, I guess," he said. He also never uses steel wool because he finds it leaves a residue that discolors his stains, which he makes from whatever paint he happens to have.

British Columbia carver Arnold Mikelson, another demonstrator, was especially popular with visitors. He specializes in spectacular fantasy animal forms, carved in a species of eucalyptus. Since this show was heavy with realistic pieces, Mikelson's carvings seemed even more fantastic, and his demonstrations were always crowded. Through it all, Mikelson never lost his intense concentration on his work.

The organizers of the show had arranged to ship several hundred carvings directly to Toronto from the International Wood Carvers Congress, a major annual show held in early August at the Great Mississippi Valley Fair in Davenport, Iowa. This connection and the promise of big cash prizes helped produce the avalanche of 1,800 entries, more than anyone had expected. Show officials were frankly stunned. "As more and more carvings arrived, we kept throwing up shelves for some place to put them," one organizer said. The result was a jam-packed display area, which was roped off from visitors. Thus pieces crowded together on wall shelves were often 10 ft. away from viewers. The combination of distance and sheer numbers of carvings made it impossible to get a clear view of most of the work, much less to appreciate the high quality of craftsmanship.

Nonetheless, all those connected with the show agreed it was a huge success, and Canadian National Exhibition officials plan to sponsor it again next year.

Ray Jenkins is a Toronto cabinetmaker and Ann Pappert is a free-lance journalist. They are writing a book about Canadian furniture makers.



Dixie Lea Muir's 'The Buffalo Hunter,' above, carved from a single block of black walnut and 15 in. high, won Best of Show prize. 'Snowy Owl,' carved by William Schulz of Scandinavia, Wis., won Best of Class prize for life-size decorative birds.

Carving Lab

A basic exercise for beginners

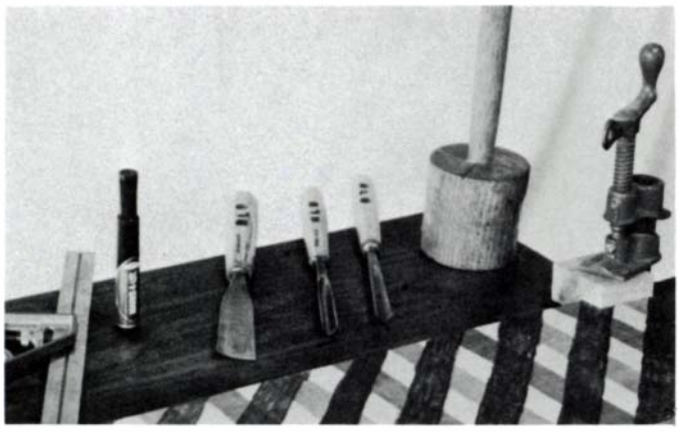
by Robert L. Buyer

Woodcarving classes are usually unstructured meetings where a teacher advises and helps a student with a carving project. This method has the advantage of enabling a student to produce a finished carving immediately. The disadvantages are needless time spent fumbling around, often discouraging results, and at times the creation of poor work habits. This is how I learned to carve. I've often thought that some simple exercises in basic tool handling would have helped me tremendously, and would have reduced the time it took to learn.

Therefore, in preparing to teach woodcarving last year, I developed a tool lab to introduce the basic techniques. It went rather well, and I hope it will help both novice carvers and other teachers. I am not advocating hours of tedious exercises, one after another, which must be mastered and yet produce only chips. These exercises concentrate on the gouge, parting tool and veiner, and how the various cuts are affected by the grain of the wood. Just experiment with it and observe carefully at each step.

You'll need a piece of soft wood (pine or bass) at least 6 in. wide, 10 in. long and 1/2 in. thick; two clamps for holding the wood to the bench; one or more carver's mallets, preferably of different weights and styles; a carpenter's square, soft pencil and a broad felt-tip marker; and three straight (not bent) carving tools—one gouge (such as a 5-sweep, 20 mm), one veiner (about 12 mm) and one parting tool (about 6 mm).

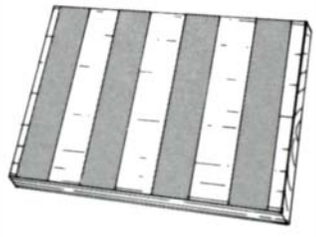
Please don't rush out and buy a kit of tools just for this exercise. If you have access to professional tools through a school or a friend, by all means use them. If you don't have access to tools and are sure you want to take up carving, then the three tools needed for this exercise constitute a beginning set and should be bought individually. You will be ahead of the game, both artistically and financially, if you buy full-size, professional-quality tools one at a time. As you gain skill, you will learn exactly which ones to buy next. A few fine tools are much better than a roll of small, clumsy ones. Swiss tools (my favorites because of their iron, shape and octagonal handles) currently cost between $5 and $10 each, and the three specified here can be purchased for about $20 total.



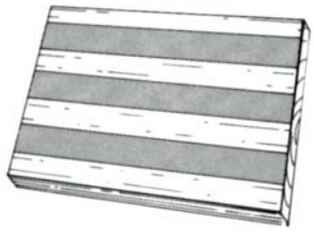
Carving lab equipment includes (left to right) gouge, veiner, parting tool and mallet. Clamps hold down board marked for cutting; lines parallel to grain are drawn on underside of board.

1. Draw a series of parallel lines on the wood, about an inch apart. Draw some lines parallel to an edge, some perpendicular to this edge and some at a 45° angle. With the marker, shade between the lines to make a band parallel to the edge of the board, another band perpendicular to the edge and a third band on the diagonal. Now clamp the wood securely to the top of the workbench, with the clamps as close as possible to the ends of the board.

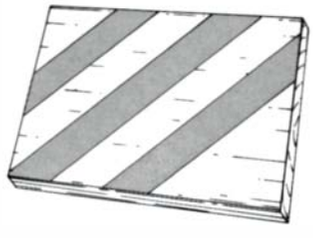
2. Use the gouge and mallet to cut across the grain and remove the shaded band perpendicular to the edge of the board. Hold the gouge in your minor hand (left if you are right-handed) and the mallet in your major hand. Drive the gouge across the board from near to far, first cutting one edge of the shaded band, then the other.



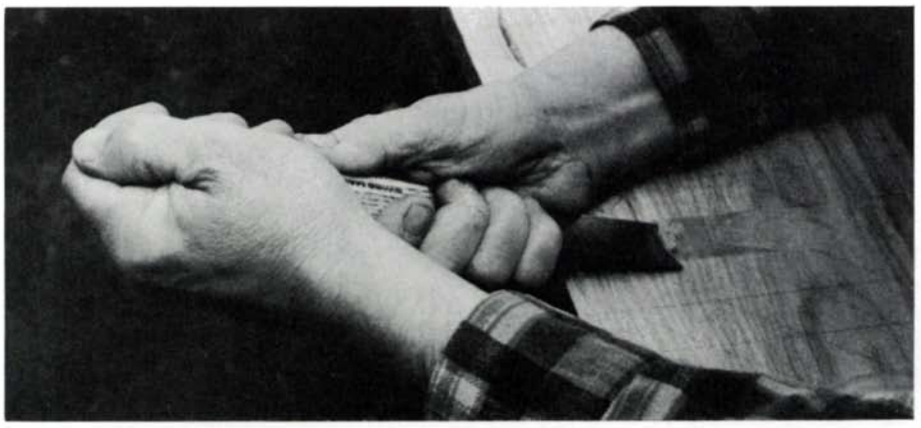
3. Make a cut along the grain to remove the shaded band parallel to the edge of the board, again holding the gouge in your minor hand. Use the mallet to drive the gouge along the board from right to left, first cutting along one edge of the shaded band, then the other.

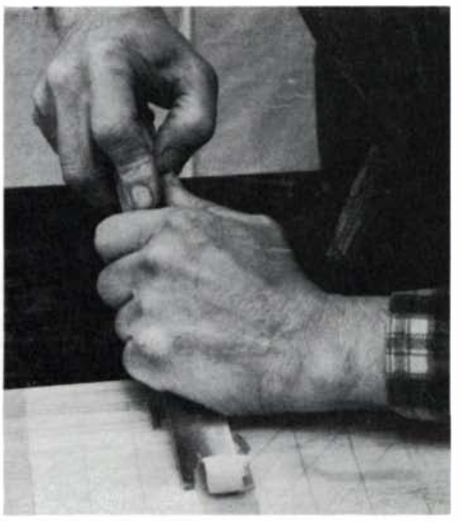


4. Now remove a diagonal band of wood, still holding the gouge in your minor hand. Use the mallet to drive the gouge across the board from near to far, cutting along one edge of the shaded band, then the other.



5. Observe the edges of the diagonal cut you just made, and note which edge is smooth and which feathered. Repeat the cut that made the feathered edge, but this time drive the



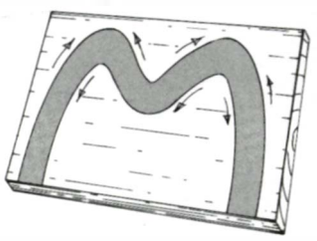


Above, gouge cut across the grain, made toward the carver. Minor hand powers cut, while major arm rests on stock for control. Right, major hand powers gouge cut across the grain, made away from the carver, with minor forearm as anchor and elbow as pivot.

gouge from far to near. Now this edge will be smooth.

6. Carve away another diagonal band, this time using the veiner to cut each edge line. Drive the veiner from far to near for one edge and from near to far for the other, so that both edges are smoothly cut. Then use the gouge and mallet to clean out the wood between the veiner cuts. Carefully compare these results with the band cut by the gouge alone. Repeat, but this time use the parting tool instead of the veiner.

7. Use the felt-tip pen to draw an arch-like design on the wood, as in the diagram. The band should be about an inch wide, and the design should begin and end at the edge of the board. Carve out the band, using the veiner or parting tool followed by the gouge, as in step 6. Change direction as necessary to get smooth edges all around the design.



8. Now repeat all of the preceding steps, but change hands—carving tool in the major hand, mallet in the minor hand. Try the exercises again, this time without a mallet.

9. If you have more than one mallet, or access to other carving tools, try the same exercises with them and carefully compare the results using large and small tools of the same shape, or tools of different shapes, but the same size.

By now it should be very clear that a carving tool produces a smooth edge on the side that cuts with the grain, and a feathered edge on the side that cuts against the grain. The tools can cut toward you or away from you. You can hold them in either hand, and you should be able to select the proper tool for a task. You are well on your way to becoming a carver.

The following is advice about using carving tools. These points are presented not as gems of wisdom cast off by the sages, but as the condensate of the blood, sweat and tears of a dozen years of carving.

—Drive parting tools and veiners without rocking motion. Drive gouges with one rock per cut, to get a slicing action.

—Use the proper-size tool. Never "bury" the corners of a carving tool in the wood. If both corners are not visible you are cutting too deep or using the wrong size or shape of tool.

—Always keep two hands on tools: either one on the carving tool and one on the mallet, or both hands on the carving tool. Never use the palm of the hand as a mallet.

Mallet powers gouge; guiding hand holds center of tool and pivots from elbow.

—For easy identification, position the carving tools on the bench (not on the work) so the cutting edges face you.

—To rough out carvings in-the-round or remove the ground of a relief carving, cut across the grain, usually with a veiner and mallet.

—Draw lines on the carving with a parting tool.

—Finish cut with gouges, using a slicing cut and no mallet.

—In lettering: First, incise the center; second, cut from each side to the center; then cut serifs.

—In relief carving: First, remove ground; second, set in edges; third, smooth ground close to final depth with no. 3 spoon and/or carver's router; fourth, model carving.

—Use a soft pencil and dividers frequently to check dimensions on the plans and redraw on the stock.

—Whenever possible establish "points" of measure on the carving and plans. Mark these points with an *X*. Points are usually extremities (such as the tip of the nose, center of the head, bottom of the throat) and joints (ankle, knee, hip, shoulder, elbow, wrist).

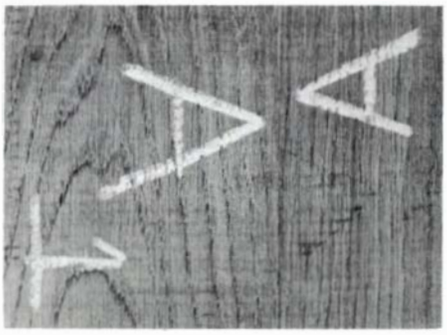
—Begin the carving at the place containing the most excess wood. Continue by carving away layers of wood—do not work on one area until it is complete, then move on to another. Instead, work on the carving as a whole, going around and around and making smaller and smaller cuts as you approach the final dimensions.

Bob Buyer, 45, is a technical writer who also teaches woodcarving and runs a sawmill/lumberyard in Norton, Mass.

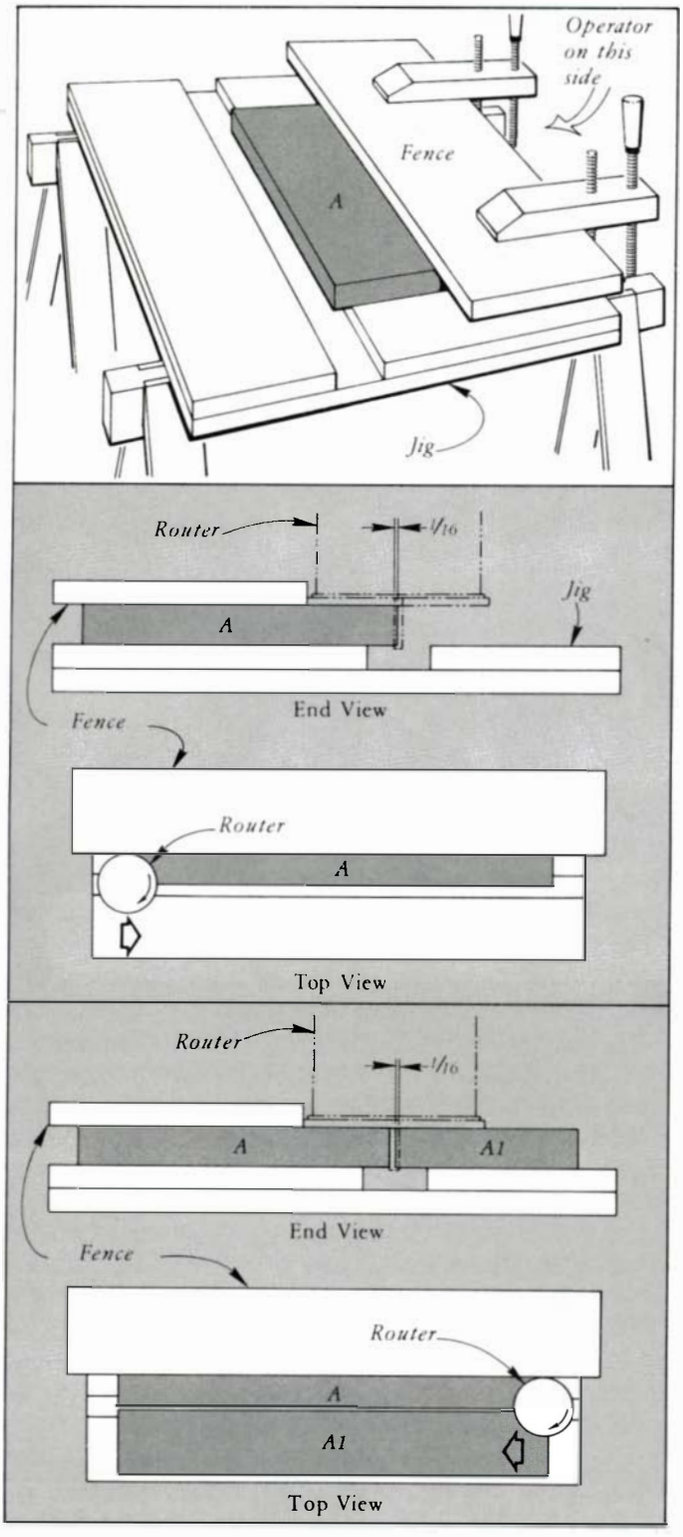
Routed Edge Joint

Fence guides router for seamless fit

by John Harra



Joint is invisible.



A basic task of woodworking is joining two or more pieces of wood to make a wide piece, with no apparent seam, for things like tabletops. It can be a difficult, time-consuming job and one that does not always turn out well. I have developed a system for edge-joining pieces of wood using a router, several clamps, a jig, a ruler and a fence. The results are consistently near-perfect and, with a little practice, can be achieved in a few minutes.

Ideally, two pieces of wood would mate perfectly if they were held edge-to-edge and both edges were cut smooth with a single pass of the router. Any variation from a straight line would be mirrored on both pieces. The router is a most versatile tool, but even at 22,000 rpm it isn't powerful enough to cut that way. My system uses a fence to guide the router along the edge of the first piece to be joined; then the second piece is clamped facing the first and routed against the same fence. Thus any bumps or hollows in the fence are imparted to the first piece and transferred in reverse to the second piece. A hill in one piece will have a corresponding valley in the adjoining piece. The two pieces of wood are perfect mirror images and when joined, look like a single piece of wood.

This router system of edge-to-edge lumber joining can be used to match two pieces with "S" curves or irregular compound curves, as well as straight pieces, as long as the curves are gentle. Thus beautiful grain patterns don't have to be disrupted by straight-line cuts. By joining along the natural flow of the grain, rather than through the grain pattern, you can build a large table apparently constructed from a single piece of wood.

The species and thickness of wood are really not critical. I've routed everything from pine to ebony. Anything from 1/4 in. to 2 in. thick can be routed easily. I have routed 3-in. thick maple using a special bit. With soft woods it is more difficult to get a clean edge because the grain doesn't shear and cut as easily and often rips away. Harder woods have more resistance and break away cleanly.

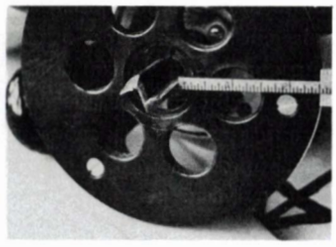
For this kind of routing, a straight bit is used because the two edges to be joined must be perpendicular to the surface of the wood and parallel to each other. Convoluted or fluted bits won't work. Nor will a bit with a narrow cutting area. The cutting surface of the bit has to be at least 1/2 in. in diameter—3/4 in. is best because the peripheral speed makes the smoothest cut with minimum friction. Also, the chips are the right size for the router motor to blow away. With larger bits, the chips are larger and tend to pile up. The bit should be long enough to cut at least 1/4 in. deeper, and preferably 1/2 in. deeper, than the thickness of the wood. The shank size of the bit is important, too. A 1/2-in. shank is pref-

erable. If you have a small router with only a 1/4-in. collet capacity, you'll have to rout very slowly because of the tremendous strain on the bit. If the bit bends—and it can—it becomes eccentric and can whip itself out of the machine.

Now on to the process of achieving a flawless edge joint. You'll need to construct a routing jig to hold the edge of the wood off the bench so the router can cut the entire surface to be joined. Cut a piece of 3/4-in. thick flakeboard, 18 in. wide and longer than the longest boards you plan to join. Glue or nail two more pieces of flakeboard or plywood on top of this piece, one about 6 in. wide and the other about 10 in. wide, leaving a 2-in. space between them. This gap not only allows the router to cut below the surface of the wood, but also provides a path of escape for the sawdust. This is important because unexpelled sawdust can work around the bit, fill up its normal clearance space and cause it to whip dangerously back and forth.

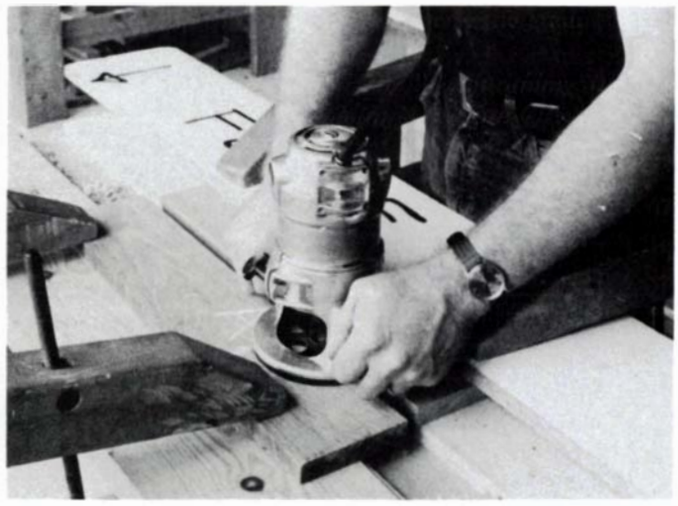
Rest the jig on sawhorses, rather than your workbench. Four large clamps—I prefer wooden jaw clamps—will be needed to hold the lumber on the jig. The routing fence can be made from any piece of 3/4-in. material such as flakeboard or plywood. It should be at least 6 in. wide and at least 4 in. longer than the lumber you'll be routing.

Mark the pieces of wood to be joined (*A-A1, B-B1,* etc.) so it will be easy to identify matching pieces. It's best to match all the lumber you'll need for the whole tabletop first, and then join it together. Take either piece from a pair to be joined and place it—let's say it's *A*—on top of the jig so that the edge to be routed is over the slot in the jig. Then place the fence on top of *A*. The key to the operation is the distance between the leading edge of *A* and the front edge of the fence. It must be a little more than the distance from the cutting flute of the router bit to the outer edge of the router base. To determine this distance, first insert and tighten the router bit. (Be sure the router is unplugged and the off-on switch is off.) With a ruler flush against the bottom of the router, rotate the bit by hand so that it just ticks the end of the ruler, and read the distance to the edge of the router base. The distance varies from router to router, but let's say it's 2-1/2 in. The fence is then clamped down at both ends so that it is exactly this distance from the edge to be routed plus 1/16 in. This means the router will be cutting away 1/16 in. from the leading edge of the lumber.



To begin routing, stand between the clamps with the fence in front of you. Hold the router with the left hand and turn it on with the right hand. Place the router flat on piece *A* with the bit just off the wood to the right. You will rout from right to left so that the blade, which is rotating clockwise when seen from above, is cutting into the wood. Holding the router firmly, bring it toward you against the fence, and move it slowly into and along the wood from right to left.

After routing *A*, turn the router off and leave *A* clamped in place. Place the adjoining piece of wood, *A1*, on the jig so that the edges to be joined are facing each other and separated by the diameter of the bit (in this case 3/4 in.). Now, move piece *A1* 1/16 in. closer to piece *A*—the amount of wood you will remove from *A1*. Clamp *A1* down and check both ends to be sure that the distance from *A* is exactly the diameter of the bit less 1/16 in. If the gap is too narrow, the router may stall. And if you have to interrupt the cut, you are almost certain to ruin it.



Operator guides router along fence from his left to right to cut 1/16 in. from second piece of wood.

Now turn on the router and, standing in the same position, place it at the left end of the jig, with the bit just off the edge of the wood. You'll be routing from left to right this time. The router rests on both *A* and *A1*, and is held against the fence. In this position it will cut off 1/16 in. from *A1*, but nothing from *A*.

After you've finished routing *A1*, turn the router off. Unclamp *A1* and bring it forward to *A* (which is still clamped in place) to check for errors. If the pieces don't quite match, you can rout another 1/16 in. If there are gaps, you haven't routed deeply enough. If the pieces have been routed correctly, there is only one position in which the boards will join. When the right alignment is found, the seam will virtually disappear. Pencil a fine line across the joint to help match the pieces again when you're ready to glue them.

The same procedures can be used to join wood along curves. Visually match the grain of the pieces to be joined. Mark the faces of the pieces *P* and *P1*. Draw the desired cutting line on *P* and using a band saw, sabre saw or hand saw, cut along this line. Place *P* over the mating piece *P1*. Trace along the line you've cut and cut piece *P1*. You'll now have two roughly-mated pieces. Again using *P*, trace along a new piece of wood to be used as a fence and saw along this line. Follow the same procedures for setting up the wood and routing as for a straight-line joint. Curved edges routed in this manner will not be perfect mirror images, especially when the curve is severe. But a slow curve or a gentle "S" curve will fit together nicely to form a clean joint.

Flaws in this system are caused by flaws in the wood. Avoid severely twisted wood, narrow boards and wood with knots. Cupped or bowed wood can be clamped flat for routing and planed level after glue-up. Rout the flatter board first, tacking a piece of plywood on top of it to obtain a stable surface. Finally, a word about grain. What you have to do is stop and think, which way is the grain going? Then if the router is tearing it up flip the wood over to reverse the grain.

John Harra, 33, owns the John Harra Woodworking Studio, a cabinetmaking shop and school in New York City.

All three Shaker round stands are made of cherry and finished in clear varnish. Stand at left (The Shaker Museum, Old Chatham, N. Y.) is subject of this article; center stand (Metropolitan Museum of Art) has tapered Sheraton-style convex legs dovetailed into urn-shaped pedestal; right, top of early 19th-century stand (The American Museum in Britain, Bath, England) is 16 in. in diameter.

Shaker Round Stand

Three legs are dovetailed to turned pedestal

by John Kassay

Round stand is a name given by Shakers to the pedestal, tripod candle stand. These stands were derived from the English Queen Anne and Sheraton styles. American cabinetmakers made them less ornate and Shaker cabinetmakers further simplified the stands in line and form, in accordance with their religious doctrines.

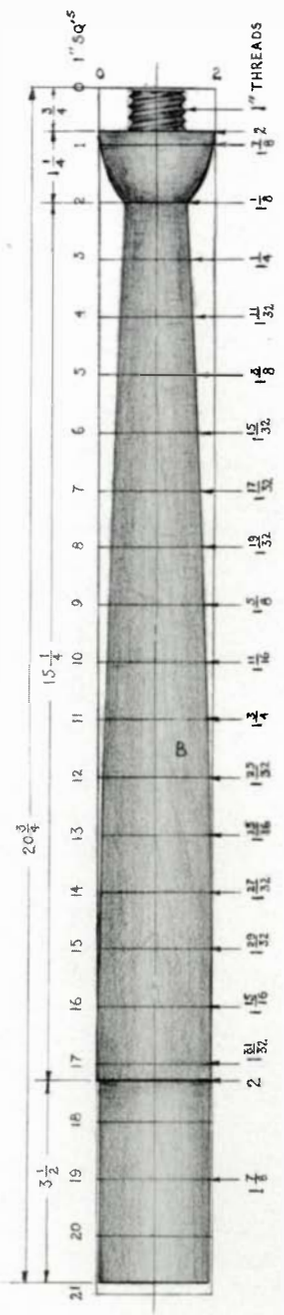
The stands shown here were all made in the first half of the 19th century, when the Shaker sect was at its peak. They were used to furnish the retiring rooms of the Shaker's communal dwellings, which often housed 100 or more people. Today, these graceful stands make lovely accent tables. To duplicate the one shown, you need about 7 board feet of cherry.

Construction of the stand should start with the legs (*A* in measured drawing). Draw a full-size pattern of the leg, including the dovetail pin, on a piece of thin cardboard and carefully cut it out. Mill the stock for the legs to the required 3/4-in. thickness and position the pattern on the wood with the grain of the leg in the longest direction, as in the front-view drawing. Trace the pattern three times and then separate the legs with rough cuts; make no attempt to cut to size. The ends of the blank that will form the dovetail and the bottom of the foot are now cut precisely to length and perpendicular to each other. Sandwich the legs together and firmly nail two scrap pieces of 1/4-in. plywood on these end surfaces. This assembly is now sawn to final shape and sanded as a single unit. Separate the legs, lay out the dovetail pins very precisely and cut the shoulders and sides with a dovetail saw. Of course they can be cut on the table saw, but that makes the operation less personal. Clean up with a chisel.

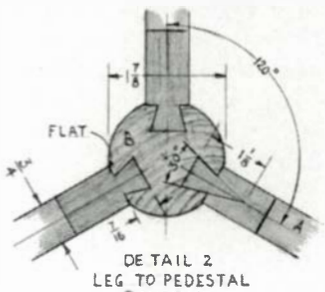
To make the pedestal (*B*), turn a piece of cherry, 2-1/8 in. square and 20-3/4 in. long, to a 2-in. cylinder. Lay out the pedestal with its upper end at the tailstock. To make an exact reproduction of the original stand, mark pencil lines along the cylinder at 1-in. intervals to locate parting tool cuts at the diameters shown. The experienced turner, like the craftsman who made the original, will find it sufficient to part the smallest and largest diameters. Remove the excess wood with a gouge. Then the pedestal is rough and medium-sanded.

A tenon, 1 in. in diameter and 11/16 in. long, is established on the upper end of the pedestal to hold the disc (*C*). On the original table, wood threads fasten the pedestal to the disc. If you have a 1-in. wood threading tap-and-die set, by all means use it. Otherwise, the tenon is simply glued into a hole in the disc. At the lower end of the pedestal, turn an absolutely straight cylinder, 1-7/8 in. in diameter and 3-1/2 in. long. This is where the legs will be dovetailed to the pedestal. Finish sanding the pedestal while it is in the lathe. Be sure to

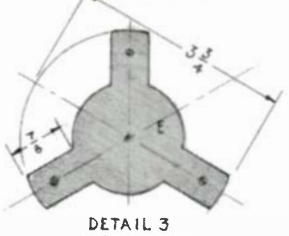
John Kassay, 58, teaches cabinetmaking in the Department of Design and Industry at San Francisco State University.



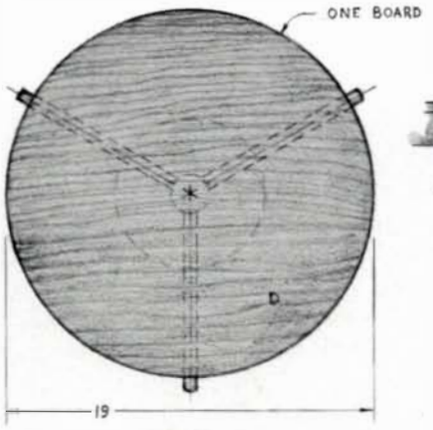
DETAIL 1
PEDESTAL TURNING



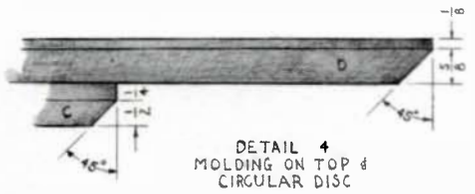
DETAIL 2
LEG TO PEDESTAL
DOVETAIL



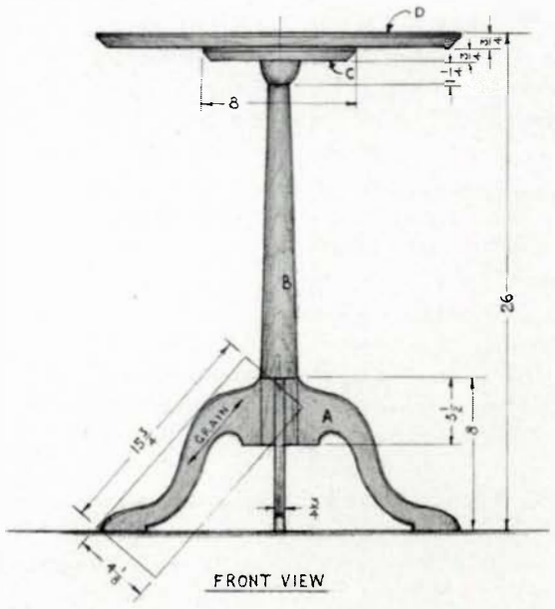
DETAIL 3
SHEET METAL
PLATE.
20 GA.



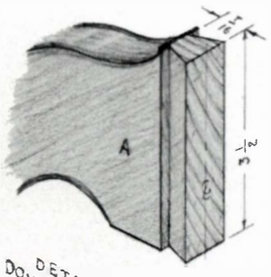
TOP VIEW



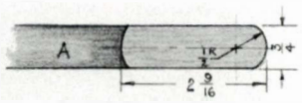
DETAIL 4
MOLDING ON TOP &
CIRCULAR DISC



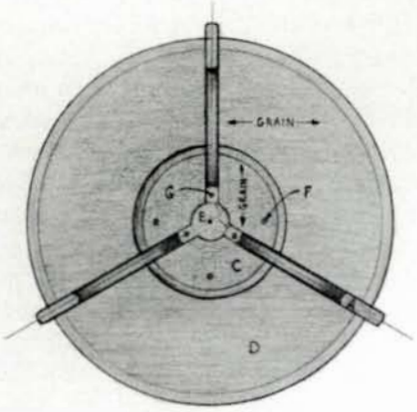
FRONT VIEW



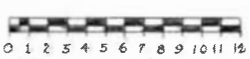
DETAIL 5
DOVETAIL ON LEG



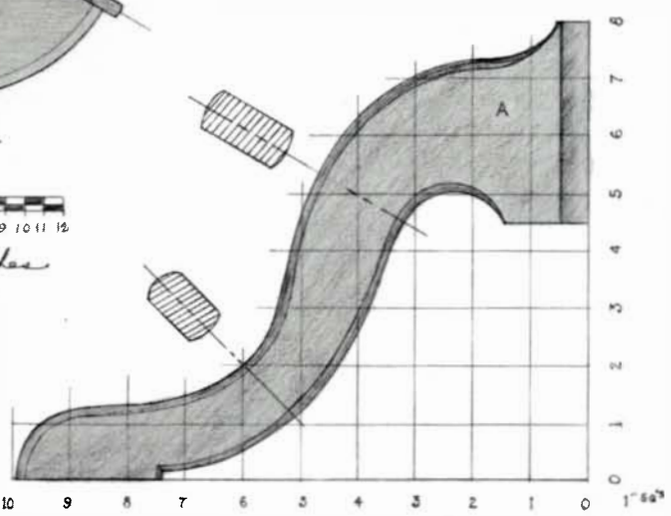
DETAIL 6
UNDERSIDE OF FOOT



BOTTOM VIEW



Scale in Inches
all Views



DETAIL 7
LEG IN PROFILE AND SECTION

COLLECTION OF
THE
SHAKER MUSEUM
OLD CHATHAM, NEW YORK.

Scale in Inches - all Details

MEASURED & DRAWN by John Kassay

dampen the wood to raise the grain, and sand along the pedestal with the lathe turned off in order to remove any circular scratches.

Choose the most attractive grain pattern on the pedestal and locate one leg here. The other legs will be located 120° right and left from this point (detail 2). Index the legs to the pedestal with pairs of identification marks. Lines establishing the center of each leg are drawn on the bottom of the pedestal and extend along the sides. Then parallel lines 3/8 in. from these center lines are drawn on each side. To enable the legs to seat properly against the pedestal, absolutely flat surfaces must be cut within these outer lines. Cut a series of kerfs with a backsaw and pare away the excess wood with a sharp chisel. Redraw the center lines on these flat surfaces, using the center lines on the bottom as a guide. Draw lines 3/16 in. on each side of these center lines to indicate the thickness of the dovetail pins, 3/8 in., at their shoulders. Hold each leg in position against the bottom of the pedestal, and trace the outline of each dovetail pin (three lines for each) on the bottom of the pedestal. These three lines, along with the two parallel lines on the flats, determine the material to be removed to produce the dovetail sockets. With a brace and a 5/16 auger bit, bore a series of holes along the center line of one leg. Count the number of brace revolutions to gauge the depth. The waste wood is removed with wood chisels. Patience along with much trial fitting is now necessary. Make certain right from the start that the leg is being committed perfectly straight; do not force the leg in place. These dovetail sockets may be produced using a router, a dovetail bit and a home-designed jig for supporting the router while the piece is still in the lathe (see p. 20). On the other hand, by the time you have tooled up, you could be gluing up. After the legs are fitted to the pedestal, they are disassembled and a spokeshave and abrasive paper are used to form the curves on the upper and lower edges, as shown in section in detail 7.

Plane stock for the circular disc (*C*) to the finished 3/4-in. thickness. Mount it on a lathe faceplate and turn to the indicated diameter and chamfer. Finish-sand while the disc is on the lathe and bore a 1-in. hole on center for the dowel end of the pedestal. The disc may instead be bandsawn as described below. Bore and countersink four equally spaced holes for flathead wood screws (*F*), which fasten the disc to the top.

Fabricate the top (*D*) from three or four narrow boards that have compatible grain patterns. The circular shape and undercut chamfer can be turned outboard on a lathe, made with a hand router or a homemade circle-cutting jig on the band saw, or cut by hand with a bowsaw or a sabre saw.

Before assembly, the parts of the stand should be rough, then medium-sanded. Make a jig of plywood to hold the legs and pedestal in an upright position while the glue hardens. Apply glue to both pins and sockets.

The disc is first screwed to the top with its grain 90° to the grain of the top and then glued or threaded to the pedestal.

Shakers often used a thin, sheet-iron plate (*E*) to reinforce and cover the dovetail joint. If your dovetails have been well made, the plate is not necessary.

To finish the stand, raise the grain and fine-sand. Carefully dust and apply a coat of clear furniture varnish. If a stain coat is desired, it should be of a brown shade and is applied before the first varnish coat. Three or four varnish coats are necessary. The final coat is hand-rubbed with fine (4F) pumice or rottenstone lubricated with lemon oil, and waxed.

Cutting Corners

How to mount marquetry

by Peter L. Rose

Many marquetarians still use white glue and a press to mount their pictures, because they aren't sure how to use the modern contact glues. And many who have advanced to contact glue use a brown-paper slip-sheet to align the picture and the board. Either way, it is very difficult to make mitered border veneers meet precisely at the corners of the mounting board. The methods described here are the least complicated and most direct solutions to these problems.

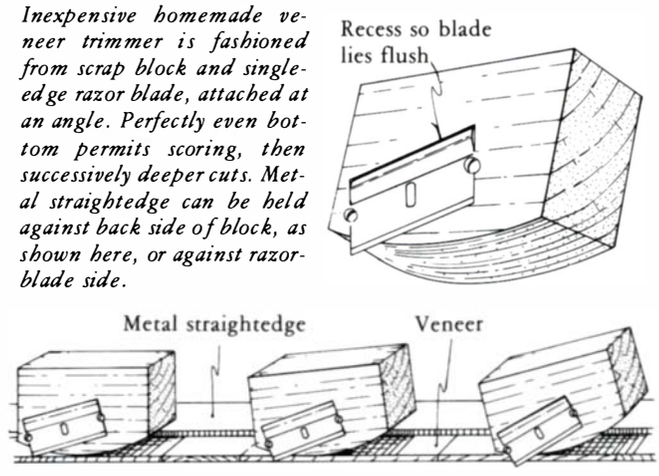
Trimming veneer

Once the marquetry picture is complete, the edges must be trimmed square and clean so the border veneers can fit tightly against them. Use a carpenter's square to mark two adjacent sides, and continue around the picture by lining up one arm of the square with one of the lines previously drawn. With a single-edge razor blade, make several passes against each edge. Do not try to cut through in one pass as this may damage the veneers.

My $30 foreign-made veneer trimmer works well on straight-grained veneers but not on irregular-grained wood. This trimmer is difficult to operate because the blade has to be set at a fixed depth; it is awkward to control when going over the veneer in several passes. Used in one pass, its cut is not perfectly straight and either splits the wood or follows the grain. This trimmer is not to be confused with a veneer saw, which works well, but for a perfectly flush cut (in matching veneers or making borders) sawn veneer must have a final sanding or planing in a wood jig.

My own veneer trimmer costs almost nothing and for me it works better. The advantage is that several passes can be made, lowering the blade a little each time by a slight hand movement. Thus it is easier to trim irregular grains and hard

Inexpensive homemade veneer trimmer is fashioned from scrap block and single-edge razor blade, attached at an angle. Perfectly even bottom permits scoring, then successively deeper cuts. Metal straightedge can be held against back side of block, as shown here, or against razor-blade side.



veneer. The 3/4-in. wide block of wood keeps the blade perpendicular. Because of the curved bottom, each pass can cut more deeply. The curved bottom can be cut with a sabre saw, or on a power jigsaw with the table perfectly flat. Medium sandpaper glued or attached with double-faced tape to the bottom of a metal ruler makes a guide that will not slide on the veneer. I change blades frequently—one blade can be used twice by turning it around. Dimensions of the trimmer aren't critical, but the bottom must be even, or it will stray away from the straightedge.

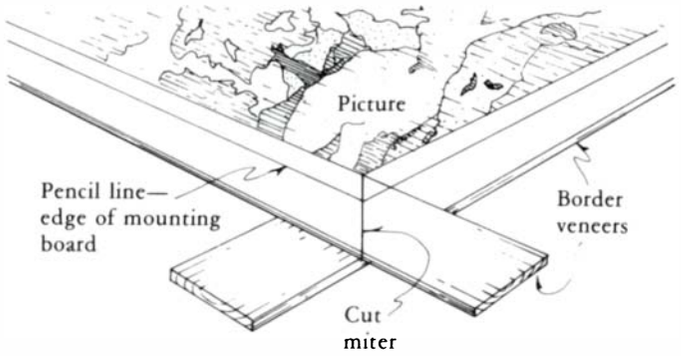
Borders

Four strips of veneer should be prepared for the borders, but a good inch wider than required and several inches longer. Lay them tightly along each side of the picture, front side up, with the corners overlapping, and tape to the front. Now turn the picture over, so the back side is facing up, as in the drawing at the bottom of this column. Put two small pencil marks on each border veneer an equal distance from the picture itself, cut the mounting board to size, and align it between these marks. Pencil a line around the board on the border veneers and write "back" on the board so you can replace it exactly the same way. Remove the board, and with straightedge and single-edge razor blade cut from each corner of the picture through the corners you just penciled on the borders. Do this very carefully, as you will be going through two layers of veneer. Remove the waste and the border miters should fit exactly together. Miters cut this way will always meet exactly at the corners of the board, even if the board is not cut quite to size or is a little out of square.

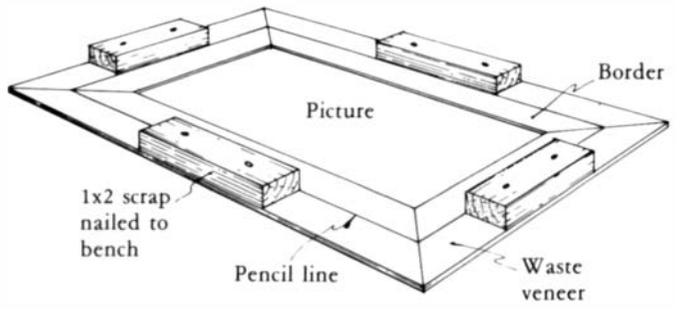
Turn the picture over again, tape the entire face with masking tape butt-to-butt, and remove the tape from the back side. In a paper cup mix crack filler (sanding dust) with white glue until it is creamy and press it into any cracks with a putty knife. Remove excess filler and lay a board over the picture for several hours. When the filler is dry, the picture is ready to glue. I prefer Constantine's veneer glue because it is thinner and easier to work with than other brands of contact cement. Do not use water-based contact glues for marquetry, because the water will cause the veneers to expand, and gaps will be created in the picture.

Back

To veneer the back of the mounting board, choose a piece of veneer about an inch too large on all sides. Lay the back side of the mounting board on the veneer and pencil a line around the board. Spread contact cement thinly on both surfaces. If the wood is porous it is best to let the first coat dry and apply a second coat. Go beyond the pencil line to make sure the edges will adhere. When the glue is dry, nail four pieces of 1x2 or similar scrap wood to the veneer along the outside of the pencil lines. This creates a frame into which the mounting board can be dropped, to ensure perfect alignment. The scrap wood won't stick to the veneer because contact glue must be on both surfaces before it can make a bond.

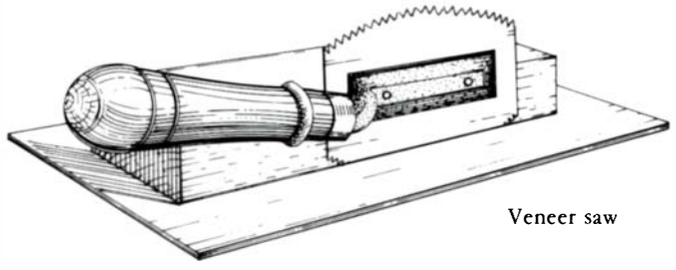


With reverse side up and oversize borders taped to picture, miters can now be cut through both borders at once to ensure perfect fit.



Scrap pieces nailed to waste veneer outside pencil lines form frame that aligns mounting board during glue-up with contact cement.

Carefully lift the board by its edges and turn it over, glue side down. Hold it over the veneer, a fraction of an inch below the surface of the four pieces of scrap wood, and drop it squarely into place. Apply a little pressure with your hands, then remove the nails holding the scrap to the bench. Turn the board over and roll down the veneer to ensure contact. Now with your veneer saw trim off the overhanging veneer.



Always triple-check everything before gluing, because veneers once glued cannot be moved.

Edges

The edges of the board should be veneered next. Apply glue to two opposite edges and to two oversized veneer strips. When the glue has dried (usually about 20 minutes), hold the mounting board over one of the veneers and slowly lower it into place. Roll to ensure good contact, then trim with the veneer saw. Do the opposite edge next, then the remaining two sides in the same manner.

At last the board is ready for the picture itself. Lightly sand the back side of the picture, to make sure it is smooth and free of lumps. Lay the mounting board on the picture, with the back sides of both facing up, to verify that the miters, corners and pencil marks line up properly. Mark an *X* on the top edge of the board and of the picture so there will be no guessing, apply glue to both surfaces, let it dry, and tack down the guide strips, as when veneering the back of the board. Drop the board into place, roll down tightly and trim the edges. Your picture is ready for sanding and finishing.

Pete Rose is a founder of the Marquetry Society of America and writes for the Society's newsletter.

Small Turned Boxes

Grain direction determines technique

by Wendell Smith

Walnut box, 6-in. diameter.

Small wooden boxes offer the woodturner an excellent opportunity to try his hand at design. I would like to describe some techniques I use to make boxes for storing small items such as jewelry. One approach to the design of such turnings that I particularly like is to inlay circular veneers into box lids. The availability of many figured veneers allows an almost unlimited number of attractive wood combinations. Some wood/inlay combinations I enjoy are: walnut/thuya burl, padauk/ebony, maple/ebony, cherry/tulipwood, mahogany/madrone burl, mahogany/amboyna burl, walnut/*Dalbergia sp.* (rosewood, cocobolo, kingwood, etc.).

Depending upon whether the grain is to run horizontally or vertically in the completed box, the sequence of operations in box turning is somewhat different. I've divided the discussion according to this difference.

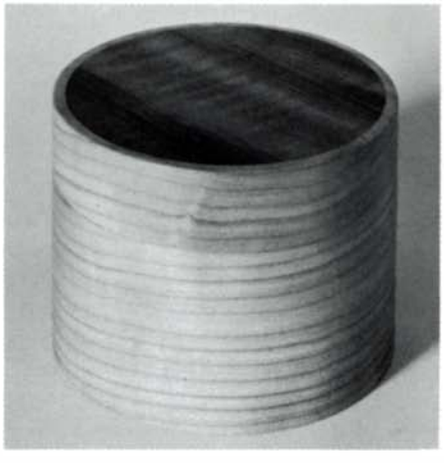
Grain is horizontal

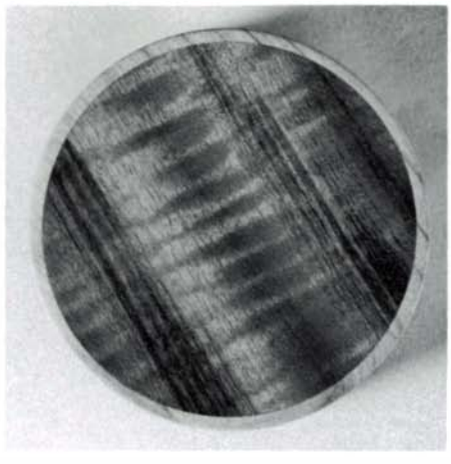
Turning boxes of horizontal grain involves primarily faceplate techniques. Useful lumber thicknesses are 2 in. and 3 in. With 2-in. stock, I generally use the full thickness for the base, and resaw another piece from an adjacent section of the same board for the lid. This point is quite important, because differences in color and texture between boards can be very apparent if one is used for a base and another for a lid. A 3-in. blank may be resawn into 2-in. and 1-in. pieces for the base and lid, thus permitting the figure to carry through from top to bottom. Resawn lid blanks should be given ample time to return to equilibrium with the ambient humidity prior to turning. Then glue round waste blocks of 3/4-in. plywood with paper interleaving to the bottom of the base and the top of the lid. Polyvinyl acetate (white) glue and brown wrapping paper serve the purpose satisfactorily. The faceplate, of course, is screwed to the waste block.

I turn and finish-sand the inside of the lid first. The lid is then removed from the lathe and the glue block split off. The base of the box is placed on the lathe, and a shallow recess turned to accept the lid with a snug fit. The base is now capped with the lid, and the two held together with a flat center in the ball-bearing tailstock. The support of the tailstock eliminates the necessity for a tight jam fit. Unless a jam fit is very tight, slippage may occur when turning the base and the lid together, which invariably burnishes the wood. And a very tight fit may require prying to remove the lid, which can easily damage the box. Before capping the base with the lid, the top edge of the base is sanded. Thus, those surfaces on the base and lid that contact each other are now complete, and so is the inside of the lid. With this arrangement, the side of the box and lid may be worked together, and then finish-sanded. Before removing the tailstock, the lid is "clamped" to the base by wrapping the joint with masking tape. I use 1-1/2-in. tape, which is amply strong.

The top of the lid is now finished as desired. One precaution: If a knob is desired, it is usually better to add a separately turned one rather than to turn the lid and knob from the

Wendell Smith, 46, is a research associate in color photography at Eastman Kodak in Rochester, N. Y. His turnings, which he sells through art galleries, have been exhibited in several juried craft shows. Smith uses a Rockwell-Delta lathe and Sorby gouges.





Grain is horizontal in 3-1/2-in. diameter cherry box, left, with koa veneer inlaid into its lid, center. Box at right is goncalo alves, 4-1/4 in. in diameter. Although both boxes are plain cylinders, subtle changes in shape make each distinct.

same piece. Because a large amount of wood must be removed from the top of the lid to leave a knob, re-equilibration of the lid with the ambient humidity may lead to cupping.

Upon completion of the top of the lid, the masking tape and lid may be removed and the interior of the box finished. Boxes in which the grain runs horizontally rather than vertically are more prone to develop sticking lids with humidity changes. Consequently, the interior of the box should be sanded until the lid fits loosely. For this type of box, a loosely fitting lid is a properly fitting lid.

There is a trick to removing waste plywood blocks that prevents damage to the bottom of the finished turning. The splitting wedge (an old plane blade) should be inserted between the two layers of the waste block closest to the paper interleaving—not between the waste block and the paper. This removes about 80% of the plywood. The remainder, still glued to the paper, has no strength and is easily pried off with a chisel. Scraping and sanding complete the job.

To inlay a veneer into a box lid, the first step is to soak, press and dry the veneer. Once dry, the veneer should be kept under moderate pressure to keep it flat until ready for use. It is then clamped with a circular wooden block against a wooden faceplate previously flattened in the lathe. The wooden block is held in place with a ring center in the ball-bearing tailstock. The ring center indexes the block for later re-centering at the gluing stage. The block should be about 1/8 in. smaller in diameter than the desired circle of veneer.

A tool rest is now brought as close as possible to the veneer and block. With the lathe running at a slow speed, the veneer is cut using a skew or diamond-point chisel. Using this method I have cut circles with undamaged edges even from recalcitrant veneers such as burls.

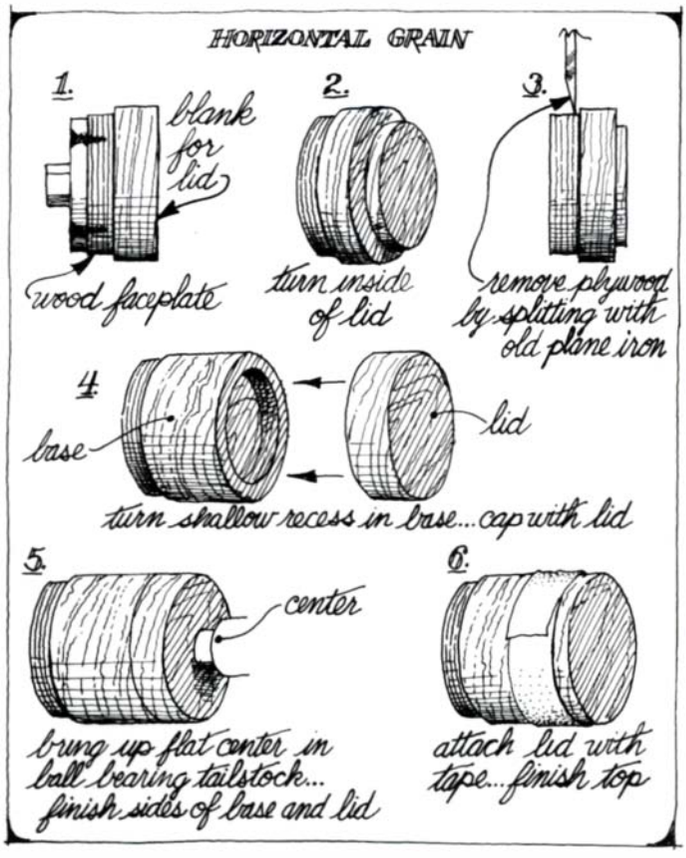
To prepare the box lid for the veneer, I first turn a slightly undersize recess. A "straight-across" scraper is used to flatten the bottom of the recess. The diameter of the recess is carefully enlarged by using a parting tool to pare off a small amount at a time. This means frequently stopping the lathe to test the fit, a tedious but necessary process. The fit should be snug—anything less results in an unsightly glue line. I remove the tightly fitting veneer for final gluing with the shop vacuum cleaner, using the last gentle gasp of suction after the vacuum has been turned off.

To attach the veneer, I use a polyvinyl acetate (white) or an aliphatic resin (yellow) glue, both of which are water-based. Put the glue on the box lid—not on the veneer. A water-based glue applied to the veneer will cause the veneer to expand rapidly and it will be difficult to fit it into the recess. Finally, the inlay is clamped in place in the lathe using the same circular wooden block (previously indexed with the ring center for re-centering) as was used in cutting the veneer, with waxed paper inserted between the veneer and block. After overnight drying in the lathe, the lid may be finished.

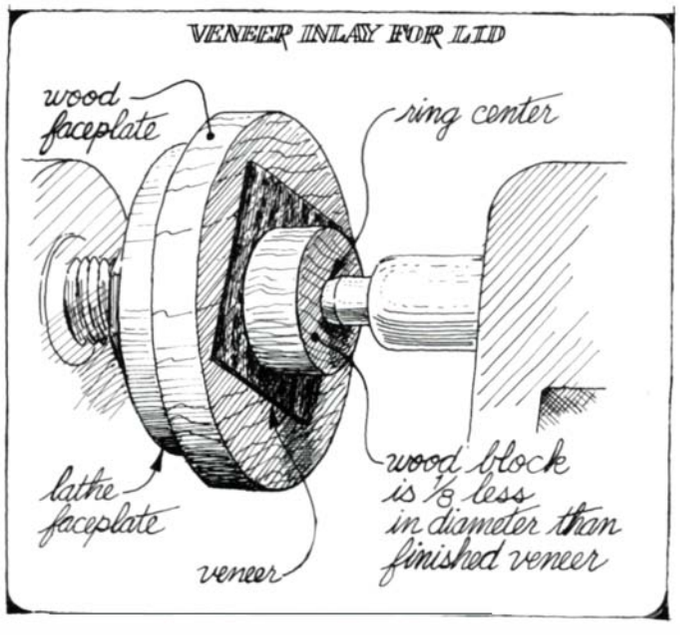
Grain is vertical

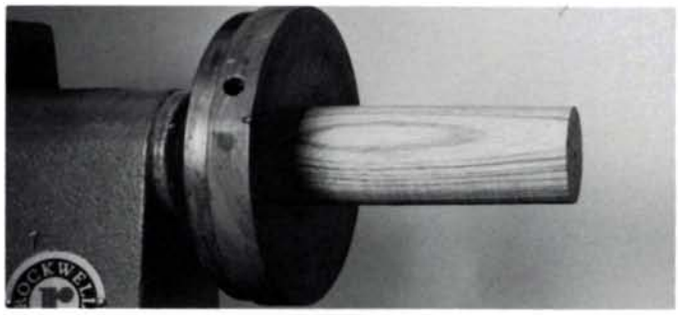
I generally turn vertical-grain boxes (such as a ring box) from 2x2 spindle-turning stock. Because the lid is separated from the base on the lathe, allowance must be made for some waste.

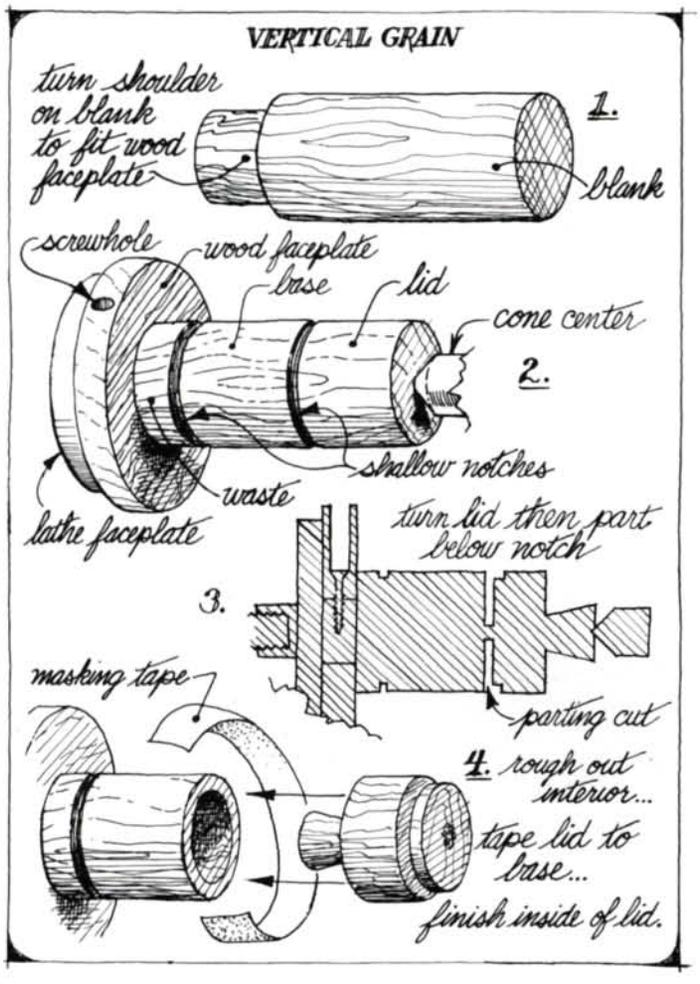
The blank is first placed in the lathe between centers and turned to a cylinder. A shoulder is then turned at one end to fit tightly into a homemade chuck, as shown in the diagram,

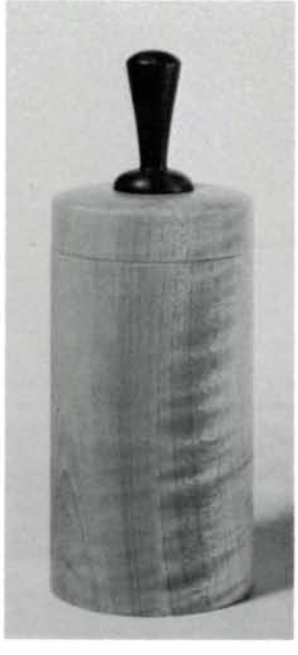


Horizontal-grain box in cherry, 10 in. diameter, 2-1/4 in. high, shows design possibilities permitted by the method diagrammed above. Lid is mostly finished with tailstock for support, then taped in place for final shaping of knob.









and securely fastened with two countersunk screws.

The lid can be prepared in two ways. If the wood is figured, it is desirable to have the figure carry through from base to top in the completed box, as shown in the photograph. Consequently, when the lid is parted from the base, it must go back on the same way it came off. If the wood has little or no figure, it is somewhat easier to prepare the lid in the reverse sense; that is, after parting from the base, the lid is turned around and refitted. Since the method for figured wood is more involved, I'll describe it in detail.

The cylindrical blank, fastened to the chuck, is mounted in the lathe with a cone tailstock center supporting the free end. After truing so that the cylinder runs smoothly, a shallow notch is cut with the parting tool where the lid will meet the top of the base. A second shallow notch is cut at the bottom of the base, no closer than about 1/2 in. from the chuck. These notches assist in visualizing the relative proportions of the base and lid and other aspects of the design of the box. In estimating the height of the lid, about 3/16 in. extra should be allowed at the tailstock end for later removal of the cone center mark. Shrinkage and expansion are not much of a problem with vertical-grain boxes, so a knob may be turned as an integral part of the top.

The knob and top of the lid are first roughly turned to the desired shape. Then the lid is parted from the base, the parting tool entering the cylinder about 1/8 in. below the notch previously cut between base and lid. The interior of the base is next partially roughed out to accept the inverted lid, which is fastened to the base by wrapping the two with masking tape. This automatically centers the lid, and its inside, including the shoulder, is now easily finished. A slicing cut with the skew is ideal for finishing the bottom of the lid, as this exerts little force and leaves a surface that requires a minimum of sanding. After sanding the bottom of the lid and shoulder, the masking tape and lid are removed.

The turning of the remainder of the box is similar to the method for horizontal-grain boxes. The interior of the base is first enlarged so the lid will fit snugly. The tailstock is brought up, and the side of the box and lid are worked together. The joint is then taped, the tailstock removed, and the handle and top of the lid completed. One must take very thin slicing cuts at the end of the handle to avoid breaking it. Finally, the lid is removed and the interior of the box is completed.

I remove the box with a parting cut that goes nearly to the center of the cylinder. To prevent fibers from being torn from the center of the base, I terminate the parting cut when about 1/4 in. of wood remains. Parting is completed with a coping saw, leaving the 1/4-in. nubbin of wood on the box. The box is then turned around and snugly fitted to the approximately 1/2 in. of waste wood still protruding from the chuck, by turning the waste wood to size. The box is supported with the tailstock cone center touching the nubbin, and all but the very center of the base can be cleaned up with a slicing cut of the skew, followed by light sanding. The nubbin is then removed with a jeweler's saw and any remaining waste sliced off with a chisel. Hand sanding completes the base.

Homemade chuck holds cylinder with vertical grain, photo at top, for turning sequence shown in the drawing. At left is soft maple box, 1-7/8 in. in diameter and 5 in. high, with separately turned knob of walnut. Myrtlewood box, right, is 2 in. in diameter and 3-3/4 in. high.

Hardware Specialists

Catches, latches, locks, escutcheons, casters, table slides, hinges...

Readers often ask us for sources of specialty hardware, for example, a Chippendale door pull, miniature hinges, or fittings for a baby's crib. In order to respond, we sent a questionnaire to 49 retailers, wholesalers and mail-order firms. The information below is adapted from these questionnaires and from catalogs. This alphabetical listing cannot be inclusive: There are more firms than we know of, and we haven't tried to list every item offered. But it is a starting place for the craftsman looking for a particular mechanism or a period hardware style. We hope readers will tell us about other sources, and we'll pass the information along in a future report.

Note: Some firms sell "wholesale only," a term with various meanings. In some cases the buyer must be in business and purchasing for resale, not for personal use; in others, meeting the minimum order is the only restriction. Check before ordering.

The following firms carry a complete line of hardware that includes cabinet hinges, hinges for clocks, pivot, knife and invisible hinges, reproduction hardware, pulls, locks, knobs, handles, escutcheons, casters, gliders, catches and latches, with specialties and hard-to-find items as noted.

Antique Hardware, 24 Birch Ave., Toronto, Canada. (416) 962-0471. Catalog, $1.00; $5.00 minimum order. Complete line; custom bathroom fittings, grilles. This company does not export outside of Canada.

Ball and Ball, 463 W. Lincoln Hwy., Exton, Pa. 19341. (215) 363-7330. Catalog, $2.00; $4.50 min. Brass hardware to customer specifications; repair of furniture and house hardware. Very complete line of brass and iron reproduction hardware, cast and extruded hinges, bed fittings, clock finials, much more.

Ballsun Co., 1953 S. Alameda, Los Angeles, Calif. 90058. (213) 749-7171. Wholesale only. Catalog, $5.00; $10.00 min. Complete line; shelf supports, bed fittings, knockdown fittings, table slides, drawer slides, lift and lid mechanisms, upholstery hardware.

Barap Specialties, 835 Bellows Ave., Frankfort, Mich. 49635. (616) 352-9863. Catalog, $0.50; no min. Complete line; lamp hardware, drawer slides, lazy Susan bearings, Swiss musical movements, upholstery hardware.

J. D. Beardmore & Co., Ltd., 3-5 Percy St., London W1P 0EJ, England. (01) 637-7041. Catalog, $8.20; no min. Complete line; French, Chippendale, Victorian, Colonial, wrought-iron reproduction hardware. Handmade grilles.

A. Constantine & Son, Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461. (212) 792-1600. Catalog, $0.50; $5.00 min. Complete line; bed fittings, drawer hangers, lift and lid mechanisms, upholstery hardware. Special hinges include concealed piano, lazy-tong, rising butt.

Craftsman Wood Service Co., 2729 S. Mary St., Chicago, Ill. 60608. (312) 842-0507. No wholesale. Catalog, $0.50; no min. Complete line; bed fittings, knockdown fittings, table slides, upholstery hardware, lift and lid mechanisms. Swiss music movements, chair swivels, wrought iron legs, sewing machine hinges, lamp hardware.

18th Century Hardware Co., Inc., 131 E. 3rd St., Derry, Pa. 15627. (412) 694-8421. Catalog, $2.00; $50.00 min. Complete line; custom hardware. H, HL and card-table hinges. Full line of reproduction hardware includes Heppelwhite, William & Mary, Queen Anne; bed fittings, porcelain casters.

Faneuil Furniture Hardware, 94-100 Peterborough St., Boston, Mass. 02215. (617) 262-7516. Catalog, $2.00; $5.00 min. Reproduction hardware in many styles. Cast brass Chinese character pulls, leg ferrules, platform-rocker springs, lazy Susan bearings, finials. Hinges include card-table, folding-screen, invisible.

Gaston Wood Finishes, Inc., Box 1246, 3630 E. 10th St., Bloomington, Ind. 47401. (812) 339-9111. Catalog, $1.00; $4.00 min. Casters, pulls, knobs, latches, escutcheons, shelf supports, door hinges.

Otto Gerdau Co., 82 Wall St., New York, N. Y. 10005. (212) 943-6200. Wholesale only, $50.00 min. Complete line; importers of European cabinet hinges, miniature hinges, knockdown fittings and upholstery hardware.

H. A. Guden Co., Inc., 1593 Bangor St., Copiague, N.Y. 11726. (516) 842-5140. Wholesale only, $20.00 min. Complete line; shelf supports.

Minnesota Woodworkers Supply Co., 21801 Industrial Blvd., Rogers, Minn. 55374. (612) 428-4101. No wholesale. Catalog, $1.00; $5.00 min. Complete line; steel table legs, brass grilles, piano hinges, porcelain casters, revolving-shelf hardware.

Period Furniture Hardware Co., 123 Charles St., Boston, Mass. 02114. (617) 227-0758. Catalog, $2.00; no min. Custom hardware; reproduction hardware in many styles, procelain knobs, drapery holdbacks, brass doorknobs.

Rocky Mountain Antique Hardware, 2344 9th St., Denver, Colo. 80211. (303) 455-0182. Wholesale only. Free catalog, no min. Custom brass hardware, full line of reproduction hardware, bathroom fittings, shelf supports, bed fittings, drawer hangers.

Selby Furniture Hardware Co., 17 E. 22nd St., New York, N.Y. 10010. (212) 673-4097. Wholesale only. Catalog, $1.00; $25.00 min. Complete line; vertical bed mechanisms, knobs and handles, concealed hinges, modern pulls, lift and lid mechanisms, knockdown fittings, table slides.

Simon's Hardware, 421 Third Ave., New York, N.Y. 10016. (212) 532-9220. No mail order. Complete line. Specialists in cabinet hardware, with more than 23,000 items in stock. Knockdown fittings, lift and lid mechanisms.

Trans-Atlantic Co., 420-40 Fairmount Ave., Philadelphia, Pa. 19123. (215) 629-0400. Free catalog, $25.00 min. Wholesale only. Importers of butt hinges, fasteners, pulls, knobs, handles, locks, escutcheons, catches, latches.

Noel Wise Antiques, 6503 St. Claude Ave., Arabi, La. 70032. (504) 279-6896. Catalog, $1.00; $4.00 min. retail, $50.00 wholesale. Complete line; extruded brass hinges, shelf supports, bed fittings, rolltop desk hardware, key bows, finial hinges, butler's tray hinges.

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The following firms do not carry a complete line but are hardware specialists, as noted.

Aaron Supplies, 435 Benefit St., Pawtucket, R. I. 02861. (401) 724-9790. Miniature (1 in. = 1 ft.) Chippendale drawer pulls and butt, H, HL and T hinges.

Acorn Manufacturing Corp., Mansfield, Mass. 02048. (617) 339-4500. Wholesale only. Catalog, $1.00; $25.00 min. Colonial and wrought-iron reproduction hardware, shelf supports.

Bergen Point Brass Foundry, 179 W. 5th St., Bayonne, N.J. 07002. (201) 339-1351. $20.00 min. Cast brass items to order. Brass, bronze and aluminum hinges; table legs, shelf brackets.

Delson Hinges, Inc., 5 Tosun Rd., Waterbury, Conn. 06716. (203) 879-1451. No mail order, $25.00 min. Custom hinges, also hinges for cabinets, clocks, miniatures, tables and chests.

George Gordon, Box 144, 3850 Monroe Ave., Pittsford, N. Y. 14534. (716) 586-5160. No wholesale, no min. No catalog. Solid cast brass cabinet hinges; pivot, knife and invisible hinges, lift and lid mechanisims.

Philip J. Grande, 513 E. Orange Grove Ave., Burbank, Calif. 91501. (213) 848-8715. Wholesale only. Miniature (1 in. = 1 ft.) Chippendale drawer pulls and butt, H, HL and T hinges.

Reliance Import Co., 15616 S. Broadway, Box 84, Gardena, Calif, 90247. (213) 532-9777. Wholesale only. Free catalog, 1 case min. Importers of far Eastern divan hinges and hardware, casters.

S & S Hinge Co., 9467 River St., Schiller Park, Ill. 60176. (312) 678-0770. Free catalog, $25.00 min. Custom, continuous and butt hinges.

Terry Hinge and Hardware, 14606 Arminta St., Van Nuys, Calif. 91402. (213) 787-9000. Wholesale only. Free catalog, $50.00 min. Custom hardware; knockdown fittings, lift and lid mechanisms.

Tremont Nail Co., 21 Elm St., Box 111, Wareham, Mass. 02571. (617) 295-0038. Free catalog. Minimum order, 1 lb. per size, retail. Old-fashioned cut nails.

Unhinged

Many contemporary furniture makers strive to add a sculptural quality to the pieces they design and build. John McNaughton, an art teacher at Indiana State University-Evansville, goes a step further—his furniture can be taken apart and rearranged as abstract sculpture. Or, his abstract sculptures can be rearranged as tables. The example shown here, known alternately as "The Hinge Table" and "Who Needs a Giant Hinge?," also exhibits the artist's fascination with simple hardware parts such as the spring, hinge or chain.

McNaughton prefers to work in plywood because, like his pieces, it is neither traditional nor conventional. Thus he is not inhibited by reverence for fine hardwood or the compulsion to display its beautiful grain. And plywood comes in large, relatively cheap sheets, allowing him to experiment freely.

He favors 3/4-in. C/D fir ply because he finds it has fewer interior voids than A/D or A/C grades. It also contains less cedar, which means exposed end-grain surfaces will be a lighter, more reliably uniform color. After bandsawing the layers and gluing up his forms, McNaughton shapes the wood with 7-in. discs of 16-grit abrasive powered by an auto body grinder. He cleans up with progressively finer grits attached to soft-foam grinding heads, and finishes with satin urethane.

—Linda J. Davis