

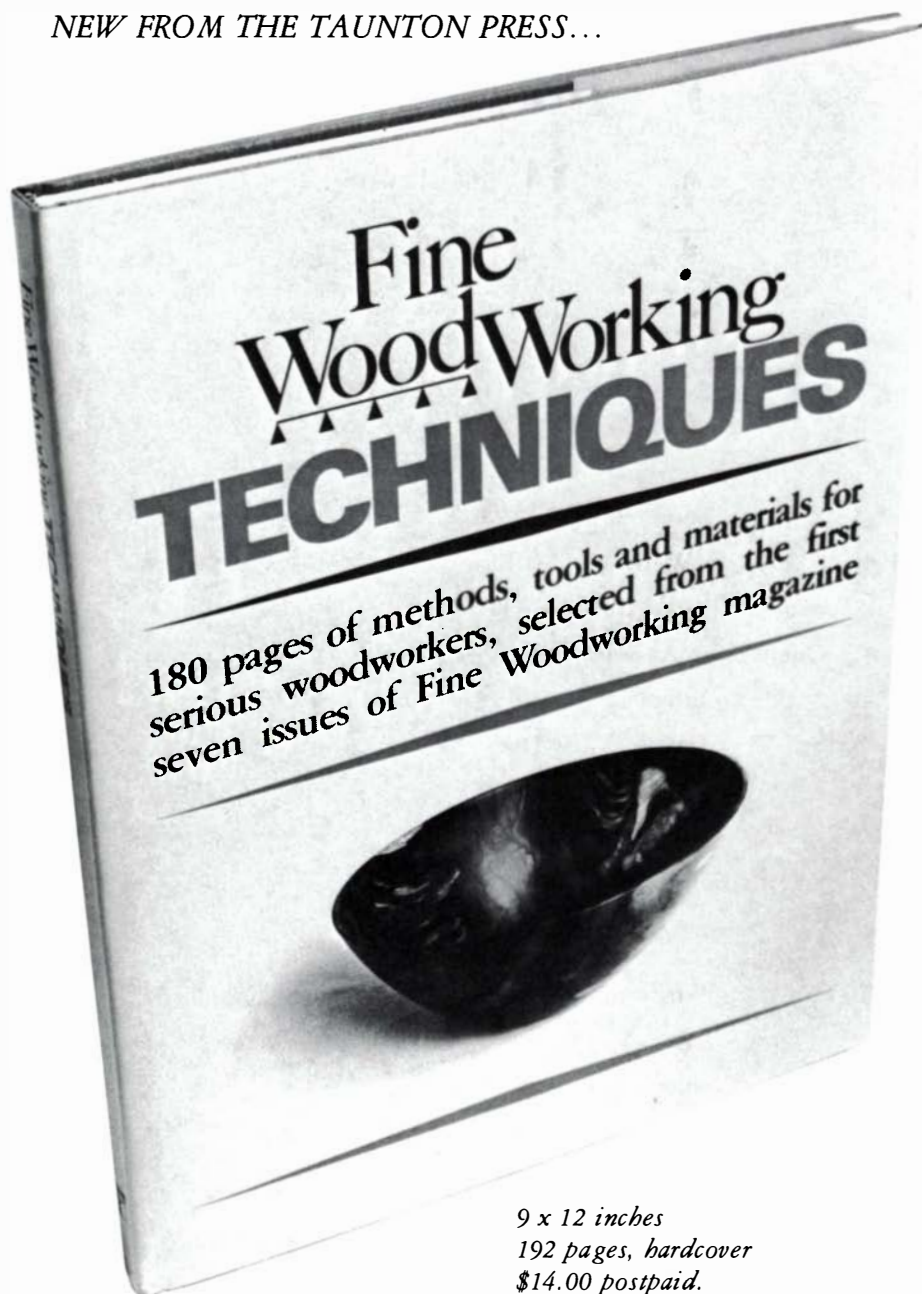
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November 1978, No. 13 \$2.50

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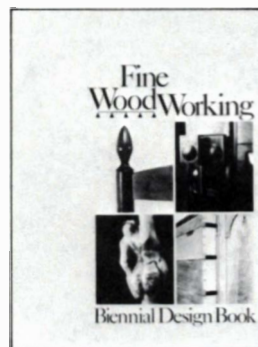
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Cover: The first steps in relief carving are outlining the design with a V-tool, then widening the outline with a gouge of medium sweep, as shown on our cover. This establishes the level of the background and makes room for trimming the raised portion to a clean, vertical edge. The carver then clears the entire background before beginning to model the design itself. With mallet and gouge, an adept carver can outline, set in and clear the waste in the time it takes the novice to find his router bits. The wood is butternut; discussion begins on page 56.

Fine Woodworking®

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LETTERS

George Frank's "Stains, Dyes and Pigments" (Sept. '78, pp. 58-59) has stirred me to write you.

I am 33, have been a working cabinetmaker for six years, and am always striving for technical improvement, as well as esthetic growth. I share the sentiment of cabinetmaker Richard Scott Newman, who has remarked that for young cabinetmakers woodworking knowledge is in a dark age, with many of us isolated from the body of classical technical knowledge, each having to rediscover techniques probably common to the European line of knowledge. Especially poor is our knowledge of finishing technique. It seems that the only persons with good, extensive knowledge are the older artisans in industry. Frank's remark on the lack of data from American finish suppliers rang so true. I use the products of a major firm on the East Coast, but haven't been able to gain comprehensive product application data from them.

—Newell White, Rochester, N.Y.

Thank you for the information on staved cones by Thomas Webb in Spring '78, (p.75). I've been working on an oak trombone and encountered the staved-cone problem when gluing up wood for the bell. This was before I discovered your article, so I had filled several pages with computation before I had an answer for the bevel setting. After making the first two pieces I could see how far off this answer was, and switched to the trial and error system with scrap wood before proceeding. I went through the same computation with your article and see that both methods agree. Would that I had had your method sooner.

I have found the Rockwell Uniplane machine to be a valuable precision tool for work of this type. Staves can be rough-sawn with band saw or circular saw setups, and then tried to a

line with the Uniplane table set to the proper angle. I notice that the radial-arm saw set up on p. 73 of the Spring '78 issue would result in making rip cuts with what is basically a cross-cut mode... perhaps not the best policy...

—Jack Freeman, Manhattan Beach, Calif.

With reference to "Making Chisels" (Summer '78, p. 18), Lester Rishel gives misleading and erroneous information on tempering a cutting edge. The term "tempering" refers to the removal of hardness from steel. Hardening is the process by which steel is heated to a cherry-red color and quenched in a liquid. In the hardened state, steel is brittle. The hardness and brittleness are reduced by drawing the temper. The hardened surface is partially polished to remove scale, then, carefully reheated until the brightened surface indicates color temperatures ranging from a light yellow to a deep blue. A dark-straw color is appropriate for percussive tools such as chisels. As soon as the proper color develops, the steel is quenched in water to arrest the tempering procedure.

Annealing is the process by which steel is heated to a cherry-red color and allowed to cool slowly. This process removes the hardness and permits filing and/or drilling...

—Joseph E. Brown, Sudbury, Mass.

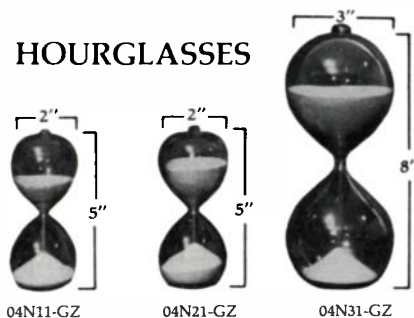
EDITOR'S NOTE: For a fuller treatment of tempering and hardening, see "Heat Treating" (Fall '76, pp. 50-52).

I enjoyed reading "Parsons Tables" by C. Edward Moore (Summer '78, pp. 70-73). I have done rather a lot of veneering, especially with the problem veneers, burls, crotches and other cantankerous sorts. I, too, like "the crispness of mitered corners that meet exactly," and wanted to find a quicker, less trial-and-error, less frustrating method when I faced 25 sets of

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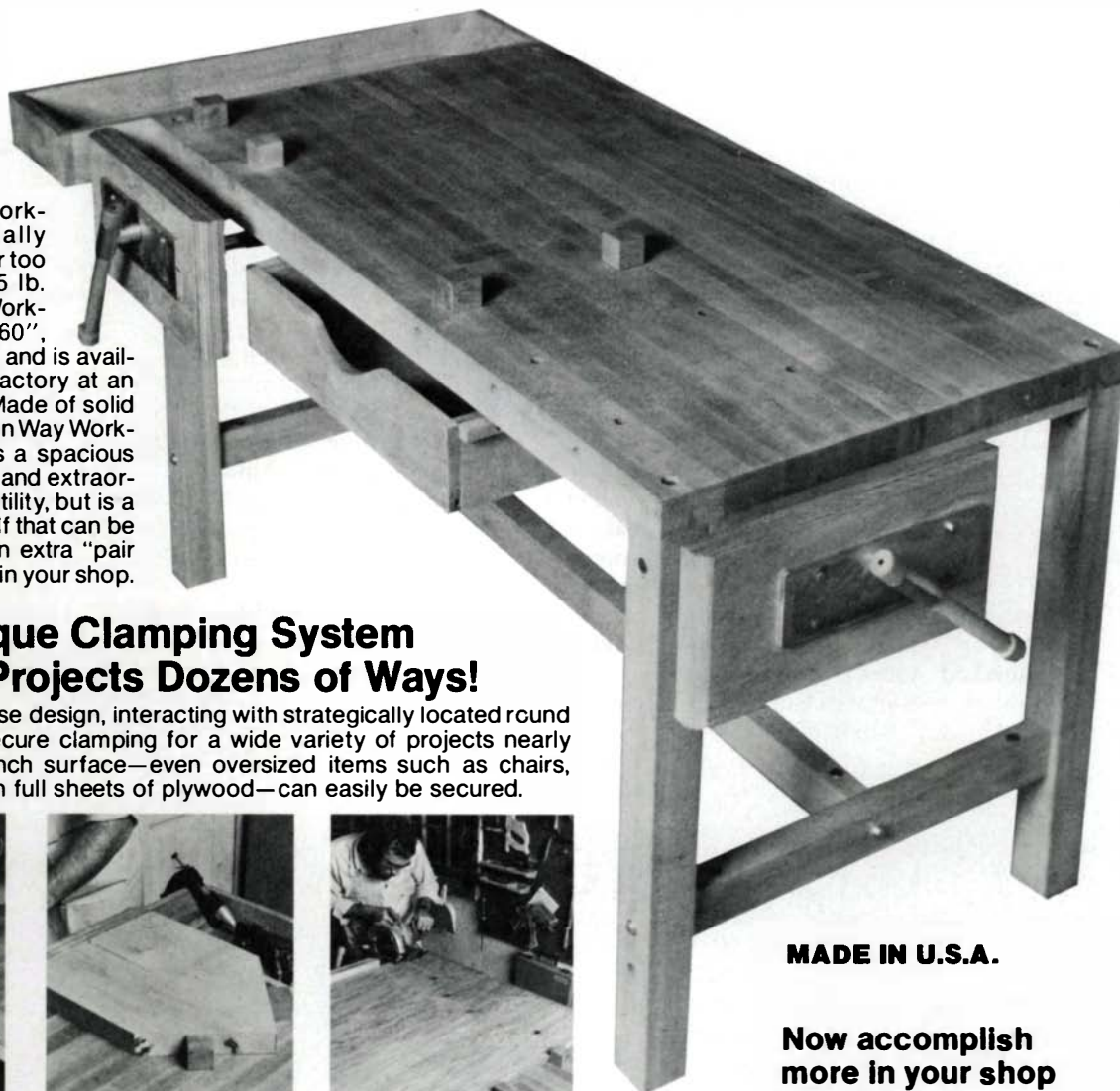
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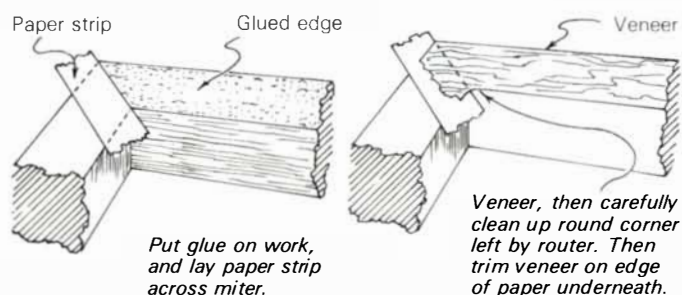
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LETTERS (continued)

custom-built speaker enclosures. Here is the method, not necessarily better, just an alternative, perhaps less tedious.

First, I prepare a strip of veneer longer and slightly wider than the surface it is to cover. Then I prepare short strips of newsprint, longer than the full diagonal length of the miter and having one long edge perfectly straight.

I spread glue on the edge to be veneered and place a strip of paper at either end, with the straight edge exactly splitting



the diagonal as determined by outside and inside corners. Then it's a simple matter of placing the veneer on its edge, making sure it overlaps everywhere. Clamp (I wax the cauls to keep them from sticking to any glue that squeezes through, a problem especially with butts and burls). When dry, I use a ball-bearing, carbide-tipped trimmer to clean up the edges, carrying the router around the corners. Trimming inside corners leaves a small radius that needs to be carefully cleaned up with a sharp chisel.

Next, place a straight edge exactly joining inside and outside corners and trim, being careful to keep the tool as nearly vertical as possible, to avoid bevel-induced gaps. If you use a

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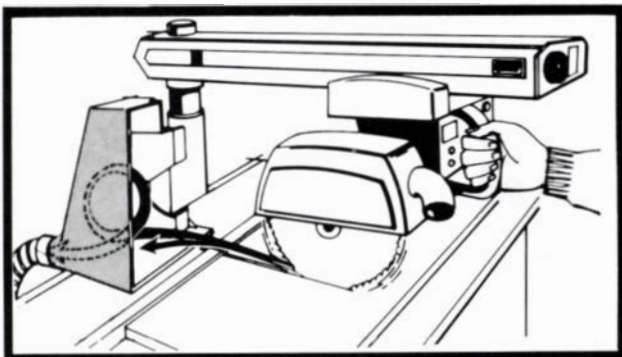
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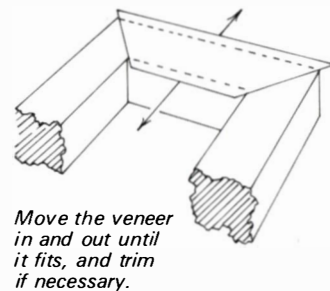
knife or razor blade to trim, pull from outside to inside corner, to avoid splitting away any errant grain.

The newspaper prevents adhesion where unwanted and allows the trimmed-off portion of veneer to be removed, leaving a perfect miter glued down exactly in place without the worry of creep or improper layout.

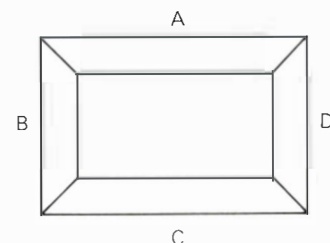
Using this method, I veneer opposite edges, trim the miters and then fit the adjacent pieces thusly: Using a strip slightly wider and a good deal longer than the remaining edge, trim a 45° miter on one end. Place this mitered end exactly as it should fit up against one end of the already glued strip. The other end should overlap the opposite glued strip. If the strip being worked on wanders too far at the other end, the first miter can be trimmed fat or thin using a straight edge. Now, down at the untrimmed end, and with the trimmed end exactly positioned, sight inside to outside corner and scribe lightly. Remove the veneer and trim the second miter ever so slightly fat. Reposition and check for exact mating. The extra width of the strip allows it to be positioned in or out to accommodate the final trimmed length. Any necessary trimming is easily seen and accomplished now.

When gluing, be sure to put glue on the mitered ends of the veneers as well as on the edge surfaces. The already positioned and glued strips keep the presently-being-glued strips from creeping. When dry, trim as before and sand.

—Alf Sharp, Woodbury, Tenn.

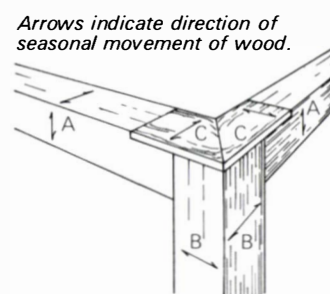


ED MOORE REPLIES: Alf Sharp has a good, workable method for veneering the edges of speakers or tables with no adjoining center field. I would adjust his sequence so as to avoid fitting two sides—he veneers in the order ACBD and fits B and D, while the order ABCD requires only one fit with two ends (piece D).



Re "Parsons Tables," I would never use a rubber roller to apply glue to veneer. The layer would be too thin, and the minute the veneer is put on it would absorb the moisture from the glue before it could be clamped down, so the veneer would not bind very well to the surface. I would apply glue with either a paint roller or a brush. Be sure to put on enough glue so after the veneer is pressed down, glue will ooze out around the edges. A piece of paper under the caul will prevent sticking.

The joint that Moore uses will eventually telegraph through. The aprons (A) will expand in the summer when the humidity is high and contract in the winter when the humidity is low. The wood will move at least $\frac{1}{4}$ in. in each direction, which means it will move a total of $\frac{1}{2}$ in. or more. The leg (B) will not move in the same direction so eventually the caps (C) telegraph through or even break off. Another joint for a Parsons table is shown in the drawing at the top of page 10. Just cut the ends of all three pieces to be joined at 45° on two





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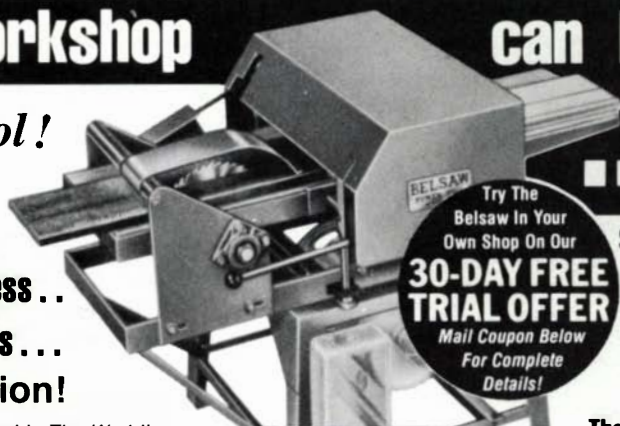
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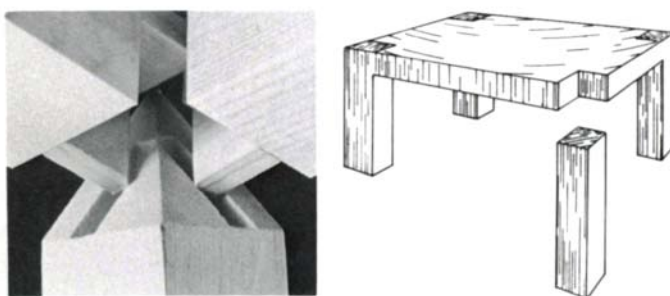
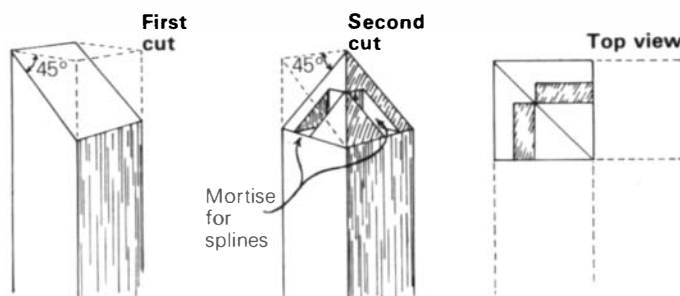
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LETTERS (continued)



Two more ways to build a Parsons table: Sequence of cuts, top, results in tricky corner joint (photo). The leg and apron pieces are cut identically. Or Parsons table can be made like a butcher-block table, right. Because long grain is being glued to long grain, the joint will be very strong, and even stronger with splines or dowels.

sides. Then rout out the grooves for the splines and the joint is ready to be glued. The pieces can be veneered before the joint is cut.

—Tage Frid, Foster, R.I.

The article in your last issue on tambours written by Alphonse Mattia was very interesting. . . In 1967 I made a hi-fi cabinet out of walnut wood. Due to space limitations I could not use sliding or swinging doors so I decided on tambour doors. Each slat was 1/2-in. walnut, 9 3/4 in. by 1 1/2 in., with each outer side slightly beveled. I used a 1/4-in. dowel at each end of each slat; thus the curve was made with a much shorter radius than using the tongue in the groove would have allowed.

—Leonard K. Pfiffner, Riverside, Conn.

Raymond Blue asks, "Isn't beeswax gummy when mixed with turpentine?" The answer is, "Yes, it sure is." I was indeed surprised that Ian Kirby even suggested beeswax for finishing, for just that reason. Furniture waxes contain, mostly, paraffin, which is easy to rub to a polish, but is rather soft, and not too long-wearing. Therefore, some carnauba or candellilla wax is added, because these waxes are harder and make a longer-wearing polish. Then the whole is blended with either mineral spirits or turpentine until it becomes a paste of the right consistency for application. I usually use a lot of mineral spirits and make my wax into a thick liquid, which can be wiped on easily, allowed to dry a while and then buffed; it saves a lot of unnecessary labor in application.

As for beeswax, a small amount can be added to a carnauba/paraffin mix to secure a duller finish. Only a little beeswax can be used, or the product becomes too sticky to polish. . . .

—John S. Carroll, Emlenton, Pa.

IAN KIRBY REPLIES: I've used beeswax all my life, and I would have stopped if it was sticky. As with any finish, it will give you problems if you use it incorrectly. If one procedure achieves a good result and a different procedure does not, then it seems to me that the procedure is at fault, not the material.

There is a limit to the amount of detail that can be included in a short article, especially on as complicated a subject as wood finish-

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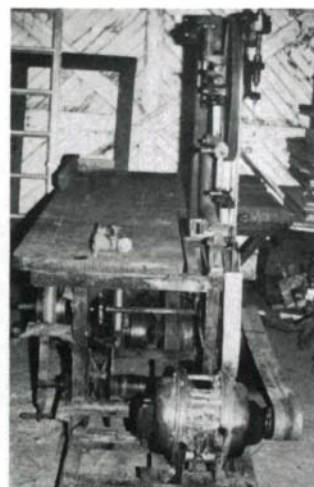
ing. For emphasis, I would repeat that the turpentine in which the wax is dissolved must be pure—mineral spirits cannot be substituted. You should get good results if the work is prepared with two thin rag coats of dilute shellac, sanded lightly in between. It is better to mix the shellac fresh by dissolving pure shellac flakes or buttons in methyl alcohol, because many commercial preparations have additive resins and polymers, but they will do if you can't get pure shellac. The wax mixture should not be too thick, nor be put on too thickly. It should be well polished (a stiff brush does a fine job), and several days should elapse between applications.

In "Letters," Summer '78 issue you carried a suggestion on a lubrication for woodscrews. This is what I have used for years: One part beeswax, one part rendered beef tallow. Heat until it is completely mixed. It is solid enough so that when a screw is dipped in, it takes up enough of the mixture in the threads for easy driving. It does not rust the screws if they happen to be steel. The mixture never hardens with age.

—K. G. Gathey, Roanoke, Va.

I bought this gas-powered saw two years ago and converted it to individual electric motors for each unit. It's a Parks combination machine. It has a 16-in. rip capacity, 5½-in. cut; a 10-in. swing-up cut-off (foot operated); a 23-in. band saw; a ¾-in. shaper shaft; a 12-in. jointer, and a mortising attachment. The unit weighs about 1,200 pounds. The model and serial number tag is gone. I helped the old man who owned it in his shop when I was a boy and I am now 66.

—Martin Flinn, Strawn, Tex.



While Doyle Johnson appears to have a first-rate dust collection system (Sept. '78, pp. 76-78), it also appears to have quite a number of electrical hazards built into it. First of all, the 28 volts of the control system is simply too great to have on the exposed pieces of the jury-rigged switches at the vacuum ports. Hand contact with the contact straps is almost certain to occur when a damper is pushed closed. Although 28 volts is probably not lethal except under unusual conditions, it can yield an unexpected shock which may lead to injury due to involuntary reflex action of the operator. Electrical-parts houses stock many varieties of switches that would fulfill the simple requirements of the system.

Next, the article suggests that Johnson has the system plugged into a lighting circuit and controlled (or controllable) from a wall switch. The ordinary 15-amp. lighting circuit really isn't meant to feed a ½-hp motor on a continuous basis. Although he states that he has sufficient capacity on his lighting circuit to run the collector motor, others attempting to duplicate the system will probably have the standard 15-amp. circuit.

The electrical schematic does not show the third wire safety ground. While Johnson may well have installed this wire in his system, others who are not in the electrical trade may not be aware of the need for this wire. And finally, the 1975 revised National Electric Code... requires installing a ground fault interrupter receptacle for any outside receptacle. Johnson may have installed this protection in his system, but others unfamiliar with electric circuits may not be aware of the code requirements.

—Robert Mateer, Lanham, Md.

METHODS OF WORK

Methods of Work is a forum for readers to exchange the tools, jigs and tricks they've devised. Send precise details, sketches (we'll redraw them) and negatives with photographs, if any. We pay at the rate of \$100 per magazine page, minimum \$20, upon publication.

Tank steamer

Letters in recent issues of *Fine Woodworking* suggest a need for a simple and safe wood steamer. I have made many chair rockers, back boards and splats, as well as wooden hoops, with the one described here.

It is a 12-in. by 60-in. hot-water tank with the top cut out. It has wrap-around insulation and a plywood lid with a soft rubber gasket. A 10-lb. weight holds down the lid. The tank sits on building tiles, and an electric hot plate is set between them. Presoaked wood is suspended above the water line on twine string. A caution: When removing wood, raise the lid slowly and away from you to avoid the hot steam. For longer wood, a downspout could be attached to the tank.

—Albert J. Gnaedinger, Pocahontas, Ill.

Removing mill marks

In order to achieve a good finish, the tiny ridges left by milling machines must be removed. The best method my students and I have found for removing mill marks is with the cabinet scraper (Stanley #80). The problem is being able to see these mill marks. By rubbing a piece of white chalk over the entire surface of a surfaced or jointed board, one can readily see these imperfections. The mill marks show up as white waves across the grain.

You can then scrape with a cabinet scraper until the chalk marks—and the mill marks—disappear. Drag the chalk across the stock again and it will hardly leave a mark. Using a cabinet scraper also reduces sanding time.

—Dennis W. Kempf, Bellevue, Wash.

Locking up tools

A miniature padlock attached to the plug of a portable tool or a free-standing machine prevents unauthorized use in the school shop. At home it is a safety measure that keeps small children from "helping." More than one plug can be locked



with a single padlock; the one shown here is Master Lock Co. No. 9B, available at hardware stores. Tools may also be locked to a fixed object, for security.

—R. Bruce Hoadley, Amherst, Mass.

Homemade cabinet scraper

Cabinet scrapers can be made to special shapes from old hand or power saw blades. Cheap saws seem to work as well as good ones. The ideal thickness is about $\frac{1}{32}$ in., and 3 in. by 5 in. is a nice size. After cutting out the scraper with tin snips—little nibbles will do a better job than big bites—hammer the edge to remove irregularities. With the scraper flat on an oilstone, rub to flatten the edges and continue the process begun with the hammer. Next, drawfile the edge in a vise, then back to

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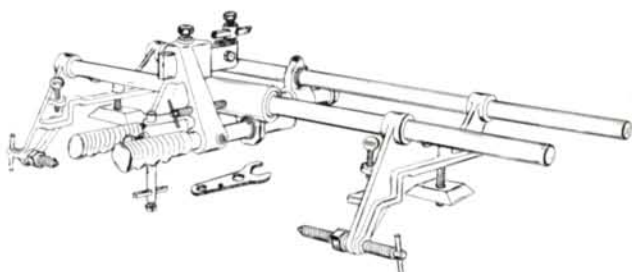
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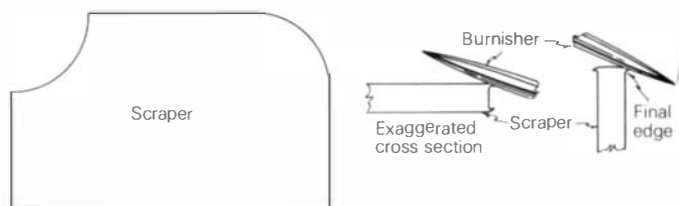
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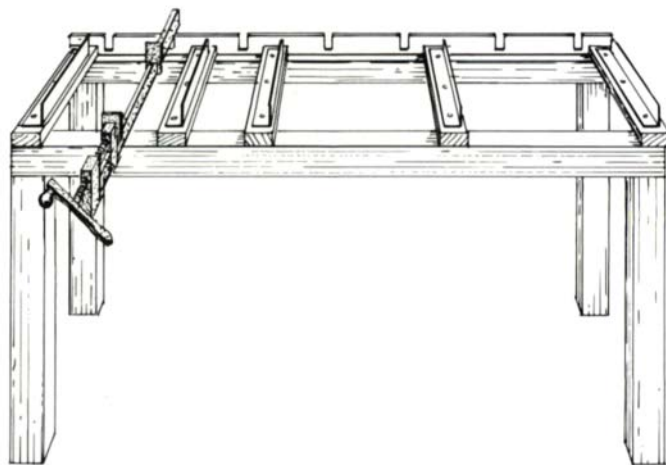


the stone, then draw the stone along the edge as you did the
file. The object is to produce a sharp, square edge. Next, turn
the edge with a piece of steel—a burnisher is best but a drill
shank will work, as will an auto valve stem—anything hard
and smooth. Hold the scraper horizontally, with the end of
the edge you are working on braced against your chest. Then,
pressing hard, draw the tool along the whole edge; reverse
direction and do the other side. Then hold the scraper ver-
tically away from your body and turn the edge down. The
edge can be renewed several times by turning it down before
you need to use the stone again.

—John Owen, Isaacs Harbor, N.S.

Gluing table

A most functional and sturdy gluing table is made of angle
irons bolted to a wooden base. Dresser, tabletops and wide
boards for beds are easily glued up using such a table. The
construction allows easy application of clamps, and the spe-



cially notched board at the back even holds bar clamps erect
and up against the underside of the boards while you align
and level them with one hand and crank the clamp with the
other. If the vertical face of the angle iron is too narrow, it
must be built up to make room for easy placement of clamps,
since at least one will go on the underside of the board. Glue
dribbles are easily cleaned off the irons with a few smacks of a
hammer after they've dried.

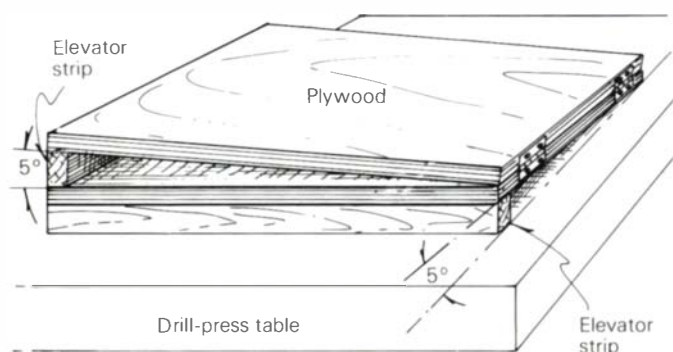
—James B. Small, Jr., Newville, Pa.

Drilling angled holes

For my early American reproductions, such as cobbler's
benches and step tables, I have found that splaying the legs
about 5° in two directions is just about right.

I recently made a simple fixture for my drill press for bor-
ing the holes in the tops of these articles. I used two pieces of
¾-in. plywood, 18 in. square; to both pieces I fastened a strip
of wood to give me the desired 5° angle. This then works as a
compound sine block. The plywood squares are hinged to-
gether; if you want the holes flared in only one direction, fold
the top piece out of the way.

To determine the height of the elevating strip, I multiplied



the length of the plywood piece by the tangent of 5° (0.875) and got 1.575 in., or roughly 1 1/16 in. I then ripped one edge of two pieces of wood, 18 in. by 1 1/8 in. by 1 in., to get 1 1/16 in. After sanding down the inside edge, I fastened each of these flush with one of the edges of each plywood piece, and hinged the two pieces together, so the angles were at right angles to each other.

I cut the legs to length, with a double 5° angle on each end, before tapering and turning ends to fit holes in the tops. Of course, the angle can be changed by just multiplying the tangent of the desired angle by the length of the plywood pieces, and using the result for the height of the elevator.

—Eugene Roth, Honeoye Falls, N. Y.

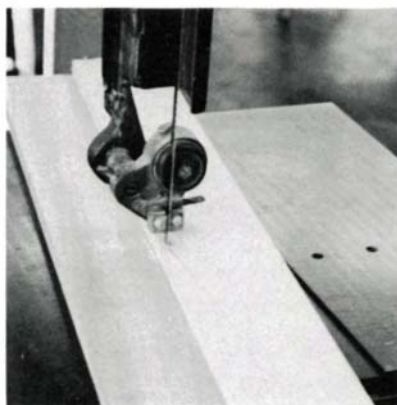
Curved edge joint

A simple system exists for making close-fitting edge joints along a curving line. This quick and reliable method works equally well for major design pieces and for rough work.

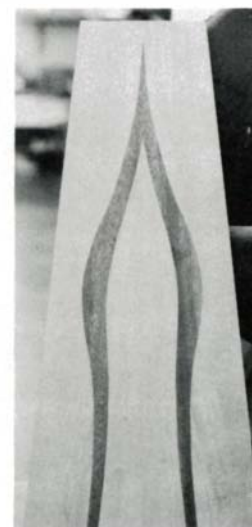
The idea is to cut both of the pieces to be joined simultaneously, as in marquetry, one above the other. The desired de-

sign is laid out on the upper one, and the boards overlapped a distance appropriate to the line. They need to be firmly but temporarily fixed in this position, by means of nails, glue, clamps, double-stick tape, etc. The assembly is then cut on the band saw with a bold and sure stroke, since any stopping and wiggling will result in a hole along the glue line. Frequently the two pieces can be held during cutting just with one's hands, doing away even with the fastening.

When the waste parts are removed, the major pieces should fit together very well. Even if the sawing went off the line, at least they match. There may be a small gap evident along the glue line where the curve is sharp. This results from the radius differential between the two sides of the saw kerf. In practice



Edge joints can be cut by overlapping contrasting boards and bandsawing along the line of the design. Joint is then glued and clamped. Result, right, is a resawn and bookmatched pattern.

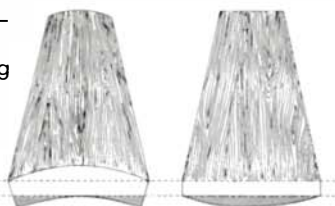


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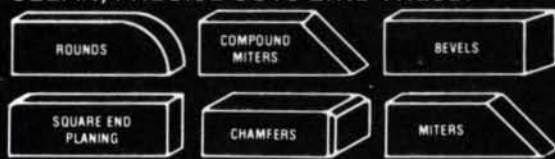
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METHODS (continued)

this is not a problem, however, because it usually can be pulled up in gluing without undue stress. A little judicious shaving at the ends would also solve this problem.

When wide boards are cut by this technique, the upper one sometimes droops out of parallel with the band-saw table. This is prevented by tacking a filler piece along its outer edge to hold it up. Joining thick wood brings out new possibilities—the lamination can then be resawn and bookmatched.

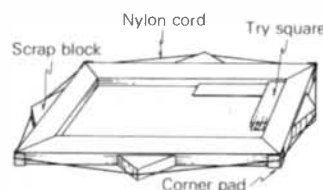
This method is good for relatively unimportant edge-joining such as in jigs, mockups and secondary pieces. Here a strong, acceptable joint can be accomplished in a few seconds, with no concern for straightening edges, planing, etc.

—Sam Bush, Pottstown, Pa.

Picture-frame clamp

This is my no-cost solution for clamping a picture frame: Clamp all four pieces at once with a length of nylon cord. Measure the outside perimeter of the frame and tie a non-slip knot so the cord will just fit around. Then use four or more scrap blocks between the cord and the frame to stretch the cord tight and draw up the joints. Pieces of cardboard or leather folded over the corners prevent the cord from digging in. If the frame twists when tensioned, place a weighted piece of plywood on top—after you have tested the squareness of the frame. (Try the procedure dry first, to spot bad joints). On narrow frames, use eight blocks, all located near the corners. With white glue, heavy clamping pressure is not required to make a solid, lasting joint.

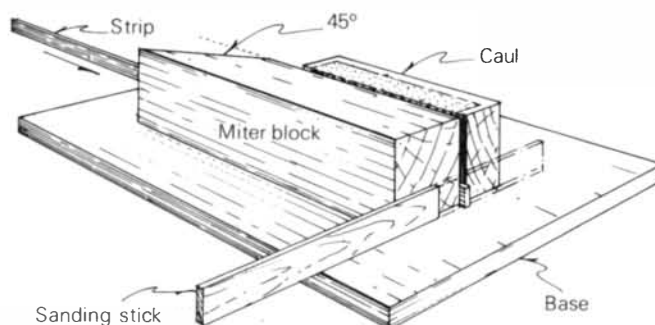
—Duane Waskow, Marion, Iowa



Joining decorative strips

When fitting out a project with decorative wood strips and binding (on a guitar or violin, a marquetry frame, or a fancy box) a most difficult operation is making tight butt or miter joints between the strips—especially if the wood is white. A little jig, which I call a miter block, surmounts this problem. It will produce good, flat gluing faces on the ends of the strips at 90° or 45° (or whatever angle you design it for), and will also trim them to perfect length.

The block itself is a square of metal or dense hardwood (say 2 in. by 2 in. by 6 in.), with opposite faces parallel and all four faces mutually square. One end of the block is cut at 90° and the other at 45°. It is placed on a flat base, and the purfling (decorative) strip, rough-trimmed and marked for length, is placed (usually vertically) against the block's side and the base, and held securely in place with a straight caul. The left hand holds both block and caul so that the strip's end protrudes slightly past the end of the block. The right hand holds a small, straight sanding stick (a high-quality metal nail file is best) against the end of the block (the guide), and works the stick to and fro, sanding the end of the



METHODS (continued)

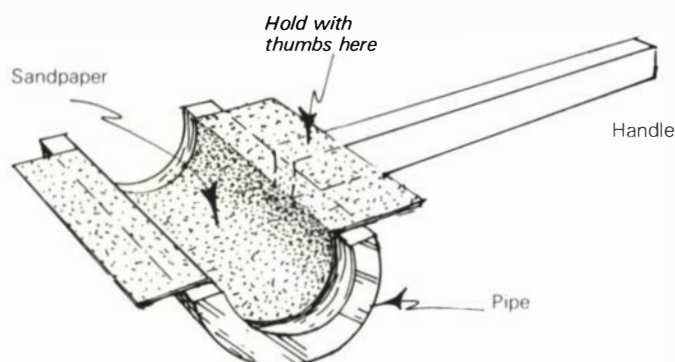
strip until it is flush with the block's end and the length mark is reached. Sandpaper glued to the caul grabs the strip so the left hand can feed it into the moving sanding stick. The process is complicated to describe, but a cinch to carry out. By changing the orientation of the block, both inside and outside miters can be obtained. The block can be used for pearl, ivory and other inlay materials as well.

—William D. Woods, Phoenix, Ariz.

Steel-wool holder

Cut a hollow rubber ball into two pieces, one smaller than the other (for two different sizes). Into these hollow pieces place your steel wool and use, instead of final sandpaper, for finishing your woodworking projects. The rubber ball will keep the steel wool together and also keep it from sticking your fingers. I find that steel wool makes a better finish than sandpaper on the clocks I build.

For sanding round pieces on the wood lathe I use a home-made tool. I have them in different sizes. Take a piece of pipe

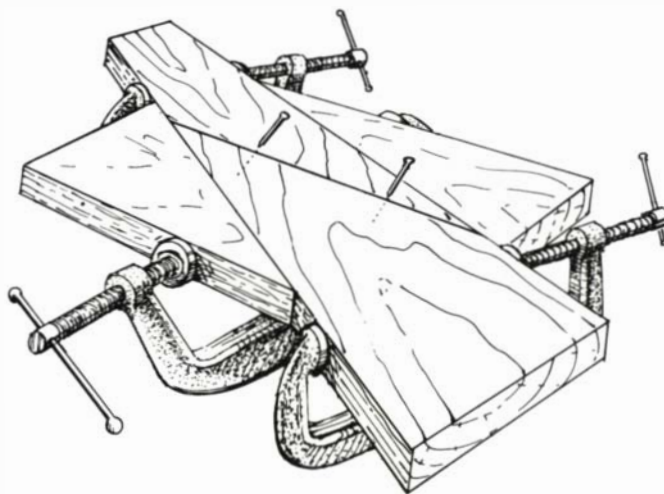


in a length to suit your needs and split it in half lengthwise, then weld a handle on it. Lay sandpaper or steel wool in the cup and hold with your thumbs back from the work.

—George Eckhart, Kenosha, Wis.

Clamping a scarf joint

A scarf joint can be securely clamped as shown: After spreading the glue, tack the pieces to be joined with pin brads (#16/18) cut to 1/4 in. long. Then sandwich the pieces between



wedges made of soft, wet wood. While one C-clamp applies pressure directly on the surfaces to be joined, two others hold the wedges in position.

—Price G. Schulte, St. Louis, Mo.

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BOOKS

The Encyclopedia of Furniture Making by Ernest Joyce, *Drake Publishers, Inc.*, 381 Park Avenue So., New York, N. Y. 10016, 1970. \$14.95, cloth; 494 pp.

Cabinetmaking and Millwork by John L. Feirer. *Chas. A. Bennett Co., Inc.*, 809 W. Detweiller Drive, Peoria, Ill. 61614; revised edition, 1977. \$19.16 cloth; 992 pp.

The Encyclopedia of Furniture Making and *Cabinetmaking and Millwork* are probably the most complete books on their subjects in print today. Joyce is British, and Feirer is American. The merits and defects of their books reflect in great part this fact.

In *The Encyclopedia of Furniture Making*, the emphasis is on hardwood construction and the esthetics of furniture-making. It begins by identifying and explaining how to use all the major hand tools with more than enough detail to get one well started, then goes on to name the major power hand tools and stationary power tools. But it does not give enough detail for one to have enough confidence to plug them in or turn on the switch. Power tools do not really interest Joyce, and his book begs you to go somewhere else to learn how to use them.

There is a large and comprehensive chapter on workshop geometry and drawing. Quite obviously Mr. Joyce expects the craftsman both to design and make the furniture, not read someone else's blueprints. I think this is an important point. Unless one person does both things a dangerous division of labor occurs in which all too often the designer does not fully understand the materials from which the piece is made and the builder of the piece does not understand the esthetics of design. Such a division of labor is the mode in *Cabinetmaking and Millwork*, and from it arise most of that book's problems. But more about it later.

The Encyclopedia of Furniture Making next discusses materials, with an emphasis on hardwood solids, plywoods and veneers, in that order. Only eight pages are devoted to plastics and laminates. The section "Basic Techniques" demonstrates how to transform raw timber into furniture with only hand tools. It is only when he gets to bending and laminating that Joyce shows the use of heavy power tools.

Perhaps the best thing about *The Encyclopedia of Furniture Making* from the standpoint of the home craftsman or small-shop owner is that it not only illustrates all the major woodworking joints and where they are appropriate,



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BOOKS (continued)

but that it also discusses where they are not, and where alternates or substitutions can be made. The same is true for his discussion on hardware.

The fifth part of this book is also invaluable. Here Joyce shows examples of furniture, some traditional, but most modern, that with only very rare exceptions are in the highest taste and worthy of study and emulation.

There is not much here on finishing or upholstery. Another problem, typically English, is the poor correlation between the text and the illustrations. A random example: The section on sliding flush doors, p. 316, refers the reader back to diagram 242, which is on p. 315. One can go quite mad trying to flip the page back and forth to look at the diagram and read about it at the same time. But even with these faults, *The Encyclopedia of Furniture Making* is a first-rate choice for the novice and even the advanced professional, especially because of its wealth of obviously shop-tested advice.

Feirer calls his book *Cabinetmaking and Millwork*. The title should have been *Millwork and Cabinetmaking*, for the emphasis is upon heavy machinery, industrial production and commercially prefabricated materials. The sections near the beginning on furniture designs and styles are a key to the drawback of this book: In a volume of nearly one thousand pages only one column, less than one third of a page, is devoted to the history of cabinetmaking. This is hardly adequate in a book "designed for an advanced wood-working course." Worse, the photographs that illustrate various historical periods of great cabinetmaking are all of modern mass-produced adaptations or "reproductions," though they are not so labeled in the book. The photographs and illustrations of "good furniture and cabinet design" are also of commercial pieces, most of which are, quite frankly, hideous.

Cabinetmaking and Millwork does excel, however, in its very long and comprehensive discussions of the safe, efficient and sometimes even creative use of the most common portable and stationary power tools, plastics and standard prefabricated hardware items. But when it comes to hand tools, *Cabinetmaking and Millwork* leaves you lost. On page 230, for example, he shows illustrations of various handsaws. Of the uses of the rip saw he says, "To cut with the grain. Caution: support the waste stock. Never allow end of saw to strike the floor." Period. But how do you hold the rip saw? How do you keep it cutting in a straight line? At what

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BOOKS (continued)

angle do you hold it? Drawing 20-3(b) of the saw in use shows the saw being used incorrectly (the angle is far too shallow for efficiency, accuracy or safety). *Cabinetmaking and Millwork* has page after page of such tool illustrations, but no practical advice on how to use the tool it illustrates. I think the problem is that Feirer meant his book mainly as a text for woodworking courses. He therefore expects the shop teacher to show you how to use the tool. All Feirer wants to teach you is how to recognize the tool. And what is true for hand tools is unfortunately true for woodworking techniques as well. There simply is not enough explanation in *Cabinetmaking and Millwork*.

By way of comparison, let me focus on how each book explains how to install butt hinges. Even though both books spend about the same space on the subject, *The Encyclopedia of Furniture Making* offers far more very necessary information, quite obviously garnered from years of experience, about such things as how to position the knuckle of the hinge to avoid binding, how to taper the hinge housing, how to reposition a screw after it has once been driven (it's done with the aid of a wooden matchstick), etc.

So the real difference seems to be in the level of practical advice. Examples can be found throughout the books. It's as if Ernest Joyce were standing there with you as you work, offering advice, while John Feirer walked off to look for a shop teacher.

Now don't get me wrong, Ernest Joyce occasionally walks off too, and sometimes just when you need him most. So which book do I recommend? Keep in mind that there is no one complete and comprehensive book on cabinetmaking. But as I said at the start, these two books come closest. If you have to choose only one, then by all means Ernest Joyce's is by far the more useful. But *Cabinetmaking and Millwork* complements it in many of those very places where *The Encyclopedia of Furniture Making* is most weak. Read *The Encyclopedia of Furniture Making* first, then *Cabinetmaking and Millwork*. You need both wings to fly.

—Sandy Cohen

Shelves, Closets & Cabinets by Peter Jones. *Van Nostrand Reinhold Co.*, 7625 Empire Drive, Florence, Ky. 41042, 1977. \$14.95 cloth, 304 pp.

Appearances can be deceiving, and those who would view this as just another compendium of popular-monthly type weekend projects should

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reconsider. Perhaps the author presents his case best. In his introduction, he states: "This is a book . . . for the person who loves the feel of a smooth edge, who cringes at the idea of hiding an unusual grain under layers of paint. It is for the person who enters his workshop in quest of the perfect right angle, the absolute joint, the person who will gladly spend half a day planning a single cut with his saw so that it will be exactly right. This is a book that aims at giving you, the reader, a sense of the dynamics of designing a project for your own special needs, and then executing it with the highest standards of craftsmanship you can achieve."

On first glance, however, the designs in this comprehensive investigation of building storage spaces seem uninspired. A great deal of the design aspects leave much to the craftsman's talents at embellishment, and some are decidedly stolid. The suggestions regarding kitchen cabinets, however, contain more useful ideas and more pleasing designs.

Cabinets, closets and shelves are significant items in any professional carpenter's repertoire. For many, they are the bread-and-butter items that subsidize more intriguing projects. For the homeowner or other woodworker called upon to solve pressing storage problems, there are many challenges in giving pleasing form to necessary function. To this end, Jones' book is admirably suited—the drawings are clearly understandable and detailed, the text informative. The section on veneering and inlays puts this book a cut above others of its kind, as does the section on the characteristics of certain woods and the proper methods of finishing them. In some instances, such as in veneer types, color would have been much more illustrative, though price considerations could well have dictated the decision to use black-and-white photographs.

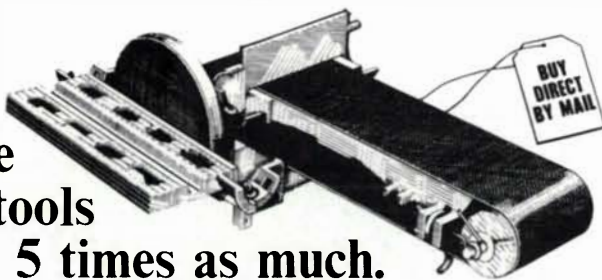
In all, *Shelves, Closets and Cabinets* is a practical, if not inspired, idea-book for the average to fairly advanced woodworker faced with the problem of providing attractive answers to aggravating storage problems.

—James W. Fiddes

Mission Furniture: How To Make It by Henry Haven Windsor. *Peregrine Smith, Inc., Box 667, Layton, Utah 84041. \$5.95 paper. 120 pp.*

This is a reprinted selection of turn-of-the-century pieces from Windsor's three volumes on mission furniture, first published in 1909, 1910, and

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- Each entry must be of original design and the primary material must be wood. A designer and a craftsman may enter jointly. Period furniture must be "after the style of," not a precise reproduction of an antique or a published plan.
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- Put your name on the back of every photo. Be careful that ball-point pens don't emboss or mar the image, and that wet ink on the back of one photo doesn't rub off onto the next.
- Each entry must be accompanied by its own entry blank. Blanks are available upon request from the Taunton Press, or clip the one here, zerox or hand-copy it.
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- If you want your photos returned, enclose a stamped, self-addressed envelope. All entries will be kept until the book is published in June, 1979.
- The decision of the editors is final. Craftsmen whose work is selected for publication will receive a complimentary copy of Design Book 2, and may purchase additional copies at wholesale price.

1912, and aimed at providing amateurs or woodshop students undergoing manual training with suitable projects. Here may be found forty designs, most accompanied by dimensioned drawings, a material list and instructions. The latter are extremely spotty in some cases, but most indicate at very least the proper construction sequence.

The mission period was one of revolt against Victorian extravagance, and the Arts and Crafts movement was well underway. Gustav Stickley's style falls into the "mission" category (Spring '76, p. 44) and probably the tenets of his very articulate philosophy should be applied to evaluate what Windsor's designs strive after. The furniture described makes extensive use of mortise and tenon construction. No purist, Mr. Windsor designed for screw, cleat and nail side by side with this more traditional joinery. The principles of allowing for expansion and shrinkage of large pieces are often ignored, however, quite notably in the design of a square extension table. Windsor advocates veneering oak over solid pine cores in one section. I don't think Stickley would have tolerated this. He rejected the use of veneers altogether. Another matter about which the author was ill-informed is the application of water stains. He did not know about raising the grain with water and sanding beforehand.

Judging by the methods of construction shown in this book, one has to revise a few cherished opinions. First, the respect and veneration we feel for things crafted in days of yore needs to be sharply qualified. We must assume the rebellious turn-of-the-century "craftsman" (in Stickley's sense of the word) had integrity but lacked knowledge of why traditional wood constructions hadn't changed through the centuries. For, as soon as cheap supplies of machine-made wood screws became plentiful, the more revolutionary cabinetmakers and designers felt they were entirely freed from the tyranny of traditional techniques and threw everything overboard. It has taken American woodworkers until recently to rediscover exactly what principles were violated. That we now perceive more clearly the limitations of the screw is due largely to the observations of restorers and repairers of antique furniture, who are the ones who must deal with the oversights of our forefathers.

For better or for worse, designers employed the labor-saving wood screw. Complicated constructions were made feasible, constructions which would be either impossible if attempted using



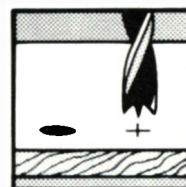
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BOOKS (continued)

traditional joinery or so costly in time as to be totally impractical. One unexpected result of the "craftsman's" use of screw construction appears clear: It freed him to explore balance, proportion, and the decorative interplay of horizontal and vertical lines and surfaces. In fact, the Arts and Crafts movement actually sensitized designers to these factors. When you eliminate ornamental facades and superfluous decoration, you must necessarily turn to other means of satisfying esthetic requirements. It was not, and never will be, enough merely to let construction show for what it is. It was no accident that the refined dimensioning and composition of elements was raised to the highest levels in this period. That Windsor, too, was conscious of this is evidenced by his consistently pointing out sensitive solutions.

Since a lot may be learned or intuited about composition through the illustrations and drawings, *Mission Furniture* is a valuable book. Some, like myself, might use many of the constructions as exercises in proper joint design, not because they illustrate it, but because it is fun to try to find a way to let the wood move properly while retaining the esthetic cohesion of the pieces. This is not always possible. The four-corner-post constructions are, for example, almost impossible to rescue when a solid, corner-notched shelf, top, or bottom sits between them and rigid side rails are employed.

Because it gives formulas and techniques for making stains, fillers, waxes, and even a method for fuming oak, this book should be of interest to restorers or those wishing to make authentic reproduction furniture of the period. Included also in a final chapter are sections on steam-bending, making screws hold in end grain, constructing a jig for boring mortises, and using a jig for sawing tenons.

—Alan Marks

The Nature and Aesthetics of Design
by David Pye. *Van Nostrand Reinhold*,
7625 Empire Dr., Florence, Ky. 41042,
1978. \$12.95, cloth; 159 pp.

The Nature and Art of Workmanship,
by David Pye. *Cambridge University*
Press, 32 E. 57th St., New York, N.Y.
10022, 1978. \$7.50, paper; 113 pp.

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BOOKS (continued)

be good, if only because, unlike the fine arts, it is inescapable."

The quote is from David Pye's opening remarks in *The Nature and Aesthetics of Design*. Designed things surround us, and design is the common ground between art and science. Yet we have no coherent theory of what design is, of what governs and constrains the designer, or of how to separate good design from bad. In place of a theory, we have the commonplace that form should follow function. The trouble starts when one tries to pin down function—an almost impossible task—and it gets worse when one realizes that almost nothing works as it should. Says Pye, "Every thing we design and make is an improvisation, a lash-up, something inept and provisional. We live like castaways." Who wants cars to heat up, make noise and smell? Why hasn't anyone designed a sky hook or an ever-sharp ax? "Even at that," Pye continues, "we can be debonair and make the best of it. If we cannot have our way in performance, we will have it in appearance." Despite the vogue for "utilitarian" design, we always do a great deal of "useless" work: There is nothing utilitarian in making ceilings flat, it is a lot of extra trouble. Most of good workmanship is this sort of useless work, and civilization would be much the poorer without it.

Pye establishes six requirements that must be satisfied in the course of designing any object, then he analyzes the constraints each requirement puts on its ultimate shape. Four of the requirements add up to solving the problem at hand—function—although they turn out to have rather little to do with how the object looks. Things of the same shape can do different things, and things of different shape can do the same thing. What has more to do with form are his last two requirements: economy of manufacture, and taste, or style. Predictably, all six requirements contradict one another, especially the last two. The art of design is a difficult compromise. The look of a thing remains a choice the designer must make, albeit within the limits set by the six requirements.

Pye furthermore asserts that the designer has a responsibility to make beautiful things out of the compromise. Although two people may differ on whether a particular thing is beautiful, some things nonetheless are beautiful. We know them when we see them. The second half of the book is a detailed discussion of beauty, of perception and the human brain, and of originality, taste and style. But in the

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BOOKS (continued)

end, once the designer has found the form of an object, he is at the mercy of prevailing standards of workmanship in making it beautiful. "Design proposes, workmanship disposes."

Pye's analysis of design was first published in 1964. His remarks on esthetics have been added for the 1978 edition. His case for the designer paying considerable attention to esthetics is strong, although somewhat abstruse, and for me it is less valuable than his original analysis of design itself. *The Nature and Art of Workmanship* was first published in 1968, to expand Pye's ideas about the importance of workmanship and surface qualities. The 1978 edition is unchanged from the original, and for the woodworker it is the more pertinent book. Here Pye's background as a furniture-maker comes to the fore.

He writes, "Workmanship is the application of technique to making, by the exercise of care, judgment and dexterity," and it is largely concerned with surface qualities—all that we see of an object. There is a world of difference between the cabinet sitting there and the designer's idea of a cabinet, as expressed by the most elaborate working drawing. Workmanship is what for practical purposes cannot be conveyed by drawings or in words. The best the designer can do, even if he is also the maker, is draw upon what has gone before: Make it like *that*. Good workmanship will enhance the designer's idea. But if the workmanship turns out to be bad, the design is spoiled and the designer is helpless.

The problem today is not that so much workmanship is bad (it is not). The problem is that the range of surface qualities of which mass production is capable is dismally restricted. Pye argues that we not only do not recognize the importance of workmanship, we lack even the words for talking about it. He rejects the usual distinctions between hand and machine work, and between precise and rough work, offering instead his concepts of the workmanship of risk and the workmanship of certainty, and his spectrum ranging from highly regulated work to rough work (see page 84 of this issue).

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Tom Waring

mal element has a maximum and a minimum effective range." As one approaches a fine cabinet, one first sees its highly regular form. By the time one is close enough to touch it, one perceives the lively figure of the wood, in sharp contradiction to the precision of the case. Get right close to it and the whole form is lost, but the details left by the tools are evident, and at the edge of perception, the pores in the wood, the sanding scratches, perhaps the track left by a nicked plane iron. Pye contends that at any distance the elements just coming into focus and going out of focus are like the overtones in music, "a vitalizing element in the visible scene." A Formica panel lacks this diversity, while free workmanship exploits it. "... Our natural environment, and all naturally formed or grown things, show a similar spontaneity and individuality on a basis of order and uniformity. This... was the broth in which the human sensibility grew."

Equally pertinent to the woodworker are Pye's remarks on durability and on consistency, in the course of which he debunks the doctrine of "truth to material," that the woodworker is obliged to bring out the organic properties of the wood. Says Pye, "... when you cut wood you cannot do anything either to emphasize and express the grain, or to hide it unless by paint. It is there... whether you like it or not... The only way one can express the recognizable woodiness of wood is to express the fact that trees are sinuous and branching. Is it seriously to be supposed that wood ought only to be used in sinuous or branching shapes?" The truth is, we want to express not the properties of the material, but its qualities, and they are ideas, different for each of us.

The argument includes a refreshing critique of the Arts and Crafts movement as formulated by John Ruskin and William Morris. Pye concludes with an impassioned polemic for the survival of crafts of the highest quality, at any price, essential to perpetuate the esthetic diversity of free workmanship. Pye's ideas are complex—these are not dime novels. But a woodworker who takes the time to read them, whether he agrees or not, will ever after see what he does in a different way.

—John Kelsey

Sandy Cohen, an amateur woodworker, teaches English at Albany (Ga.) State College. Jim Fiddes, a former woodshop teacher, now teaches junior-high English in Danbury, Conn. Alan Marks, of Pacific Grove, Calif., is a professional woodworker.

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The editors invite questions from readers about cabinetmaking, finishing and wood technology. The answer men are: cabinetmaker and designer A.W. Marlow, author of several books about making fine traditional furniture (see p. 34); George Frank, a retired woodfinisher with 50 years of experience in America and Europe; R. Bruce Hoadley, professor of wood science at the University of Massachusetts (Amherst); and Tage Frid, professor of woodworking and furniture design at Rhode Island School of Design. We're happy to publish reader comment on the answers, for woodworking is an art more than a science, and there is always more to learn. Send questions, answers and comments to Q&A, Fine Woodworking, Box 355, Newtown, Conn. 06470.

Several readers who own what they believe are prime walnut trees have recently asked the same question: how to sell the trees for lumber and veneer, to capitalize on the current high price of walnut. We passed the question to Paul Miller, publisher of *National Hardwood Magazine*, the industry trade journal (P.O. Box 34908, Memphis, Tenn. 38134).

Miller suggests getting in touch with the Fine Hardwoods/American Walnut Association, 666 Lake Shore Dr., Chicago, Ill. 60611. The association is made up of all the major walnut veneer and lumber dealers, and will provide a list of members so the tree owner can contact one nearby. Sawmills will often be interested in a lone tree, as well as a number of trees.

One caution: walnut trees, however prime, that were planted as fence rows or in front and back yards may not be marketable. They are liable to contain buried metal—nails, bolts, parts of old signs or gates or children's swings—that will instantly ruin a sawblade costing more than the lumber is worth.

My son's family is using a black-walnut trestle table that is now in its fifth generation in the family. The joints are reasonably tight and the wood is sound. A complete restoration job is possible, but from our standpoint might detract as much as it would add. Brightening up the wood itself will be enough. After many years of farm use and being scoured with lye soap, and more years overhead in the woodshed gathering dust, it is smooth and clean but faded. I'm thinking of an oil treatment, possibly with added stain. Possibly just a good furniture polish. But in a case like this might the resins set up and preclude further recovery of the natural color?

—Henry Howard, Cambridge, Minn.
Your table brings a story to memory: I had an old aunt who, although she was close to 90, was bright and alert. Her

hair was white, her wrinkled face clean of cosmetics, and her whole person radiated goodness. When she died, I went to the funeral parlor for a last farewell and had a shock. Was this my aunt in the casket? The woman there had bright red cheeks, rouge on her lips, penciled eyebrows, the works. She looked like the bad woman in a Hollywood film, not like the aunt I loved.

Now back to your table. Please don't use any make-up on it. Wash it down once more with lye soap, scrub it hard and scrub it clean. Rinse it clear with water and leave it alone. If you really feel it needs protection, get some beeswax, cut shavings off it with a hand plane, fill a jar with the shavings, barely cover them with high-octane gasoline and let soak a couple of days, shaking the jar from time to time. The wax will become semi-liquid. With this wax you can coat your table, but be sure to take off all excess before it dries. When dry, bring up the shine with a wool rag and a scrubbing brush. Don't use any coloring. The beauty of your table is in the fact that it is old, worn and faded... keep it that way.

—George Frank

I am looking for a way to use a Record 405 multiplane to produce moldings on the narrow edge of stock. Most instructions explain using the plane on the width of stock, not its thickness.

—James Bailey

Multiplanes are all too large and heavy and usually are fitted with cutters not suitable for your fine work. I have what might be called a glorified scratchbeader (Summer '78, p. 60). I do not remember where it came from but believe it to be a tool that fits your need as well as any that I have ever seen. It's No. 728/1, made in Germany by Ulmia, whose line is sold in this country by Woodcraft Supply Corp. and Garrett Wade.

—Andy Marlow

Can you tell me of a finish (or finishing procedure) for aromatic red cedar that will retain the natural, bright color of the wood, and yet not look thick and built up like polyurethane or lacquer? Is there a particular dovetail design or scheme of dovetails you would recommend specifically for aromatic red cedar?

—Dwight Gorrell, Centerville, Kans.
In September '78, I described how open-pore French polishing is done, and I am convinced this would be the way to reach your goal. Moreover, the pores being open, your lovely cedar could freely breathe. As an alternative, you shouldn't dismiss lacquer because it doesn't have to look built up. Do the

Q & A (continued)

finest sanding you possibly can, blow all the dust away, and spray two or three thin coats of clear lacquer on the wood without any filler or sealer. Leave enough time between the coats for thorough drying, and sandpaper each coat finely before applying the next.

—George Frank

I know of no special dovetailing routine necessary for red cedar over and above for other softwoods. It is customary when dovetailing all softwoods to make the sockets wider than when working hardwoods. Beautiful dovetailing in hardwoods shows the pins tapering almost to a point. Extra width is needed in softwoods for more strength.

—Andy Marlow

I built a cabinet out of cherry wood and glued with Elmer's Carpenter's Glue. Some glue got in the corners. I wiped it clean immediately and later sanded best I could. I stained it, but where the glue oozed out is a bland white. How can I get that glue off?

—Alton R. Stephenson, Manassas, Va.

You have not sanded deeply enough. Sand until the glue spot is not visible and sand again as much.

—Andy Marlow

Some years ago I ran across a formula for making tack rags, but now that I am retired and working in my shop, I can't find it.

—W. Muir, Bainbridge Island, Wash.

Rosin, or colophony, could be found in every old cabinet shop. We used to break it into powder (in a mortar) and dissolve a teaspoon of this powder in a pint of mineral spirits. We added a few drops of linseed oil and soaked our clean rags (linen is best) in the mixture, then squeezed out as much as possible. A less elaborate method is to soak the rag in mineral spirits and sprinkle a few drops of varnish onto it. With repeated squeezing you can work the ingredients together, then squeeze out all the liquid you can.

—George Frank

We have a fine old grand piano with typical crazed varnish finish. An old piano tuner told me to feed the old finish with boiled linseed oil thinned with paint thinner. This went well the first two applications. After the third, it would not dry to the feel of a finish that could be sanded. It's been four months and it is soft but not tacky. Where do I go from here?

—Ralph Z. Neff, North Canton, Ohio

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Q & A (continued)

tact with the old; and the way you chose, the riskiest of all, to add a finish that would melt into the old one. This can only be done if you know what the old finish is, and even then it is hazardous because you don't know what it has been cleaned with, or what traces remain on the wood.

At this point I would try some experiments. First, wash the finish with gasoline. Be careful, ventilate and allow no chance of fire. Soak an area well, wipe it dry a few minutes later, and by next morning the softness may be gone. Second, try a wet Brillo pad, wash and rub an area with elbow grease and wait overnight. If neither trick works, you'll have to strip it off and start over.

—George Frank

I've been asked to restore an old table that has considerable local historic value, since it was brought to South Pass, Wyo., in the 1860s by wagon over the Oregon Trail. It is of black walnut in fair condition, and I should have no difficulty, except for one—how was the top made? It now has a face 71 in. by 35 in., with a 3½-in. frame around a panel ½ in. deep. What was in the depression—veneer, leather or possibly green felt? There is no existing clue.

—Raymond Gayle, Pinedale, Wyo.

The only reason for veneering the depressed area would be to use burl walnut, which in an area that size and depth is out of the question. Also, if the recess approaches ½ in. in depth, felt can be eliminated. That leaves leather. I would suggest using a strong magnifying glass to see if a few fibers might still be adhering to the surface.

—Andy Marlow

I recently acquired parts for an antique carbine, model 1883 Springfield, 45-70 "Trapdoor," which I am slowly restoring. The action and barrel are in good shape, but the weapon needs a new stock. A friend has given me a piece of walnut burl, but I feel like a gem cutter about to work on the Hope Diamond. I've done quite a bit of cabinet work, but this will be my first gunstock and my first piece of burl. I will greatly appreciate any advice you give me about how to proceed, so long as said advice does not include quitting before I start. Can you recommend any good books on making gunstocks or suggest any unique tools necessary for the job?

—Theodore Romaine, Tacoma, Wash.

Don't be in a hurry to start. Take the rifle to one or two gun collectors in your area, tell them what you would like to do, and you will not be able to break away from them. They will give you



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Q & A (continued)

good advice on the style of stock for that barrel, also the size it should be. I know of no special tools necessary for this work other than possibly a knurling tool. Or the stock may call for cross-hatching, in which case you will need a small carving V-tool. The mail-order tool dealers probably have books that will tell you about making and finishing gunstocks. Check their current catalogs for checkering tools, too.

—Andy Marlow

When we restore antiques the old brasses come to a beautiful patina with a little rubbing but lose that brightness after several weeks. What do manufacturers of brass hardware use to coat their brasses and hold that high lustre?

—D. A. Rothenberger, Worcester, Pa.
Clear lacquer will protect brass and silver from oxidation and tarnishing. Most lacquer manufacturers have special lacquers for this purpose, so specify your need when ordering. The metals to be protected must be absolutely clean.

—George Frank

I have been looking over a pile of cherry boards that I have had for some time. Like all such stuff there is variation in the depth of color of the heartwood, and it seems that even with lengthy exposure there will still be some variation. My plan is to use only the heartwood in a project, although this naturally may create problems where the inclusion of some sapwood would obviate piecing. Given modern chromatographic techniques, is it known what the substances and process are that give cherry heartwood its color? How, if at all, would chemical stain relate to such basic processes? The furniture industry apparently has a walnut sapwood stain to help match pieces. Does anything like this exist for cherry?

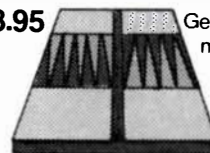
—Thane E. MacInnes, Waltham, Mass.
Relatively little is understood about the extractives that color cherry heartwood, or the exact process of their formation. There seems to be a close correlation between the death of parenchyma cells and the polymerization of phenolic-like compounds, leading to the formation of characteristic pigments.

Both the depth of color and its uniformity may be quite variable. Non-pigmented areas of heartwood (called included sapwood) are frequent in some trees. Although I am not aware of any specific stain, many woodworkers diligently match in sapwood by careful staining. There is no single color that would be called cherry heartwood, nor would you easily find two people who could agree on the shade of cherry

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Q & A (continued)

heartwood. I'd recommend that you take a sample of your darkest material to your dealer and find the closest match, then experiment a bit, perhaps tint with additional pigment, and you can probably come up with a good job of evening the color attractively. I don't believe the commercial chemical stains have any relationship (nor pretend to) to the natural chemicals in the extractions.

—R. Bruce Hoadley

We have a very fine tall clock (nearly 9 ft.) made by Goldsmith Chandler of Winchester, Va., who died in 1821. The entire case is detailed with rather intricate brass inlay, including stars, circles and diamonds. Much of this brass has worked free over the years, leaving a loose end which is further torn by cleaning cloths. Some is completely gone.

I have never attempted any work such as this. The brass is about .040 in. across the face and appears to be a semicircle in cross section—as though round brass wire was used for the inlay and subsequently scraped or sanded flat to the level of the wood. My questions are: Was round wire used? How was it glued in place? Would square brass stock be available anywhere? I probably won't tamper with this situation, but I would appreciate any thoughts on the subject.

—James B. French, Portsmouth, R.I.

I believe if you have the patience, you could do an acceptable job of restoration. Where brass ends are loose and curled up, the entire piece must be removed and flattened before reinsertion. For replacement parts, you may procure brass lines as narrow as 1/16 in. from Constantine, (2050 Eastchester Road, Bronx, N.Y.). Other special shapes could be jigsawed from material purchased at a sheet-metal shop. Do not attempt to use round rod. If the area is large enough, try Pliobond or any good contact cement. For small, narrow inserts, I have successfully used Krazy Glue.

—Andy Marlow

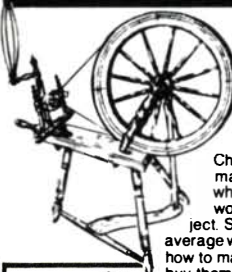
Supplies

Exotic materials and unusual supplies are a constant problem for the woodworker. In September, we published a list of recent reader inquiries, and have received the following leads:

—Pure, unthinned tung oil: Hope Co. Inc., P.O. Box 28431, 2052 Congressional Dr., St. Louis, Mo. 63141. Hope's oil is available at local paint stores and lumberyards, and the company will send you a list of distributors.

—Hardware for pepper mills and salt shakers: Woodcraft Supply, 313 Mont-

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vale Ave., Woburn, Mass. 01801; Minnesota Woodworker's Supply, Industrial Boulevard, Rogers, Minn. 55374; Peter Child, The Old Hyde, Little Yeldham, Halstead, Essex, England.

—A good finish for cups and mugs. Several readers suggest pure tung oil, the finish baked inside tin cans. Others question its safety, and suggest Salad Bowl Finish, sold by Woodcraft, or Wood Bowl Seal, sold by Constantine. Both have U.S. Food and Drug Administration approval for food utensils.

—Cast-iron hangers for a glide or swinging rocker. Heritage Design, Box 103, Monticello, Iowa 52310 sells a kit for this type of rocker, and will also sell the hangers separately.

—Gum benzoin: Caswell-Massey Co. Ltd., 575 Lexington Ave., New York, N.Y. 10022.

—Marquetry inlays: Jason French, 209 Main St., W. Chelmsford, Mass. 01863.

—Harp strings: Lym and Healy Harp Salon, 109 West 57th St., New York, N.Y. 10019, with branches in Chicago and Los Angeles; also Robert Nurley Co., 4 Belmont Hill, London, S.E. 13, England. Tom Moore of Springfield, Va., says that you'll have to choose between nylon and gut strings. Says he, "Nylon strings, in the larger diameters,

tend to sharp pitch as time goes by, whereas gut strings tend to flat pitch. Purists prefer gut strings."

We still have no source for a jack-in-the-box mechanism, slides and latches for high-chair trays and parts for Super-shop machines once made by Power Tools Inc. of Beloit, Wis. More materials readers can't find:

—Leather seats for antique chairs;

—Silver-leaf maple wood;

—Blue beech wood, also known as lever wood, hornbeam or American ironwood (*Carpinus caroliniana*);

—Amboyna (*Pterocarpus indicus*);

—Rubber tires $\frac{3}{8}$ in. in diameter for an 18-in. wheel, held to the wheel by a wire through the center of the rubber, for restoring a tea cart;

—Oak dowels in various sizes, up to 6 ft. long;

—Router bits to custom patterns, in small quantities.

Follow-up

In September '78, George Frank recommends daylight fluorescent tubes for a finishing room. There is on the market a 40-watt fluorescent tube called Vita-Lite. It was developed for medical examining rooms a few years ago, and is as close as possible to daylight with very little glare. The tubes cost about \$8 each, but last for 33,000 hours. Any electrical supply house or electric fixture store can get them.

—A. T. Martin

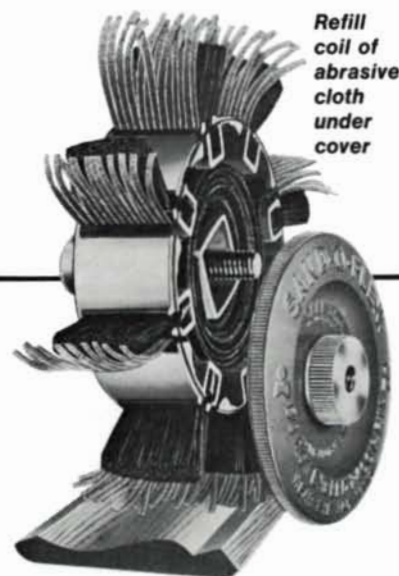
Andy Marlow may have missed what to me is the most obvious answer to Tom Jordan's question (Spring '78) about the glue line raising a hair. Not only can a glue line raise when it is white glue, but a joint can move under a strain without breaking.

—Franklyn J. Hansen, St. Paul, Minn.

Re S. A. Haskell's question about the use of epoxy (September '78), there is another problem, aside from its holding properties. Most epoxies come in two-part containers—a resin and a hardener, or curing agent. The containers frequently carry cautions to avoid contact with the skin. One family of these catalysts is generally classified as "amine." These are strong skin irritants, and once sensitized, a person may have very serious allergic reactions, even with very minor exposure to them.

—Gordon Gibson, Orchard Park, N.Y.

Of interest to me was the question (September '78) about ink stains on an old roll-top desk. I also have a very old roll-top on which I am now writing. I



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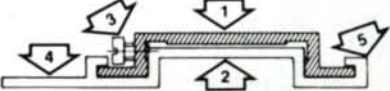
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Q & A (continued)

also had the ink stains. I bought a small bottle of ink eradicant at a local office-supply store. It worked pretty well, although it took several applications and some very deep spots of color still remain. George Frank would be happy about that.

—Ellis Rogers, Bloomington, Ind.

ADDENDA, ERRATA

Readers often ask us how to get books by Andy Marlow, a cabinetmaker of long experience (see pp. 70-71) and consulting editor to this magazine. He has written *Fine Furniture for the Amateur Cabinetmaker* (Stein & Day, Briarcliff Manor, N.Y. 10510; \$4.95, paperback); *The Early American Furnituremaker's Manual* (Macmillan Publishing Co. Inc., 866 Third Ave., New York, N.Y. 10022; \$8.95, hardcover); *The Cabinetmaker's Treasury*, written with F. W. Hoard (Macmillan, out of print, but available from Stein & Day at \$3.95 in paperback as *Good Furniture You Can Make Yourself*); and *Classic Furniture Projects* (Stein & Day; \$12.95, hardcover). These books can be ordered through local bookstores or directly from the publishers.

The deadline for *Fine Woodworking's Design Book 2* is Dec. 31. An entry blank with full details appears on page 22. More than 60,000 copies of our first book have been sold worldwide, and many of the woodworkers represented have received good connections and commissions as a result. The judges who will select pictures for publication are Tage Frid, Bruce Hoadley, Roger Barnes, Paul Roman and John Kelsey.

Photographing woodwork poses two difficult problems: contrast, since the delicate hues that make wood beautiful are so very similar, and background, since furniture is often large. The contrast problem is best solved by using even, diffused light. When possible, move the work outdoors into clear north shade, or wait for a cloudy day. Indoors, use several flood lights bounced off white walls and ceiling, or diffused through frosted plastic screens. Then, if you do your own processing or take the film to a professional lab, overdevelop it by about a third or more. This increases the contrast and will produce the deep blacks and clear whites that ordinarily result from direct light. Using direct light to make the exposure in the first place causes harsh shadows that overwhelm the delicacy of the wood and the tonal range of the

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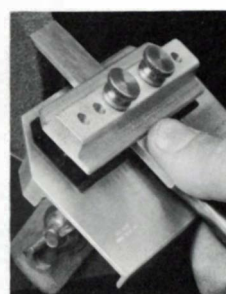
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A & E (continued)

film. If your negatives have to be processed normally, you'll probably have to print them on high-contrast paper.

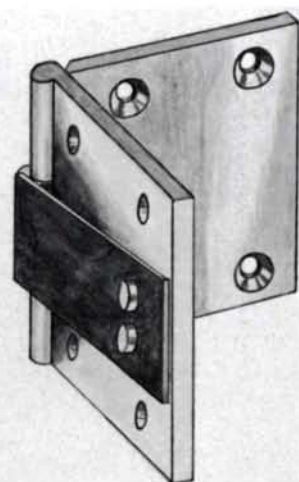
The background problem is best solved by eliminating it entirely. We use 60-in. wide pieces of doubleknit cloth, in black, white, grey or a soft green that contrasts well with the wood. The cloth can be taped high on a wall and spread wrinkle-free around and under the furniture. When you must shoot a large piece in a small room, at least isolate it from window frames and electrical outlets, and take careful note of the baseboards when composing the shot. It is remarkably easy to ruin a good photograph by unfortunate juxtaposition of the line where the wall meets the floor and a strong horizontal in the furniture itself.

In David Landen's "Used Machinery" (Sept. '78, p. 82), we gave old addresses for *National Hardwood Magazine* and *Classified Exchange*. Both of these publications have the same new address: 1235 Shady Grove, PO Box 34908, Memphis, Tenn. 38134.

We've received several letters from subscribers who picked up a discrepancy on the mailing label of the last issue. Our effort to give you expiration information backfired when the computer program took a left turn on some records and printed EXP SEP79 instead of the correct expiration date. Compulsive label-readers can calculate the number of remaining issues in their subscription by subtracting 13 (the number of the Nov. '78 issue) from the number printed on the November '78 mailing label immediately to the left of the expiration date.

Art credits: 6, 8, 10, 48-49, 59, 64, Christopher Clapp; 14-17, Joe Esposito; 41-43, M.U. Zakariya; 50-54, Mathilde Anderson; 56, Rick Butz; 68-69, Stan Tkaczuk; 77, Western Wood Products Assn., North-eastern Lumber Manufacturers Assn.

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Making Ends Meet

Sound business practices keep work and cash flowing

by Diane Crocker

Our family partnership in Walnut Creek, Calif., has had its share of the small-business ups and downs that destroy cash flow, distort cost and time estimations, and deplete effort and productivity. The upshot of our unpleasant acquaintance with the ups and downs? An introduction to Balance, the principle that helps us toward a longer career. January 1977 marked our beginning as Crocker Wood Works, makers of furniture and fine cabinetry. Our ambition was to make a good living by the individual design and construction of high-quality wood furnishings. Inherent in our goal was the desire to contribute to the body of art woodworking; on a commission basis we had the scope to achieve this.

The seed that grew into Crocker Wood Works was planted several years ago as a one-person remodeling enterprise, founded more on my husband Steve's skills and inclination than on insight. He found it an increasingly heavy load to generate new business while simultaneously producing a remodel.

Steve and I had met in a vocational furniture-making course, and we shared an interest in construction and cabinetmaking. When we later married, it seemed natural for me to help him on the job. We decided we could combine Steve's cabinet and furniture-making skills with my interest in design

and business, but we knew that if we wanted to keep food on our table we would have to balance our taste for artistic efforts with practical business techniques.

The work divided itself naturally into two parts. I handle "generation," which is what we call the activities that keep the business running: obtaining a healthy line-up of commissions. Steve's charge is "production." An overlap is encouraged in that I like shop work, and he likes to balance books.

A commission usually begins with a phone call. The client has an idea, but no design. By appointment I go to see the place, which allows me to consider the setting and tone of the room. There we can discuss their needs, rough out a solution and select wood from oiled samples. I take accurate working measurements of the room, the particular space in consideration, and any items the piece will have to accommodate. As a reference, the client can look over our portfolio of photographs.

To qualify the customer, I estimate the price of the piece he wants us to make. If interest wanes, then and there we modify the proposal to arrive at something that will satisfy his needs at an acceptable price. This is a touchy and difficult clarification, human nature being what it is, but it can save a lot of time and confusion. I have many unbuilt designs in my drawing file be-

cause I designed for more than the client would pay.

At the drawing table the information I've gathered gets chewed and digested. In its new form, a multiview scale drawing with interior features and details enlarged, it goes to Steve for pricing. This step is particularly important because we can lose the commission if the fee is out of range, or lose our shirts if we don't realistically estimate materials and labor. We "price to build," then "build to the price." This way we're less inclined to leave the profit in the hand-rubbed finish.

At my next appointment, equipped with drawing and price tag, I aim to close the sale and schedule both construction and payment. For an even cash flow we arrange to collect in thirds: first third on acceptance of the job, second third on half completion, balance on delivery or installation. If the job is short we start with a third on acceptance and collect the last two-thirds at completion.

Steve's key to a good shop rhythm is scheduling. This means that in order to have a steady flow of work we have to keep many irons in the fire. Artisans can blanch at the thought of not being able to focus heart and mind on the workpiece at hand, but accommodating the interruptions of phone calls, requests for estimates and inquiries for work to be done with an enthusiastic attitude has helped us maintain the broader focus necessary to stay in full production. After all, it's such "interruptions," we finally realized, that are tomorrow's jobs. The few that pan out are what keep the schedule full weeks in advance.

In order to remember the fire, and the irons in it, we keep an office calendar and a shop blackboard. On the calendar, we schedule consultation and estimate appointments in the early morning or late afternoon. Thus the concentration of the day isn't broken. The blackboard lists jobs ready to go, potential jobs, and shop-related things to do to stay current.

Steve never finishes one job without having a completed layout stick and stockbill, and the materials on hand for the next. This has allowed a steady flow



Black walnut desk and credenza, designed and made by the Crockers for a law office.

from job to job. It used to be a stuttering stop and start between each job that was not only painful, but a waste of time and energy.

Every day Steve looks over each job in progress, set a production goal for himself and his apprentice, checks his materials (listing what he'll need to buy as it occurs to him, to minimize the number of material runs) and lines up the order of work so that no phase holds up another. This takes just a few focused minutes and leaves him free to concentrate on the work at hand.

We're satisfying two parts of our ambition now: designing and constructing high-quality wood furnishings and developing a reputation. Next question: Are we making a good living?

In the days of the remodeling business, because the overhead expenses were largely overlooked, the hourly wage seemed to be the actual amount earned. Seeing it this way, it is easy to assume a business is in the pink. But paying the bills is only one part of making a living; equipment depreciation alone can put you out of business in a few short years.

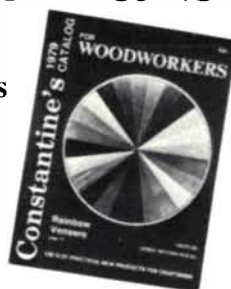
We use three points of reference—the price estimation sheet, a job-cost ledger and standard accounting books—to monitor our work and to gain insight into its financial results. During production of the job we use the estimation sheet that Steve had put together when pricing the job. All materials and labor hours (in which overhead is included) were listed and assigned a dollar value; we added a percentage to arrive at the selling price. At this juncture, it is tempting to forget that the piece was priced to build. The work now is to build to the price (granted, the best job you can do). By referring frequently to the estimation sheet, we can budget the time for each process (layout, milling, assembly, etc.) according to what we allowed in the price. This self-challenging can increase efficiency, stimulate a surprising ingenuity, encourage accurate pricing and keep the profit in the shop, not installed in the client's living room.

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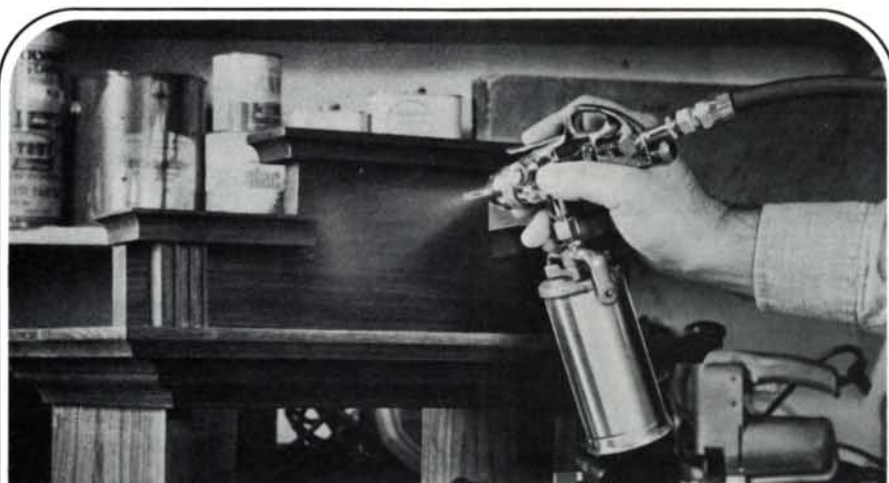
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EVENTS

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

**Young Americans: Fiber, Wood, Plastic,
Leather**—Nov. 19 to Dec. 31, Norton Gal-
lery and School of Art, West Palm Beach, Fla.

Wood: Traditions/Innovations—Furniture
and objects by American woodworkers, in-
cluding Wendell Castle, Igor Givotovsky,
Bill Keyser, Alphonse Mattia, Steve Madsen,
Jere Osgood, Bob Stocksdale, John
McNaughton, Nov. 3 to Dec. 17, Richard
Kagan Gallery, 326 South St., Philadel-
phia, Pa.

**Lecture series on the Arts and Crafts Move-
ment in America, 1876-1915**—Eight lec-
tures on Wednesday evenings, 6 PM-8 PM;
tickets, \$5., from Oct. 25 to Dec. 13. Spon-
sored by The Victorian Society in America
and The Jordan-Volpe Gallery, 457 West
Broadway, New York, N.Y.

Second Annual Philadelphia Craft Show—
Pieces by American craftsmen, all media.
Sponsored by the Women's Committee of
the Philadelphia Museum of Art, Nov.
16-19, Memorial Hall, Fairmount Park,
Philadelphia, Pa.

The Waterfowl Festival—Exhibition of carv-
ing, photography and art, Nov. 10-12.
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Harrison Sts., Easton, Md.

**The Harmonious Craft: American musical
instruments**—A wide-ranging exhibition of
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the highest level. Sept. 29 through next
Aug. 5, Renwick Gallery, Smithsonian In-
stitution, Washington, D.C.

**Cut on Wood: The art of American wood
engraving, 1780-1900**—through Dec. 31,
National Museum of History and Technol-
ogy, Washington, D.C.

Marietta College Crafts National '78—
Showcase for new work, all crafts, Oct. 28 to
Nov. 26, Marietta (Ohio) College.

The Woodworkers and the Weavers '78—
Jointly sponsored by the Mendocino Wood-
workers Association and the Mendocino
Weavers Guild, Nov. 25-26, The Guild
Store, Hwys. 20 and 1, Fort Bragg, Calif.

**Sidewalk Superintendent: A look at build-
ing in America from 1719 to 1830**—Exhi-
bition of building craft and tools, Nov. 16 to
May 11, Fraunces Tavern Museum, 54 Pearl
St., New York, N.Y.

Wood—Pieces by Michael Coffey, Robert
March, Jon Zeltsman, Anthony Beverly,
Giles Gilson, Lewis Korn, Michael Kovach,
David Ross, Union Woodworks and Edward
Zucca, Nov. 1-30, Westlake Gallery, 210 E.
Post Road, White Plains, N.Y.

**Tools and Technologies: America's wooden
age**—How tools contributed to material cul-
ture, October 30 to next January 15, Robert
Hull Fleming Museum, The University of
Vermont, Burlington.

Designer/Craftsman '78—Juried exhibi-
tion, all media, Oct. 26 to Nov. 30, Rich-
mond Art Center, Richmond, Calif.



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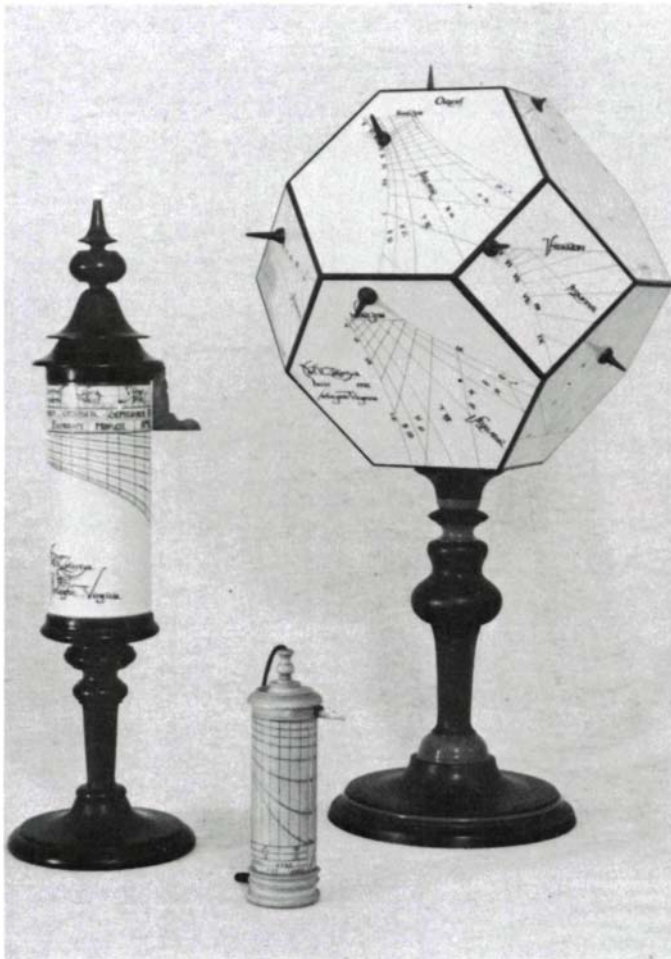
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Marshall-type microscope, 18 in. high, \$900, is made of boxwood, cocobolo and cherry. It magnifies about 100 times, although best resolution is at somewhat lower power. Its parts are disassembled at the top of the next page.

Scientific Instruments of Wood

Simple hand tools, old methods, and ingenuity

by Stanley N. Wellborn

After a brief encounter with M.U. ("Zak") Zakariya, 36, of Arlington, Va., it quickly becomes obvious that he is no ordinary woodworker. In fact, most observers look on him and his methods as throwbacks—to the 19th if not the 17th century.

Consider first the items he makes: wooden microscopes, medieval sundials, astrolabes and cross staffs, elaborately turned chess sets and candelabra, early musical instruments and a wide variety of traditional tools seldom seen in modern workshops. Add to that his work as a calligrapher of Arabic, a cabinetmaker and metal crafter, a designer of art objects based on antique patterns and an accomplished painter of still lifes and Islamic murals. Then note that he is virtually self-taught, prefers hand tools to power equipment and does most of his work by eye, using his own sense of proportion and line rather than measurements. Yet in a compact, tightly-organized

shop, he produces articles that meet industrial tolerances.

His philosophy of woodworking bears examination because of the historical perspective it gives to craftsmen who welcome the sophisticated devices, conveniences and shortcuts that are available today. "I had no tools when I started out—not even a wood saw," he says. "I had to hacksaw each piece and then use small files to get a proper fit. So much of woodworking is mental discipline and patience. If you become single-minded enough, you will find a way to get it done, even if you don't have tools or training." He observes that "the one crucial thing that early woodworkers realized was that even simple tools would do an enormous amount of work if they were sharp. Unfortunately, sharpening is the most neglected aspect of woodworking."

Many of Zakariya's designs are based on research he has done in European libraries and museums, particularly on



Parts of the Marshall microscope. Specimen stage, right, carries mirror for reflecting light, spring-retained slide mounting and small specimen tweezers. Drawer in base contains several objective lenses.



Left, low-power Nuremburg-type microscope was commonly made for students until about 1850. Zakariya's reproduction, mahogany and cocobolo, is 14 in. high and sells for \$600. Above, French Directoire-style chess set, in natural and stained boxwood, was the standard pattern of the 18th and early 19th centuries. Malayan-style set, in tray, is made of ebony and boxwood, as is the playing board. Pine box is decorated with precise knife-cut lines given emphasis by the finish. Zakariya resaws stock for chessboards and boxes with a homemade 30-in. frame saw, made of hickory for its strength and mass, with an ordinary bowsaw blade refiled for ripping. Right, Zakariya at his pedal-powered machinist's lathe.



work done in the 18th and 19th centuries by the French artisans Charles Plumier and Louis-Eloy Bergeron and the Italian turner Filippo Senger, who worked in the Court of Florence from 1675 to 1704. He has also undertaken extensive study of the five volumes by John Jacob Holtzapffel, the 19th-century British expert on materials, toolmaking and turning. "These artisans were fascinated with mechanics and invention. They pushed tools to the limit just to prove that something could be done," Zakariya says. "Sometimes, the results were perfectly god-awful, things that made a mockery of the craft. But they also produced profound and incredible works of art, things that are difficult to believe could be done on a lathe. I try to incorporate the best of what they did in my work." Although Zakariya doesn't advocate throwing out all the modern devices in the world, he does feel that woodworkers should begin with nothing but simple hand tools. "There is no question that when you put a chisel or saw into a piece of wood by hand, you understand the nature of the wood better than if you use a power mortiser or a table saw. And it's a lot less noisy, which for me is an important consideration."

As a teenager, Zakariya worked in a machine shop and a clock works in his native California, then traveled through Europe and North Africa, where he observed old-world wood and metal crafters. He returned to California to work five years for an antique dealer, where he made a number of instruments and reproductions. "That was where I learned the value of research," he says. "I'd be asked to produce a caliper or a sundial and I'd go to a book or museum and study it. Usually, it would include a number of my own variations or improvements, because I'm not interested in exact

reproductions. But making a copy was a great way for me as a beginner to see how medieval craftsmen got things done."

Now settled in Arlington, he divides his time between Islamic calligraphy and producing instruments for scientific and academic research. The bulk of his instrument-making is done on a Barnes machinist's lathe built in Rockford, Ill., and patented in 1886. He found it in a Washington, D.C., junk store. Powered by a bicycle-style foot pedal, it is similar to a lathe that Zakariya trained with in the early 1960s.

"This machine, though simple, is quite superior for my kind of work, since it has instant and variable control of speeds and a quick reverse. I think the best lathe work is frequently done at slow speeds and with extremely sharp tools," Zakariya says. The reason? "Fast speeds encourage scraping, and slow speeds encourage cutting. Scraping is necessary sometimes, but too often it is simply a lazy habit. It vibrates the work, it tears up the surface, and it simply is not as gentle a technique as cutting. In his books, Holtzapffel often said that excellent turning did not require high speeds." Zakariya advises many turners to reduce the speeds of power lathes through use of electronic controls on the motor.

The microscopes that Zakariya builds require finely cut wood threads to hold the lenses in place, and he has refined the technique of lathe threading using special hand-guided cutters he adapts from Holtzapffel. The lathe, using combi-

اَنَا خَلَقْتُكُمْ ذَكَرًا وَاُنْثٰى

Zakariya's Islamic calligraphy in the Muhaqqaq script. The text is the Koranic verse, 'We have created you male and female.'

the following: The cherry wood was stained with leather-shoe dye mixed with alcohol, soaked in linseed oil, then restained with butcher's wax and lampblack using oil-wet sandpaper on the lathe. The calibrated portion was given fifteen coats of gesso, then a coat of rabbitskin glue, after which the time indicators were drawn in pen and ink. This was followed by eight coats of polyurethane varnish, then wet sandpaper from 230 to 600 grit using liquid detergent on the lathe, and finally a combination of steel wool, rottenstone and light oil.

One of Zakariya's recent instruments is a geometrical chuck he designed from a Holtzapffel drawing to cut continuous designs in the surface of flat wood and metal. The chuck, made with hand tools of sheet steel and brass, fits on the headstock of the lathe. A flat piece of stock is mounted on the instrument and is rotated by the chuck against a spinning cut-

ter bit mounted in the tool rest. By changing gear ratios, a multitude of variations on five, six, seven and eight-pointed rosettes is possible, as well as many other designs.

Few woodworkers would attempt to emulate the kind of work done in his shop, a fact that Zakariya acknowledges. But he is convinced that woodworkers who take the time to relate what they are doing to the origins of modern woodcrafting will find the results rewarding. "These old 18th and 19th-century craftsmen were professionals in every sense. We can't hold a candle to the kinds of work they produced then," he says. "If we can keep that in mind while we work, it can't help but inspire our own production." □

Stan Wellborn, a Washington journalist, is a frequent contributor to Fine Woodworking magazine.

Making a Microscope

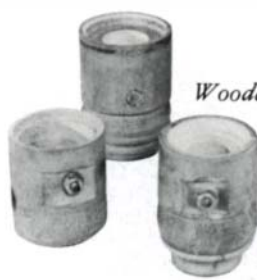
by M.U. Zakariya

Building historical scientific instruments is essentially a toolmaking process, because every instrument requires special tools and jigs. In their day, these tools were ingenious technological breakthroughs. We must often reinvent them now, occasionally with improvements, and it can be done at little expense with only a modestly equipped shop. Once made, many of these tools can be used in other projects. Hardly ever is there one correct procedure that excludes other approaches. With good improvisations you can get some tools to do the work of the ones you don't have.

The functional aspects of an instrument must be figured out before beginning the actual work. This may require research and often takes longer than making the piece. This means the geometry of sundials and scales, the optics of microscopes, as well as the working parts, how they must fit, and the special scales and divisions on altitude and navigational instruments. A choice of woods must be made, keeping in mind the use to which the piece will be put and how various woods shrink and expand. I never make accurate plans, but do make plenty of working sketches for features like threads, dimensions, details and positions. Examining old instruments can give you important clues on how to achieve your ends. An instrument should never be copied without knowing its principles of operation. You should always sign and date your work, since there are folks abounding who would pass an instrument off as antique, and in the end cause havoc among collectors and historians of early science.

Let me run through some typical steps in making the little microscope. First, the lenses are selected, measured and set aside, and the best distance between them noted on your plan. Select the wood and rough-saw it oversize. It has nine individual wooden parts, and we find that three parts (the barrel, the eye-piece barrel and the eye-piece rim) are all of similar size and will eventually go together—so they are in one piece of wood. The legs are similar, so one piece of wood is cut. Next, all this wood is turned cylindrical and the ends faced off square. Then the legs are separated into three, as are the barrels, their parted edges then being faced square.

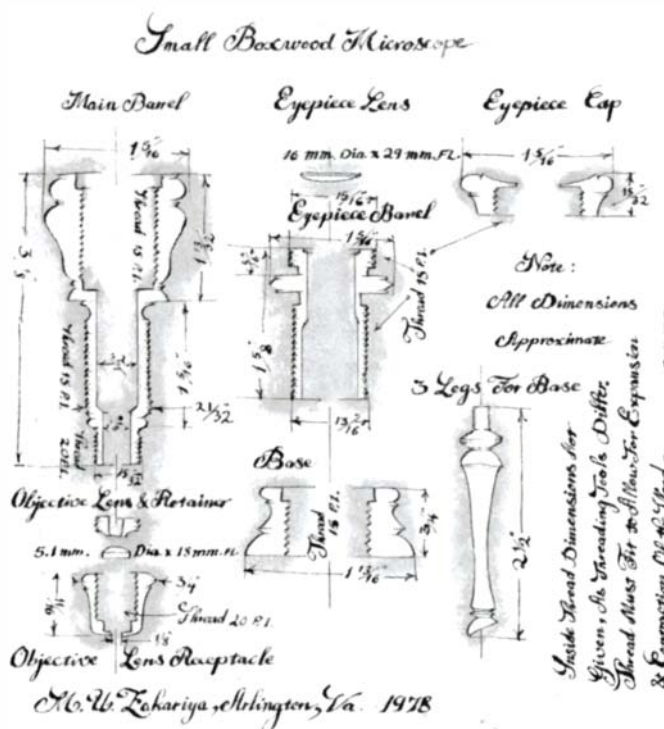
Here you will need some wooden chucks, which are easy to



Wooden cup chucks.

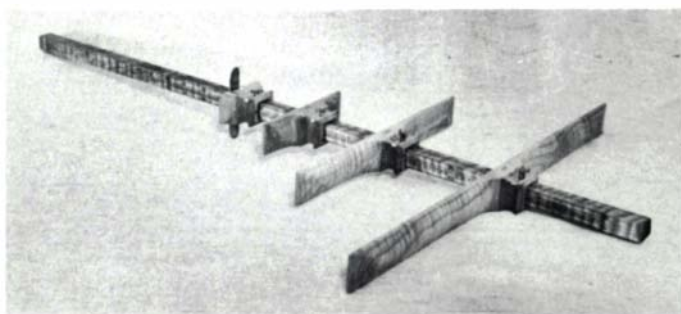


Small boxwood microscope, disassembled above, is a feasible introduction to making historical scientific instruments.

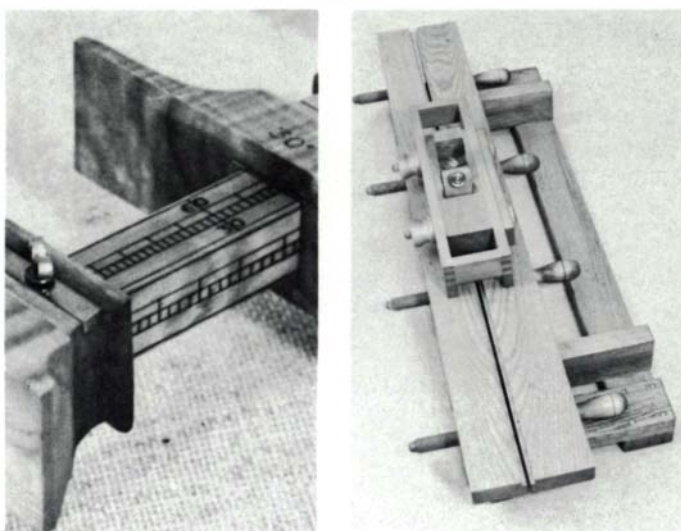


make and are described in Holtzapffel. It is a good idea to make several, for many sizes. They can be used over and over and resized as desired. Maple is a good wood. Tap one end to fit on your nose spindle thread. Put it on the nose, turn it, then saw it laterally and run a bolt through it to clamp it by squeezing the kerf. In the end of this chuck, turn the receptacle to hold whatever part you wish. You fasten the work in and release it by means of the bolt.

Figure out internal and external dimensions of threads and fits. Wood threads should fit slightly on the loose side, so when the wood's dimensions change or the roundness gets oval, the threads will still work. You will need some kind of steady rest for your lathe, to support the end of a piece you are boring or threading internally. You could start first by preparing the wooden chuck to take the barrel blank, then



In the 16th and 17th centuries, the cross staff was the standard navigator's instrument for measuring celestial elevations and thus finding latitude. The navigator first estimated the elevation of the sun or a star, then selected the appropriate vane from the four shown here. He planted one end of the staff in his eye socket, slid the vane until its ends touched the star and the horizon, and locked it in place. He then read the elevation from the appropriate scale on the staff.



A navigator could get a fix on the sun without going blind by standing with his back to it and measuring the shadow cast by one of the larger vanes. The small vane would be set at the end of the staff and aligned with the horizon. Zakariya hand-cut a set of 51 stamps for setting the numbers and letters into the wood (detail, left). He also had to make a special fine-line cutting gauge and a center-finding box. The curly maple beam of the cross staff must be absolutely straight and square, so the vanes can slide freely and accurately. Zakariya made a 5-ft. shooting board, right, to plane it. The stock is set in the groove and clamped by the four wooden screws. The plane is carried by a beechwood box that straddles the stock, so its height above the board can be set precisely. The plane iron is sharpened to a 45° bevel and sits at a 60° angle in its osage body. Holtzapffel recommends such steep angles for difficult woods, and Zakariya gets a flawless surface—although the iron must be 1/4 in. thick to eliminate chatter, and its cap must be set very fine.

support it on the end with the steady rest, bore it to size, and thread it internally. (If your lathe doesn't have a lead screw and change-gear threading carriage, you will have to find another way, such as chasers, or taps and thread boxes, or even building a lathe with a traversing mandrel.)

Next turn the barrel around, remove the steady rest and support the objective end by putting into it a tight plug with a center hole in it, and hold that end with your tailstock center. Turn it to dimensions and do the threads. Next, bore the eye-piece barrel. It can then be placed on a wooden arbor with a little powdered rosin on it to give a grip; the driven end of the arbor can be held in a wooden chuck or by a four-prong driver chuck, or whatever is convenient. Turn the long end, thread it, then reverse the barrel and turn and thread the short section onto which the eye-piece rim will be screwed. At this point, turn a depression on the end of this barrel into which the eye-piece lens will fit. Be sure the barrel and eye-piece barrel screw together nicely before breaking down the setup.

Again, using the wooden chuck, thread the eye-piece rim and bore its hole equal to the bore at the top of the eye-piece barrel. Turn the blank rim around in the wooden chuck, and turn the face detail. Screw the two barrels together, and screw on the eye-piece rim. Now you have an assembly, ready to finish. The quick way to do this is while they are all together. The rosined mandrel is driven by the headstock, and the objective end is supported by its plug with the tailstock center. Proceed to turn all outside contours. Think ahead to avoid making mistakes, like turning into a bore and ruining the piece. You may have to do this a couple of times just to learn caution. Bore and thread the base in the wooden chuck, as well as the face details of both sides. Drill the holes for the three legs. I made a division plate for this and used a bow drill fixed into the cross-slide. Then thread the base back onto the completed barrel assembly, and turn its contours. Turn the legs and glue them in. The objective-lens capsule is also done in a wooden chuck, but because it is so small, you have to be very careful. It is now ready to finish. I like to soak this kind of work in warm linseed oil.

Instead of turning the pieces assembled together, plugs to be held in a wooden chuck can be made, each plug threaded to fit each piece. Then the pieces can be turned on these plugs. The plugs can also act as sizing gauges. Eventually you may accumulate a box of these plugs and mandrels which can be fitted to other jigs.

For anyone interested in instrument-making or precision woodworking, the five volumes of John Jacob Holtzapffel—a compendium of over a century of toolmaking experience—are required reading. What isn't covered in these books can be gotten elsewhere, but the clarity of the explanations makes them the finest how-to books ever written. Volumes four and five, on plain and ornamental turning, have been reprinted by Dover (180 Varick St., New York, N.Y. 10014). The first three volumes, covering materials, cutting methods and abrasives, have not yet been reprinted. They are available in some libraries and are a key to basic hand and machine production techniques—very resourceful stuff.

The 1749 edition of *L'Arte de Tourner* by Charles Plumier is available in French and Latin text from Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801. An English translation, by Dr. Paul L. Ferraglio, can usually be obtained through inter-library loan. □

The Harmonious Craft

Fine instruments on display

by Laura Cehanowicz

Making wooden musical instruments is different from most woodworking in that to look right, feel right and sound right, every last detail must be just so—inside, outside, underneath. Musical instruments are a lot of trouble to make, but worth it, and craftsmen seem always to have reserved their ultimate skills for making them. If the work is successfully done, and the instrument sounds as good as it should, it will be played often. And whether a solitary communion between musician and instrument or a concert for thousands of people, the audience is sure to enjoy the music of the craftsman along with that of the musician, and to appreciate the skill of both.

The instruments shown on these pages are made principally of wood by living Americans. We selected them from "The Harmonious Craft," a show of more than 100 instruments in all media, which opened September 29 at the Renwick Gallery of the Smithsonian Institution in Washington, D.C. It will be on display there until next August, when it goes on national tour. The idea for the show came from the success of the Renwick's "Craft Multiples" competition in 1975 (*Fine Woodworking*, No. 1, pp. 10-15). Two Smithsonian curators began looking in early 1977 for distinguished makers and also issued an open invitation for instrument builders to come forward with their work. The curators, Lloyd Herman of the Renwick and James Weaver of the musical instrument division at the National Museum of History and Technology, chose the best-looking work from slides. Then they brought the instruments to Washington to play, to make sure they sounded as good as they looked.



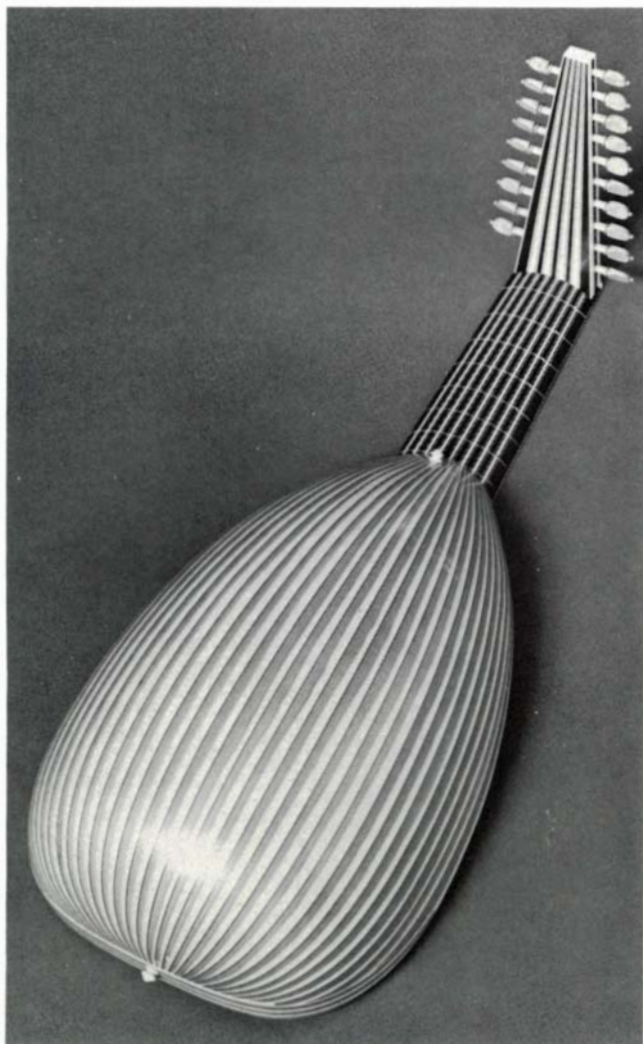
Sansa finger piano, made by Kathleen Doyle, is a traditional African design. The body and head are walnut, and the soundboard is rosewood. The top and bottom of the head are carved separately and attached by the metal helmet. Doyle is a metalsmith by trade and teaches at Penland School of Crafts, Penland, N.C.



Recorders made by William Koch, Jr., Haverhill, N.H., are based on Renaissance design. Each recorder is made in three parts from one block of wood, so that the finished instrument is matched in color and grain. Koch usually uses either cocobolo or domestic hardwoods—rock maple or black cherry. The finish is orange shellac, both inside and out. Koch, an electronic manufacturing engineer, makes recorders part-time.



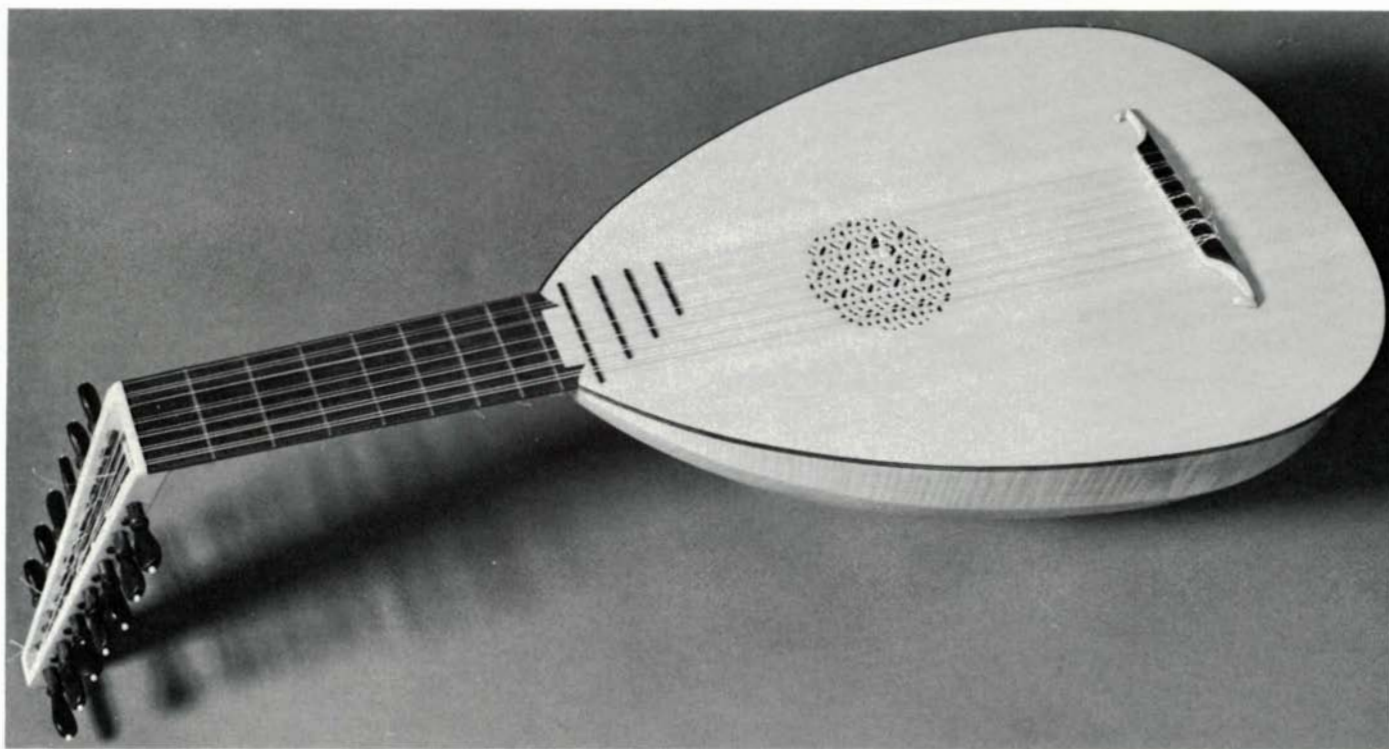
Violin by Edward C. Campbell, Boiling Springs, Pa., has a spruce top and maple back and neck. Most of the work in Campbell's shop, The Chimneys Violin Shop, is done by hand, and an instrument can take up to 400 hours to build. His violins are traditional in form, yet Campbell stresses that none are copies. Each instrument is made entirely by one man, either Campbell himself or one of the violinmakers he employs, and the design details of each are determined by the maker and the pieces of wood he works with. Campbell has been in business since 1959 and also makes cellos and violas—like his violins, mostly for professional musicians.



Robert Lundberg, of Portland, Ore., used shaded yew, traditionally favored for its fine grain and bendability, for his reproduction of a late Renaissance 10-course Tieffenbrucker lute. The lute has 31 ribs glued together with ebony spacers and weighs less than $1\frac{1}{2}$ lb. Lundberg has been making instruments full-time for about eight years. He usually builds only on commission.

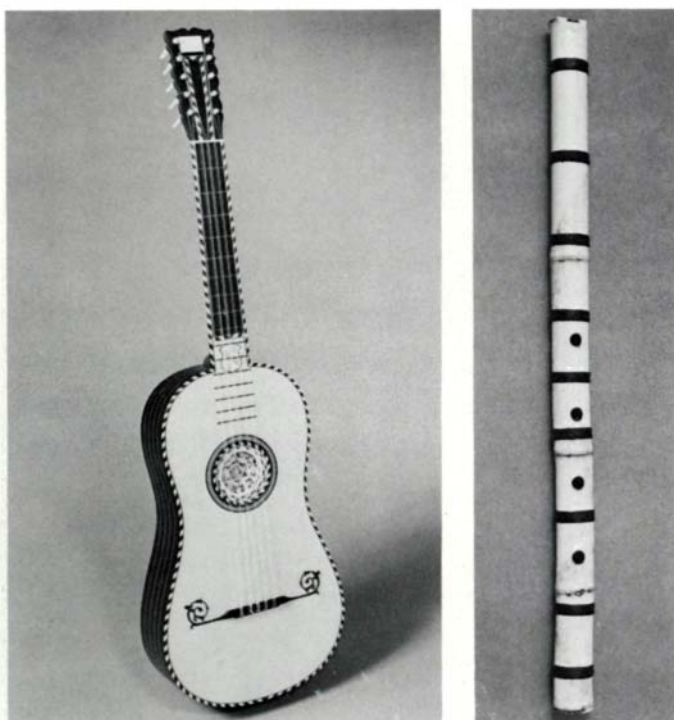


The stick, invented by Emmett Chapman of Los Angeles, looks like an electric guitar from the neck up and works on similar principles, but is played like a piano. It has ten strings, five for melody and five for bass. As with the piano, each hand works independently. The left hand plays the bass strings, which are located in the middle of the stick, and the right hand plays the melody. Sound is produced by lightly tapping, not plucking, the strings. The stick is made out of pao ferro, hand-rubbed with an oil-and-wax solution. Chapman invented the stick in 1971, after working with a guitarlike instrument that had nine strings.



Lute, made by Stu Corwin, Monte Rio, Calif., adheres closely to the design of a traditional Tieffenbrucker lute. Although Corwin designed the rose, he avoided major modifications in construction because they would change the sound and hamper the accurate reproduction of traditional music. The lute is light in weight (under two

pounds), and the top measures only $\frac{1}{16}$ in. thick. The body is curly maple, the top is spruce and the fingerboard is ebony. The finish is penetrating oil, covered with lacquer. Corwin has been a professional instrument-maker for the past eight years. He makes mostly electric and acoustic guitars.

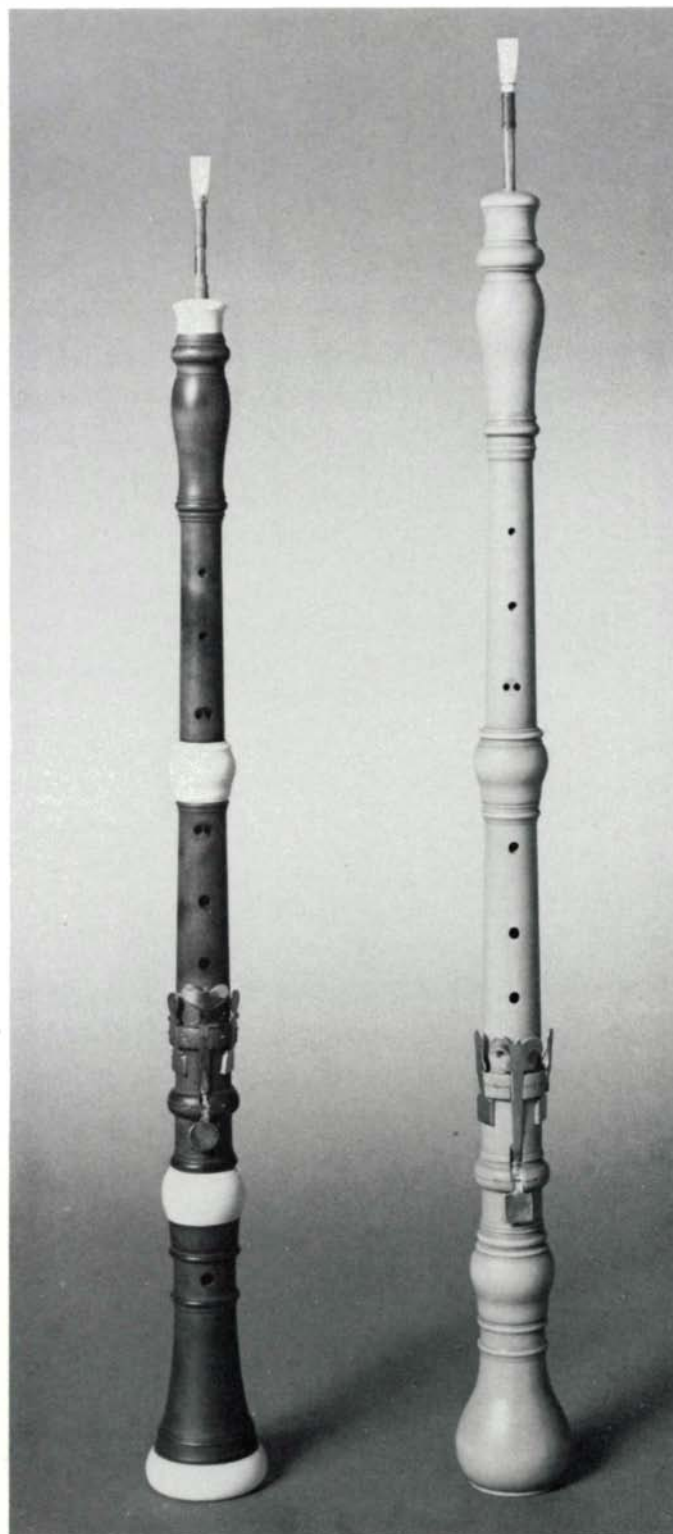


Baroque guitar, left, made by R. E. Brune of Evanston, Ill., is made in the traditional style of the early 18th century, except that its sides are laminated from two thin pieces of wood and are not lined with paper. The top of the guitar is spruce, the back and sides are ebony inlaid with maple. The neck of Spanish cedar is veneered with ebony, which is valued for its smoothness but too heavy to use by itself. The sawtooth decoration is alternating ebony and ivory. The rose is made from three or four layers of parchment, each layer containing three more layers, cut with a small knife. The finish is oil. Brune, 29, also makes harpsichords, lutes and modern guitars, and has been in business since 1966. He makes instruments on commission for professional musicians.

The ancestor of the shakuhachi flute, above right, made by David Wimberly, Diamond Cutter Fluteworks, Boulder, Colo., is an ancient Japanese instrument used for meditation and the practice of Zen. Upon it is blown honkyoku—Zen music. The instrument is not meant to be played in an ensemble or for entertainment, but is used as a tool for enlightenment. It is made of bamboo and has a linen binding that keeps it from cracking. It is oiled lightly with edible walnut oil. The bore has about a dozen coats of lacquer—adjusting layers of lacquer at different points tunes the instrument. Wimberly, 27, has been making shakuhachi flutes for eight years.



Douglas Ching, 23, of Kaneohe, Hawaii, has been making ukeleles for ten years—his goal is to make the ukelele sound as much like a guitar, from which it originally derived, and as little like the standard tourist uke, as possible. The body of this concert ukelele is only about 4 in. shorter than a guitar, but about 5 in. longer than the standard uke. It has six strings, two of them doubled, instead of the usual four. Two soundholes increase the vibrational area of the soundboard, giving a guitarlike tone. The materials are also different. Standard ukes are made entirely from koa wood, not an effective sound transmitter. Ching uses koa for the back, sides and neck, but spruce for the top and ebony for the fingerboard. He also uses interior bracing and binds the top with rosewood. Ching sprays on lacquer and wipes it off to leave a thin layer, which he then buffs. He sells his ukeleles to nightclub entertainers and also makes classical guitars and lutes.



Baroque oboe, left, made by H.A. Vas Dias, Decatur, Ga., is a reproduction of one made by Jacob Denner around 1700. Vas Dias wants instruments that sound and look like the ones made in the 18th century. The construction of this oboe is therefore traditional; his only modification was doubling the fourth fingerhole. The oboe is made of stained boxwood, the traditional material, and has ivory trim. The finish is oil. Vas Dias was a professional oboe player for twenty years before he began to make oboes full-time about four years ago.

Oboe d'amore, right, by Jonathan Bosworth, of Bosworth and Hammer Woodwinds, Acton, Mass., differs from the oboe in its bulb-shaped bell and slightly lower tonal range. This one is a reproduction of the only extant oboe d'amore made by Jacob Denner. Bosworth stresses that because he has to second-guess the original condition of the instrument, his reproductions are never exact. His oboe d'amore is made from boxwood and finished with linseed oil. Bosworth used to design heart pacemakers, but has been making and selling different types of oboes and clarinets for the past three years.

Laminated Bowls

Simple cuts produce complex curves

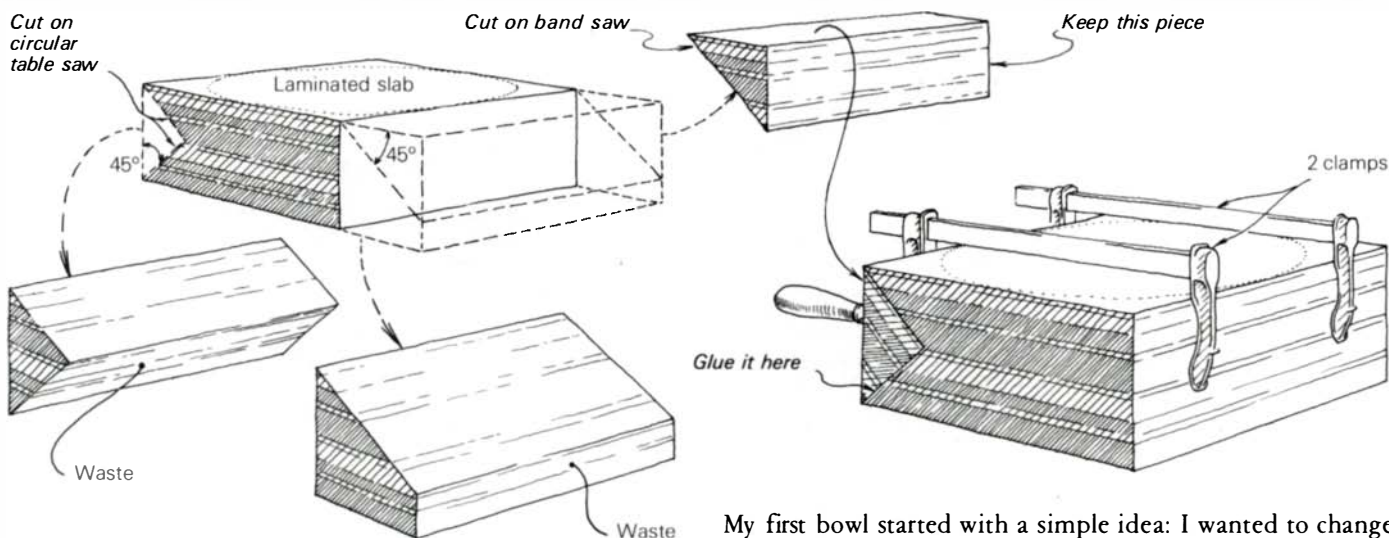
by Harry Irwin

Bowls can be turned from seasoned wood, green wood or laminated wood. The results from seasoned or unseasoned stock are similar, but the bowls produced from laminated wood are quite different. I wanted to turn some bowls but since I don't have a chain saw or a drying room, using green wood seemed beyond my capability. And I couldn't afford to purchase a large slab of seasoned hardwood either. Therefore, I turned to making bowls from glued-up wood. When I began, I did not know what form my laminations would take; the laminated bowls I had seen didn't seem especially attractive. So I decided not to look at any how-to literature and just try it on my own. The four bowls shown here are the results of my experiments.

If I could have turned bowls from solid stock I don't know if I ever would have tried this type of lamination. But now I

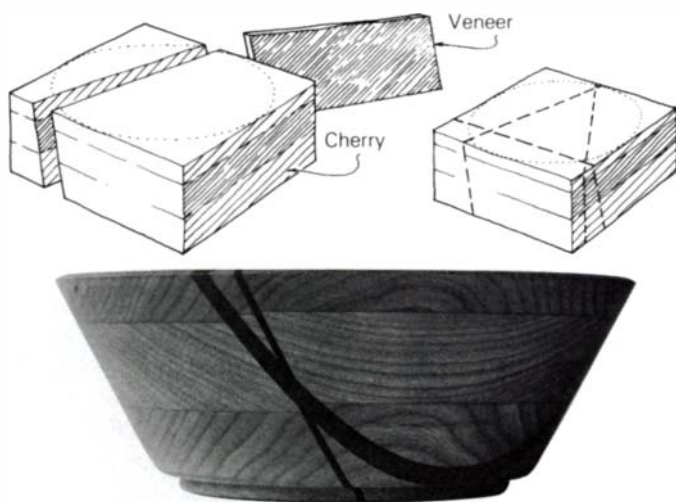
am hooked on the idea. The field of complex laminations is new and unexplored. Haphazard gluing can be unattractive, but with some creative thinking the laminations can enhance the beauty of the wood. Glue lines may not be pretty but they are no uglier than the mortar that holds bricks together. If a bricklayer makes an elegant archway he must taper his bricks; to do so he increases the mortar-to-brick ratio. The same is true for the woodworker. If he wants to achieve a bend or design through lamination, the glue-to-wood ratio will increase. Both cases are legitimate uses of materials, and neither should be criticized for its use of adhesives. The work should be judged by the finished product.

Harry Irwin, 26, a former carpenter, is a woodworking teacher living in Cambridge, Mass.



Bowl of cherry, oak, mahogany and teak, 6½-in. dia.

My first bowl started with a simple idea: I wanted to change the usual horizontal glue lines of a laminated bowl. I accomplished this with some risky end-grain gluing. I glued together pieces of cherry, oak, mahogany and teak. This block was clamped to the miter gauge of the table saw, for safety and accuracy. Then two careful 45° crosscuts caused a 90° chunk (a right triangular prism) to be released from the end grain, as shown in the drawing. This cut had to be carefully done because any unevenness would result in a poor and potentially weak glue line. The 90° must be precise too—it is easy to check with an accurate try square. From the other end of the block I cut the same shape, only here the grain is at a 45° angle to the hypotenuse instead of perpendicular. This cut, because of its length, must be done on the band saw. It will not be gluing surface so its flatness is of no special importance. This same end is then cut square for clamping. Because of the end grain, I sized the surfaces with a liberal coat of plastic resin glue. After it soaked and dried a little I applied some more and clamped it. The clamping procedure is very easy—two clamps will do the trick—then it's on to the lathe.

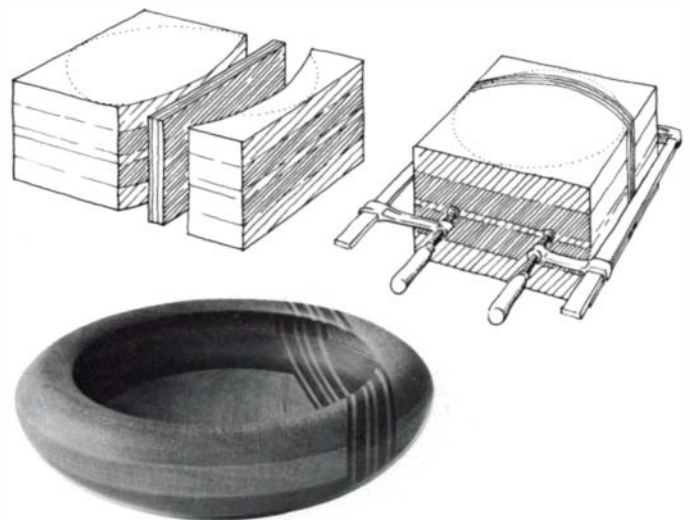


Cherry and mahogany bowl, 7 $\frac{1}{8}$ -in. dia.

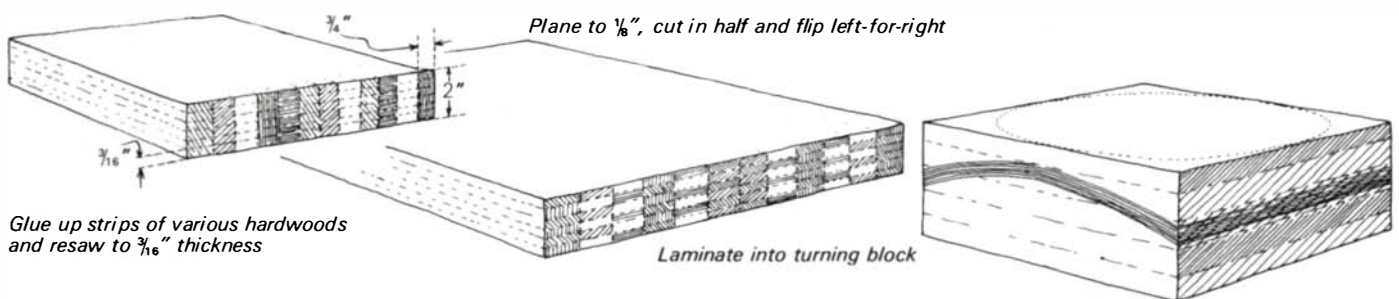
Next, I decided to pass thin sheets of mahogany through a laminated block of cherry wood. On the table saw I set the miter gauge and the sawblade for a compound angle cut. In between the two halves I sandwiched mahogany veneer. After it dried I repeated the process two more times. In the end each piece of mahogany intersected the other two, as shown in the sketch. When the blank was turned on the lathe, the mahogany became hyperbolas. The most interesting parts proved to be the intersections of these hyperbolas.

Gluing this bowl turned out to be harder than I had expected. The angle cuts, under pressure of clamping, caused the two halves to slip apart. I solved this problem with some awkward clamping from all six sides. The unorthodox cross-grain gluing might lead to the eventual destruction of the bowl. But the thin veneers of mahogany might not have the strength to break the glue joint, just as thin layers of plywood survive their cross-grain gluing. Time will tell.

The gluing problem I encountered in the previous bowl gave me an idea for the next one. It also sent me from the table saw to the band saw. So far I was making straight cuts and the lathe was changing them into curves. This time I decided to cut a curve. I started with a block made of cherry, oak, mahogany and walnut. Through this I cut (vertically) a gentle arc. In between this arc I placed thin strips of walnut and cherry. The work was first clamped together dry, to find the gaps. Then I removed high points on the spindle sander. The final gluing was easy to do. The problem of slipping I had experienced with the previous bowl was gone, because the two arcs aligned themselves naturally. Bending wood can be difficult and time-consuming: The bending jig must be made to duplicate the curve, and steam is needed to achieve the bend. But here the bending jig is no extra work since it is also the finished bowl, while the thin laminations form easily to the arc without steam.



Bowl of cherry, walnut, mahogany and oak, 9 $\frac{3}{4}$ -in. dia.



Glue up strips of various hardwoods and resaw to $\frac{3}{16}$ " thickness

Plane to $\frac{1}{8}$ ", cut in half and flip left-for-right

Laminate into turning block

For the last bowl in this series, I started with the same block as before. But this time the arc cut through the block went along the horizontal plane. The veneer to be laminated in this space also had to be glued up. I glued strips of teak, poplar, oak, cherry and walnut, all $\frac{3}{4}$ in. by 2 in., together edge to edge. They were resawn on the band saw with the fence set at $\frac{3}{16}$ in. A sharp blade is needed for this cut or else the blade will wander. The sheets were passed through the planer to bring their thickness down to $\frac{1}{8}$ in. and to remove the saw marks, thus ensuring a good glue joint. They were turned left over right and at the end grain an inlay pattern appeared. Again this block was clamped dry to find the gaps that had to be sanded away. Once glued and turned, the curved laminations in the center of the bowl became a continuous wave around the bowl.

Bowl, 9 $\frac{3}{4}$ -in. dia., of cherry, walnut, mahogany, oak, poplar, teak.

Preparation of Stock

The essential first step is obtaining a true face side

by Ian Kirby

A face side and a face edge are true reference surfaces from which accurate measurements may be taken. Proper preparation of a face side and from it a face edge are essential preparatory steps in woodworking. If this part of the job is not done correctly, one is bound to get into serious difficulties in all subsequent operations.

Preparing a face side that is flat in width, flat in length and out of winding is analogous to pegging out the site on which a house is to be built. If this first step is taken lightly and not accurately carried out, the errors compound at every building stage. No amount of connivance will prevent difficulties from arising at every turn. Yet of all the processes in woodworking, preparation of stock is often woefully done and frequently receives only perfunctory attention. Basic woodworking books do cover the process, and it seems strange to me that in teaching, the case for it must be constantly restated. I find that even quite experienced woodworkers need to be reminded of the procedures to follow. Preparation is so elementary that people seem to treat it with contempt, saving their energies for more interesting operations.

General approach

I shall discuss the general principles and requirements of preparation before going on to the specifics of obtaining true reference faces. It's always unwise to approach woodworking procedures in an ad-hoc manner because in the main there is a sequential logic to them. Preparation is no exception.

For any one job it is best to convert and prepare all of the stock at the same time, whenever it is possible to do so. This usually saves material, time and effort, and reduces the risk of making mistakes. It also ensures that all pieces to be finished to the same dimension are machined (if you are using machines) at the same setting.

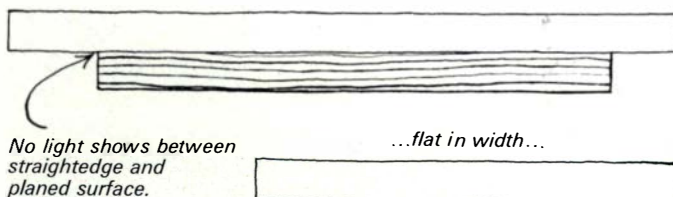
Preparation includes or at least begins with the selection of timber for the job, if only because knowing what one has to achieve from a piece of wood has a lot to do with which piece one chooses. However, selection could be considered a topic in its own right and I won't try to deal with it here. Nonetheless, the two procedures overlap when deciding whether to cut all the pieces directly to the sizes specified in the cutting list, or whether to make it a multi-stage operation by preparing larger pieces from which the correct number of smaller pieces will later be taken. This depends very much upon the available stock, and it is worth spending some time deciding how best to proceed. For machining it's usually best to work with larger rather than smaller pieces of wood. Not only is time saved, but best use is made of the length of the machine bed. Thus one maximizes the possibility of achieving flatness, since flatness is, in part, a function of the length of the machine bed. On the other hand, the wood may be so long that it is difficult to handle, or the plank may be badly sprung, cupped or twisted. Machining out these defects will require

many passes and waste a lot of material, and in such cases it pays to cut the plank into more manageable lengths first.

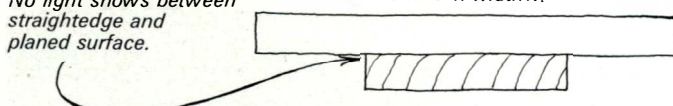
In preparing a piece of wood, whether it is a long plank which will be cut apart later or a single piece to be finished to a specific size, you have to assume that none of its six faces is an accurate reference surface. The first thing to do is to prepare a side which is flat in length, flat in width and out of winding.

The tools for testing these three characteristics are a long

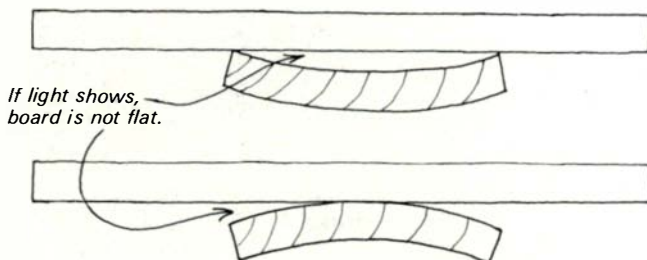
A face side is flat in length...



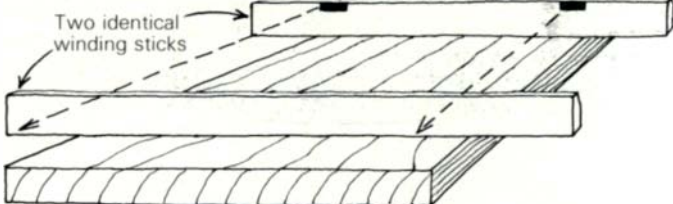
...flat in width...



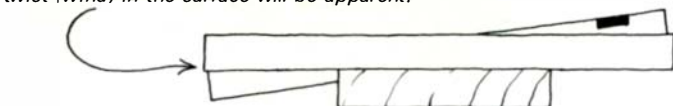
If light shows, board is not flat.



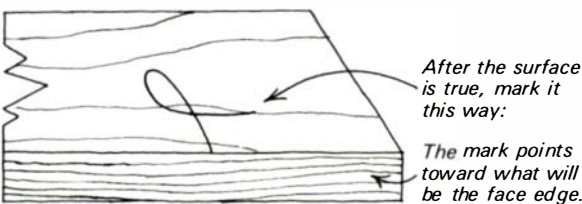
...and out of winding.



Sight along top edges of winding sticks. Any twist (wind) in the surface will be apparent:



After the surface is true, mark it this way:



straightedge and a pair of winding sticks. When a side of the board is flat and out of winding, it is marked and henceforth referred to as the *face side*. It is a reference surface from which further measurements are made. If it is not accurate, measurement can not be accurate.

Whether you choose to prepare one side in preference to the other on the basis of whether it will be exposed and visually important or for reasons connected to its role in construction is inconsequential to the primary fact that there has to be a face side. However, in many situations one does have to consider whether to put the face side on the inside or outside. The decision need not be too confusing. For instance, drawer parts should have their face sides inside, and the members of a carcass generally also have their face sides inside. This way, you retain an accurate reference surface no matter what you later do to the outside. Decide which side will be the face side by thinking ahead to the consequences of having this reference on the inside or on the outside. Since the outside surfaces of any job will be cleaned up by hand-planing or sanding, or perhaps by carving, the face side will be lost if it is the outside.

Do not, however, confuse the face side with the best-looking side. Frequently the two will be on opposite sides of the board. Also, the mark that is used to designate a face side is a clear statement that the side has been prepared and is flat in length, flat in width and out of winding. Never put a face mark on a board as a statement of intent. It is an after-the-fact mark.

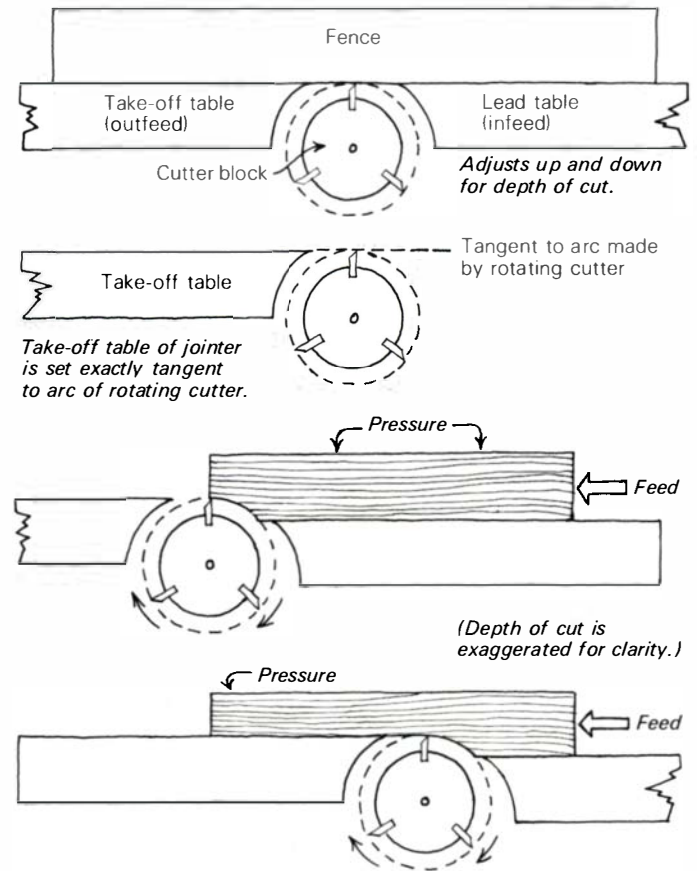
The face side provides the reference surface from which a face edge can now be produced. The face edge bears the same three characteristics as the face side, plus a fourth: It is at 90° to the face side. All further measuring and marking can spring from these two reference surfaces, and most of the woodworker's marking-out tools are designed to rely on them. The marking gauge, for example, is used to mark lines on the wood parallel to either face side or face edge to indicate width and thickness. Because it gauges directly from these established reference surfaces, it is only as accurate as they are.

It is usual to mark and cut to width first, because less energy is involved in removing the material than if it were thickened first. Whether the board is planed to width or sawn first and then planed depends on the work involved. A good rule of thumb is that if there is enough wood to take a saw kerf and leave a small amount of falling board besides, then it is worth sawing first. If not, plane directly to the line. The same is true when cutting the board to thickness. Having now four of the six faces flat, out of winding and at 90° to each other, it remains only to cut to length.

Machining the face side

The machine used to produce the face side is the jointer or surface planer. It consists of two horizontal flat tables which are adjustable in height, separated by a revolving cutter block. The lead table (infeed) is in front of the cutter block, and the take-off table (outfeed) is behind it. The take-off table is accurately set so that its surface is perfectly tangential to the arc made by the rotating cutter. Thus when the wood passes over the cutter, it meets the take-off surface with no further deflection up or down. The table is set at this height when the blades are set in the cutter block, and it remains undisturbed thereafter. The lead table, on the other hand, de-

Surface planer



termines the depth of cut and is constantly being adjusted for this purpose.

Mechanical feeds do exist but in the main the wood is offered to the machine by hand. It is held down firmly on the lead table and moved toward the cutter. At this point the wood has no reference surface, so the lead table is acting only as a carriage. Since the take-off table is set exactly tangential to the arc of the cutter, the cut surface will coincide with its surface. It is vitally important that this contact be established and maintained throughout the cut. Thus as soon as the leading edge of the wood passes the cutter, the operator shifts his hand to the take-off table and presses downward to maintain the contact, while no further downward pressure need be applied to the wood still on the lead table. Otherwise, the wood is liable to pivot or rock about the cutter and lift from the take-off table.

So long as the take-off table is set properly and the contact maintained between it and the newly cut surface, this surface will have all three properties of a face side, although it usually requires more than one pass to achieve. But provided the wood is not too badly sprung or twisted, two fairly light cuts will usually do. Two or three light cuts usually give a better result than one heavy cut, though the feed speed is of course also important in surface quality.

If the take-off table is set too low, the wood drops as it leaves the lead table and the cutters snip off the trailing edge of the board. If the take-off table is set too high, the wood tilts as it feeds and the cut is deeper at the leading edge, producing a taper.

Many shops lack a large jointer and attempt to achieve true reference surfaces with the thickness planer alone. But a thickness planer operates by pressing an already flat surface

against its lower bed, to cut the top surface parallel to it. Its feed rollers apply enough pressure to straighten cup and warp out of a board. The board straightens as soon as it leaves the machine. Thus while it will produce a smooth surface, it cannot produce a flat surface unless the board is already flat on one side. It is better to hand-plane the face side and then thickness than to attempt to produce a face side with the thickness planer alone.

If I were faced with the financial problem of having to choose between buying a wider jointer or a thickness planer, I would probably prefer the jointer because you simply must be able to produce a true reference surface from a rough board. One solution, however, would be to use a European combination machine. These have one cutter block and two tables, a jointer on top and a thickness planer below. Wadkin makes several such machines, as do the Swiss Inca and Italian Combinato lines.

Hand-planing the face side

The long jointer plane is also known as a trying plane or sometimes as a fore plane, which probably comes from the word "before"—it is the tool used before anything else. There is a similarity between the jointer machine and the jointer plane in that both have a long, true surface. In both cases this long surface is the reason they are able to produce a flat surface on the wood. The trying plane is usually 22 in. long, enough for most work.

Also, while there is no difference in level between the toe and heel of the plane's sole, as there is between the lead and take-off tables of the machine, the toe and heel part do play a similar role to the machine tables. The toe and the surface in front of the plane iron act as the initial register, but the part behind the blade is most important in imparting flatness be-

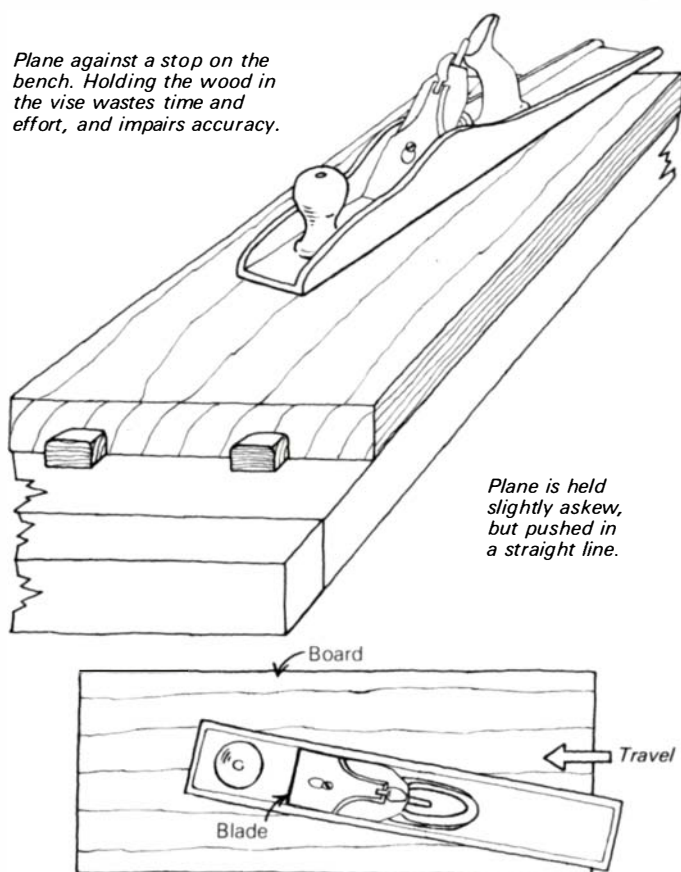
cause it is guided by the improved surface of the wood. So it is vital to maintain pressure on the rear end of the plane to ensure contact and provide progressive flatness at each stroke. Since there is no difference between the two surfaces, the inherent tendency to lift from the surface of the wood is much less apparent than with the machine.

The piece of wood to be planed should, if it is of manageable proportions in terms of width and thickness and not too badly warped, be placed on the surface of the bench against a bench stop. A less good way to plane wood is to hold it in the vise. If there is a degree of spring or twist, the pressure of the vise will probably rectify it, thereby giving a false indication of the real state of the wood when being planed. On release the wood of course returns to its misaligned state. Apart from this, the time involved in mounting the work in the vise, releasing it and changing body position to do so each time the work is checked is much greater than the time it takes to lift the wood from the bench, check it and put it down again. Further, working against the bench stop obliges one to operate the plane properly and provides tactile feedback information that one would not get if the work were in the vise. For instance, if the thrust of the plane is not directly along the axis of the wood or is not being applied horizontally, the wood will react by either toppling over or skewing round on itself. Learners will avoid forming bad habits if they plane woods on the bench in this way. The assumption here, of course, is that the bench is accurate. The surface on which one planes must be horizontal. It must be a "face side" in itself and have all the properties of a face side. A piece of wood with much of one's weight being pressed on it through the plane will easily deflect a few thousandths of an inch. If the surface it is on is hollow, it will be planed hollow. A fine shaving is only about .0015 in. thick, and there is little room for error. When a lot of wood has to be removed, sharpen the plane and move its frog back to open the mouth and take deeper cuts with each pass.

A straightedge is used to check flatness in length and width. It is necessary to hold the wood and the straightedge up to the light to ensure that no light can be seen between the straightedge and the surface being tested. Don't despise checking the board by eye at any time without instruments. It would be foolish to claim that the eye can be developed to the point where measuring tools become redundant, but one should develop as keen an eye as possible—for one's own awareness if nothing else.

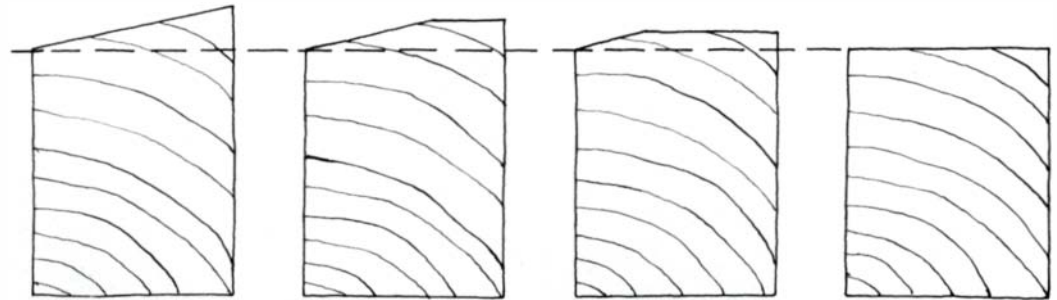
To check for winding, two accurately planed, equally dimensioned pieces of wood, known as winding sticks, are placed transversely at points along the length of the surface and sighted to read for parallelism throughout. The sticks need to be long enough to accentuate the degree of winding so it can easily be seen. The amount of twist can be gauged by the deflection of the sticks, and the remedy is to plane diagonally from the high corner at one end to the opposite high corner at the other end.

If the surface has interlocked or similarly awkward grain, set the plane mouth fine, the back iron close to the blade edge and keep the blade sharp, and it will be easy to plane diagonally or at right angles to the grain. Generally, the more dense the wood, the easier it is to plane across the grain. When the board is flat and out of winding, one should be able to take a clean, fine shaving from end to end all across the surface. When the surface is flat in length and width and



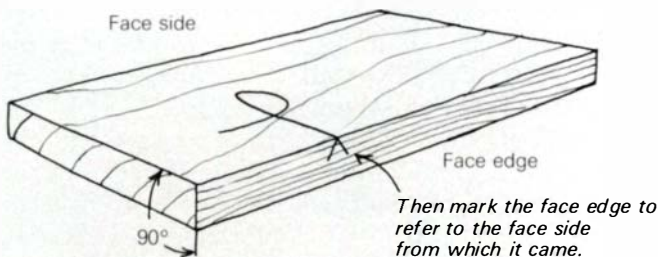
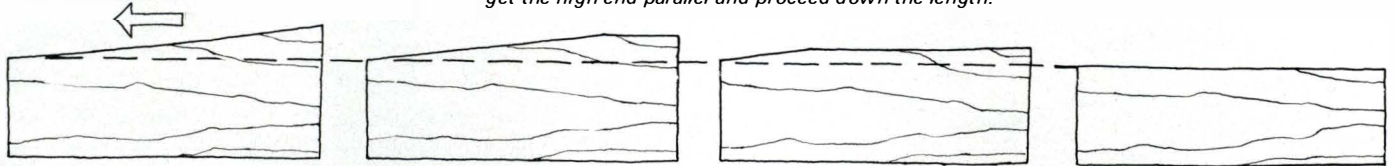
Planing the face edge

If the wood is far from 90° (when seen from the end), learn to plane from the high edge.

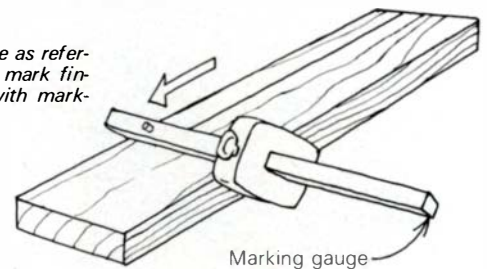


(plane this way)

If the board is wedge-shaped (when seen from the top), get the high end parallel and proceed down the length.



With face edge as reference surface, mark finished width with marking gauge.



out of winding, the face-side mark is applied to it in a position to indicate which edge will become the face edge.

The face edge

Machining the face edge on the jointer is like preparing the face sides. Pressure must be applied to the take-off table in the same way, but now the face side also has to be kept firmly in contact with the fence. The fence must make a 90° angle with the jointer bed, and it's worth checking with a square every time the machine is used. Both downward and sideways pressure need to be maintained throughout the cut, and the procedure is that much more difficult to control.

When preparing the face edge on the bench with the jointer plane, the wood should be stood on its edge against the stop, for all the same reasons as before. This will not be possible when the board is somewhat wider than it is thick, and there will be no alternative but to put it in the vise. But be aware of the problems of distortion that this might cause, although the difficulty is less than with a face side. If the wood is far from being parallel it might be best to thickness the piece before preparing the face edge.

If the wood is severely angled from 90° on its edge, one must learn to hold the plane with its sole horizontal and to take material from the high edge. Some find it a help to shift the plane sideways so the high edge of the wood is cut by the center of the plane iron, but on no account tilt the plane away from horizontal in an effort to compensate. If the piece is wedge-shaped in length, the usual procedure is to get the high end parallel to the face edge and progressively to achieve parallelism down the length of the board as the width—or thickness for that matter—is reached.

The checks for flatness are the same as before, but it is also necessary to check for right-angularity between the face side and the prepared edge all the way along its length. This is

done with a try square. When the four characteristics have all been achieved, the face edge is marked as the side was marked, this time in such a way as to indicate the face side from which it springs.

Width and thickness

The next thing is to use the face side and edge as reference surfaces from which to mark and cut to width and thickness, usually to width first. The first operation may be to saw, either with circular saw or handsaw, to within planing distance of the final dimension. One should aim to saw as near to the line as possible without touching it.

The subsequent planing by machine would be done with a thickness planer and is usually a one or two-pass operation requiring only that the thicknesser be set to the given dimension, the wood fed in and collected at the other end. It is important, however, to do all pieces that are to finish at that dimension at the one setting.

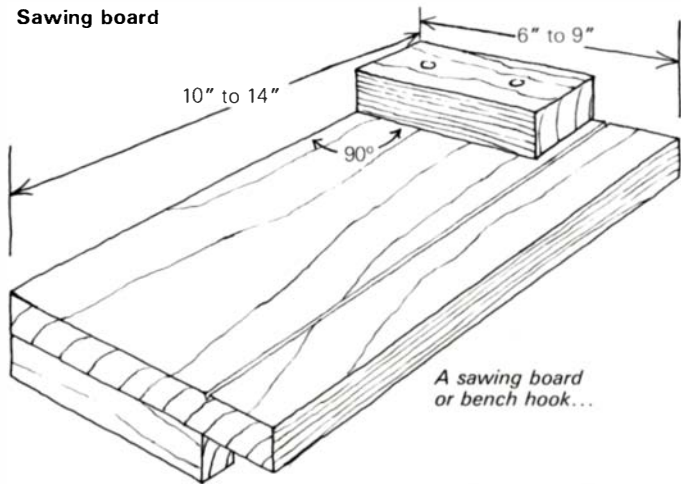
Just as it is not possible to produce a face side with a thickness planer, it is also impossible to plane to width or thickness on a jointer. The necessary accuracy comes from an already established reference surface, and the jointer is not designed to work from a reference surface. There is no guarantee that parallelism will result. There are commercial attachments for jointers to convert them to a form of thicknesser, but they have limited capacity and my inclination is away from them.

Getting to width and thickness by bench methods involves gauging all around with the marking gauge and planing to the line with the jointer plane. As before, work with the wood on the bench and not in the vise.

Length

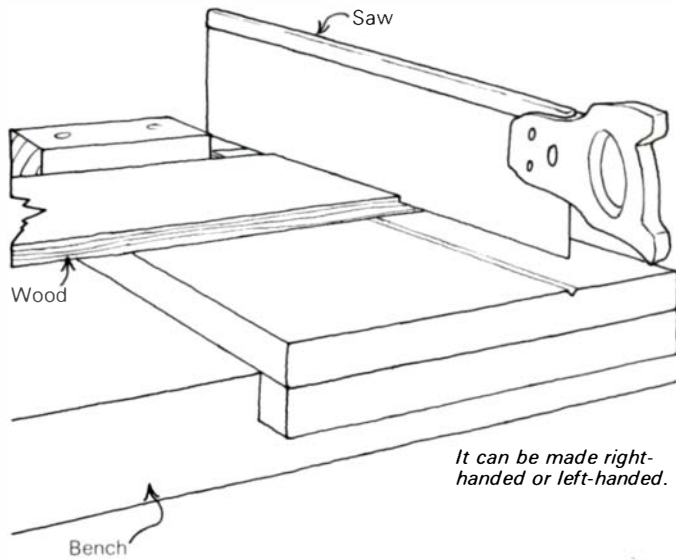
Getting the material to length is a two-part process. One end is squared off first, either with a radial-arm saw, a traveling-

Sawing board



A sawing board or bench hook...

...holds wood for cutting squarely to length with backsaw.



It can be made right-handed or left-handed.

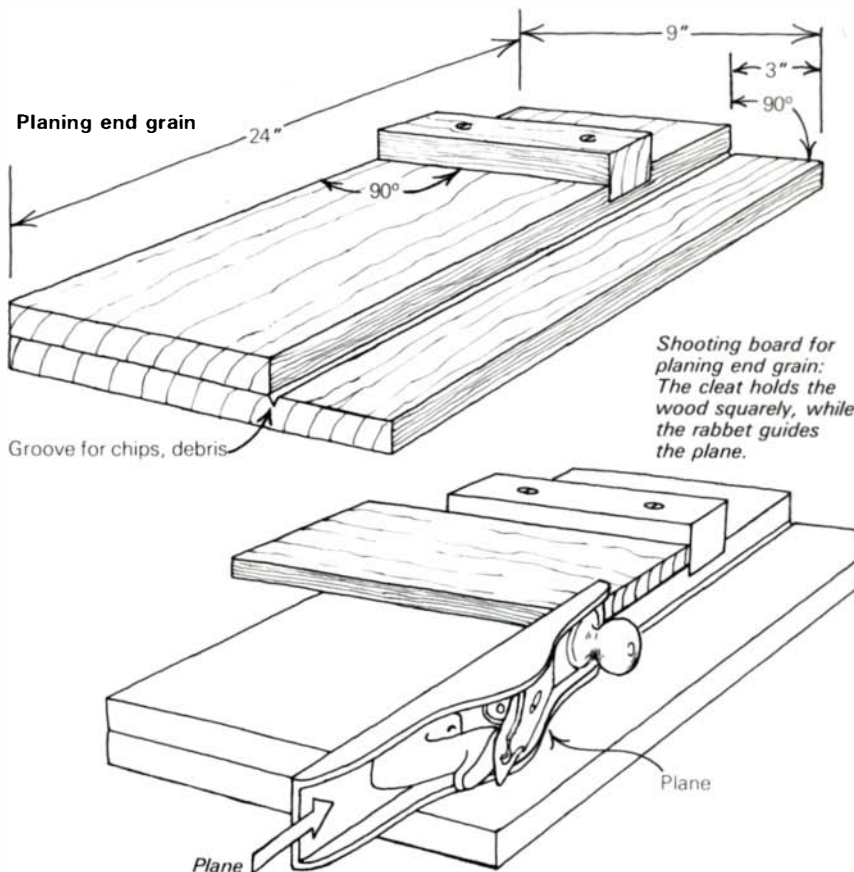
bed dimension saw, or by hand. In the latter case the wood is quite deeply knifed all around, using a try square and working off the face side or face edge. Then saw with a backsaw, holding the work on a sawing board, or with a panel saw and sawhorses if it is a large piece. The length is then measured from this end face and marked with knife and square. The excess is cut in the same way as the other end, either from the marks made, or directly by use of stops on the machine saws.

If the prepared piece of wood is later cut into pieces, care should be taken to see that all the pieces bear the face-side and face-edge marks. For although rectangularity has been achieved, one continues to use only face side and face edge as the reference surfaces throughout all subsequent work.

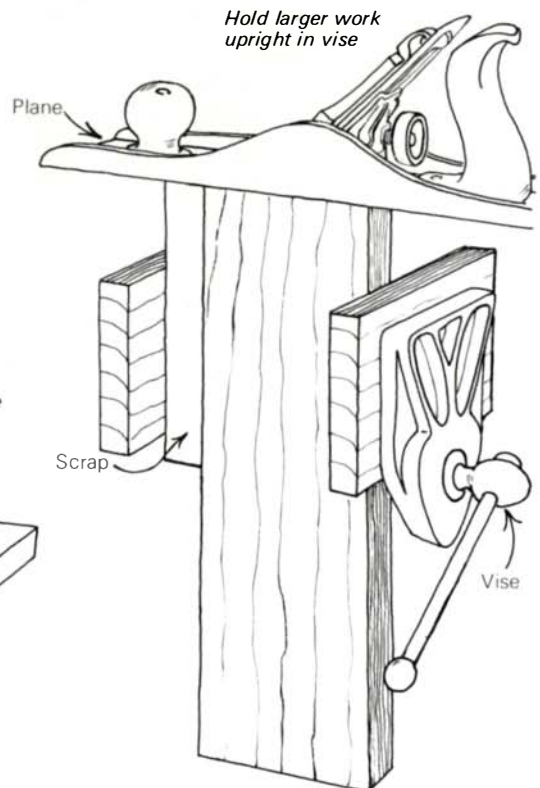
Beginners are often confused about leaving extra wood for cleaning up. In general, one doesn't leave any extra. The cleaning-up process should remove very little material. It should be what it is called—simply cleaning. The same rule applies when cutting to length, except in the case of legs or stiles that are to have mortises very near their ends. To avoid splitting the wood, a $\frac{3}{4}$ -in. horn is left on the end of the stock, to be sawn off afterward. That $\frac{3}{4}$ in. is a necessary piece, so cut to the finished length plus $\frac{3}{4}$ in.

End grain on square stock is difficult to plane, and the usual shortcut is to finish it on a disc sander. Probably the best way is with a shooting board, which controls the plane while supporting the end tissue of the wood. On wider stock it is relatively easy to put the wood upright in the vise, arrange some form of scrap-wood end support and plane as though working on the edge. The plane must be sharp, and a little paraffin wax helps greatly; the feel of end grain being cleanly cut is gratifying. □

Ian Kirby, 46, teaches in his own school, Hoosuck Design and Woodworking, in North Adams, Mass.



Shooting board for planing end grain: The cleat holds the wood squarely, while the rabbet guides the plane.



The scrap prevents splintering at the end of the stroke.

Tung Oil

Quick-drying finish is handsome and tough

by William D. Woods

If you haven't used tung oil, and you're tired of worrying about stain and filler colors, primers, adhesion, drying time, runs and drips, checking and water marks, it may be time to give it a try. While there's probably no stage of wood-working easier to mess up than finishing, it's hard to go wrong with tung oil. It yields a finish with contrast and depth, and is readily available and easy to use. It also builds well, dries quickly, and is water and solvent-resistant.

Tung oil is an aromatic natural drying oil extracted from the nuts of the tung tree (*Aleurites montana* or *A. fordii*), which is native to the Orient but now cultivated in the Gulf States. The color of tung oil ranges from golden yellow to dark brown, depending on the amount of heat used during extraction. The oil takes its name from the Chinese word "tung," or stomach, because it has a purgative action when taken internally. The properties of the oil are almost proverbial, and the preservation of the Great Wall has been attributed in part to tung-oil treatment of the masonry. In modern varnishes, tung oil is often used as a drying oil, giving elasticity and durability to the film.

Tung oil (sometimes called tung-oil varnish) is commonly available in two forms: the "pure" or unthinned state, which has about the viscosity of glycerine, and the volatilized or thinned state, which is watery or sometimes a little thicker. Although manufacturers are loath to reveal their "trade secrets," the odor suggests that the vehicle is mineral spirits or something similar. Pure tung oil can be thinned with paint thinner or turpentine; however, the commercially thinned oil, which probably contains a drying agent, dries faster than tung oil mixed with paint thinner alone. In general, the commercially thinned oil is easier to use and more versatile than the pure oil. The pure oil is also becoming harder to find.

The characteristics of tung oil are unlike those of most "oil" finishes. In fact, the name "tung oil" is misleading, because it produces not only a soaking finish but also a building finish. If brushed on like any other surface finish and left to dry, it will harden into a glossy film much like varnish. If used as an oil finish, it will build quickly and effectively consolidate the wood surface; furthermore, it will yield a much better sheen than any other oil preparation I know of.

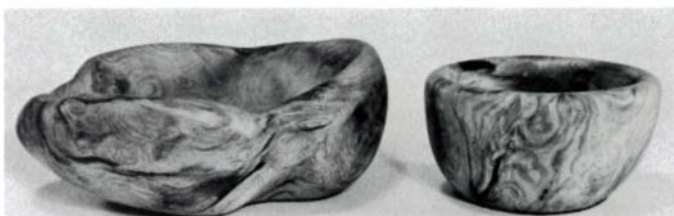
Cured tung oil is tough. When I first encountered this oil, I conducted some experiments to compare it to other finishes. I found that a dried tung-oil film is considerably more flexible than a lacquer or varnish film—it is possible to bend the film sharply double and then flatten it out again without breaking it. Although a tung-oil film is not as resistant to abrasion as urethane varnish, tung oil soaked into the wood is incredibly resistant to marring. It also shows good solvent resistance, even against a short exposure to acetone. To test tung oil's resistance to water, I made up a sample of Honduras mahogany with three soak coats of tung oil, drying it in the sun and overnight. I then applied a large drop of water to one

section of the sample and kept that area wet for an entire day. At the end of the day I dried the sample off, and with 4/0 steel wool burnished away the mineral ring left by the water. I couldn't detect any damage. My uncle, a gunsmith, claims similar results on gunstocks. He says that tung oil puts the more commonly used linseed oil "right out on the back porch." Tung oil is also often recommended for use on salad bowls, butcher blocks and other wood surfaces exposed to water, acids, oils and food residues. When used on eating utensils, however, the oil should be allowed to dry thoroughly before using. Because tung oil is not prone to checking, it is also suitable for certain outdoor applications.

In my experience, tung oil is easier to use than any other wood finish. It will prime any raw wood I have tried, including rosewood and vermilion, without delayed drying and without bleeding the color. The first coat is applied immediately after finish-sanding or scraping—use a brush, your fingers or a rag. I use thinned oil because it flows and soaks better without filling the pores, but for maximum build or a final coat pure oil is suitable. You can make thinned oil as thick as you want by exposing it to the air in a shallow pan. The oil should soak into the wood anywhere from 30 seconds to about 10 minutes, depending on weather conditions, the properties of the wood, and the particular oil being used. It may be beneficial to rub the oil into the wood with the hand or a pad. After soaking, wipe off all the excess with a clean rag. If the oil has become tacky, wipe it off with a rag moistened in fresh oil. Clean up brushes and spills with mineral spirits or lacquer thinner.

Each coat of oil should dry at least an hour, longer if it is very humid. I have sometimes recoated within 20 or 30 minutes on warm dry days with no trouble. To hasten the drying, the project may be set in the sun to cook. Tung oil does not seep out of the wood and "bead" on the surface, since it dries quickly, supposedly from the inside out. It usually does not raise the grain, and a quick rub with 4/0 steel wool after the first coat will ensure a smooth surface. Otherwise, it is not necessary to rub between coats.

The number of coats required depends on the porosity of the wood, the thickness of the oil, and the desired sheen. For protection, two coats of thin oil are often enough, although I would recommend three coats for the best durability and an



Burl bowls of ponderosa pine, 8 in. and 3½ in. in diameter, made by the author and finished with tung oil.

attractive satin sheen. After drying for a day, the surface may be burnished with 4/0 steel wool for a more even sheen. All subsequent cleaning and polishing of the finished surface should be done only with lemon-oil treatment. Although I have used tung oil as a surface finish in experiments, I do not recommend it as such, because it is not as durable as varnish or lacquer and poses the same application problems as any other surface finish.

Tung oil can also be used as a filler finish, because it will build with repeated applications. Apply the oil in the usual fashion, but let it dry until it becomes viscous (from 5 to 30 minutes). With the palm of the hand or with a rag, rub the gelled oil into the open pores of the wood much as you would a regular filler, then wipe off the excess. It will be necessary to dry the project for a day or more, because more than the usual amount of oil has been applied. Filling the pores completely may require five or more applications. Remember that the oil in the pores will shrink, so thorough drying is essential before any rubbing. This method is more laborious and time-consuming than the apply-and-wipe method.

Like many wood finishes, tung oil tends to skin over and finally to congeal if stored in a container less than about three-quarters full. If thickened tung oil is not too far gone, it can be reconstituted by adding mineral spirits and straining; however, always test such oil before using it. The problem of storage can be overcome by using a variable-volume container like a flexible polyethylene bottle. As the oil is used up, the bottle is squeezed to drive out all air before being capped. Better yet, obtain two or three of the refillable plastic food tubes made for hikers (they look like large toothpaste tubes). Cap the tube, then fill it with oil through the large open end, leaving enough room to fold the tube over and install the retaining clip. As you use the oil, squeeze the tube to eliminate the air. As for the storage life of tung oil, I have not had opportunity for a long-term experiment. It has a shelf life as good or better than traditional varnishes, if kept from temperature extremes and direct light in a nearly full, tightly sealed container.

Tung oil, because it soaks into the wood, heightens contrast and deepens color. Its finished sheen is warm, yet it permits easy view of the wood without any disturbing glare. And the disadvantages? Undoubtedly, the price of tung oil has been a deterrent to potential users—the unthinned extract is about \$9 a pint, while the thinned variety is about \$6 a quart—but a little goes a long way. One quart of thinned oil will easily finish three or four medium-size pieces of furniture. Considering the properties of tung oil, the price becomes rather insignificant. Because tung oil emphasizes most subtleties of graining, it may infrequently be found objectionable as a primer for light softwoods (spruce, for example) where the revelation of peculiar grain patterns may spoil the even, creamy color. With these woods, a test sample is in order. Personally, I think nothing looks better on wood than tung oil, because in finishing, I prefer to alter the wood as little as possible. I seldom use stains and usually make no attempt to fill the pores, which I feel are part of the wood's natural beauty. Above all, I want to see the wood, so I avoid glossy finishes. Tung oil agrees with my sense of esthetics. □

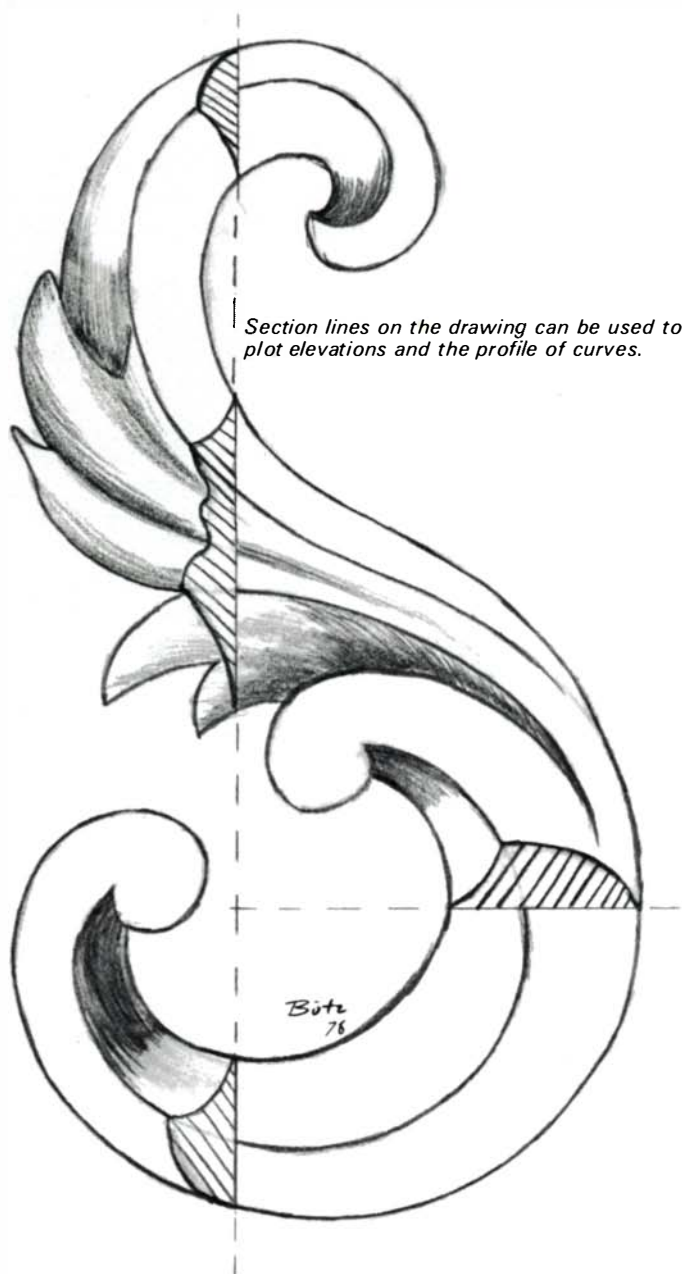
Bill Woods, 25, of Phoenix, Ariz., refinishes furniture part-time and makes guitars. He is now establishing himself as a professional woodworker.

Relief Carving

Traditional methods work best

by Rick Butz

Relief carving has been around for a very long time. Exactly how long nobody is really certain, although archeologists agree that it predates written history. However, it was not until the 17th and 18th centuries that relief carving reached its peak of technical skill in the West. During this period, wood-carvers created works of such beauty and grace that few can equal today. And yet, despite this technical brilliance, it was only a few generations until the age of machine industry brought this period to an end. Looking back, we can see that the effect of changing priorities was a decline in certain types

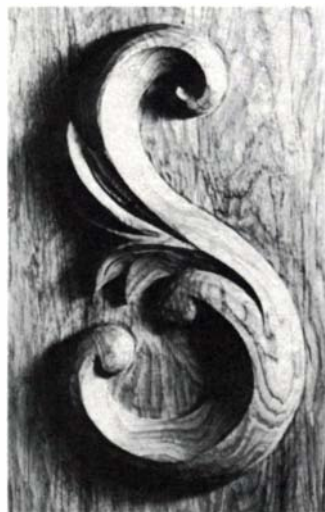


of knowledge. Skills and methods that were once common knowledge have become, at best, uncommon.

The result is that today many woodworkers might wish to incorporate carving into a furniture design, but they shy away on grounds that it would involve far too much time to be practical. This should not be the case. If a relief carving is approached with a sense of purpose and organization, all the work can be done by hand with surprising speed and efficiency—and considerable pleasure too. Whether the design is contemporary or traditional, a tasteful carving can add richness and depth to any woodworking project.

Loosely defined, relief carving is a method of creating a raised design that appears to stand free of the background. The distance that separates the raised portion from the background determines whether the carving is high relief or shallow relief. In either case, the basic carving steps are always the same. First, the background is carved away and smoothed. This leaves a raised design and a level background. Second, the design is shaped and smoothed. It is important to complete all background carving before doing any work on the free-standing parts of the design. This is not an arbitrary rule, but rather a method that greatly simplifies the work.

In addition, the carving must be well planned out in advance. Not only should the design be clear on paper, but each step of the carving should be carefully thought out and systematically completed before the next is begun. While this may sound overly technical and confining, the creative worker will find instead that such planning allows greater flexibility in shaping the wood. By solving basic problems first, one may concentrate more freely upon the work at hand. Relief carving, if approached in an orderly fashion, will continue to demonstrate that in many cases, handwork is still one of the most efficient ways to shape wood.



Before any carving can begin, it is essential that tools be razor sharp, able to cut cleanly and smoothly. A properly sharpened gouge will leave the wood with smooth polished facets. Correct sharpening is probably the greatest mystery of woodcarving, but it is often an unnecessary stumbling block. In addition to the variety of European and Oriental sharpening methods, we have several generations of Yankee ingenuity to contend with. For example, I know a very good carver who uses half a dozen stones to hone his tools. Another, equally good, sharpens only with sandpaper and spray lubricants. So who is to say what is best?

The reasonable solution is to follow whatever method works best for you without abusing the tools, and the best teacher is experience. One effective method uses only a flat stone of medium grit and a revolving cloth wheel. The gouge is sharpened with a rocking motion on the stone, using plenty of oil, until an even wire burr can be felt along the edge.



Relief carving tools (from left): V-tool for outlining, three gouges for general shaping, long bent grounder for backgrounds, spoon gouge, and flat or firmer gouge. The blank is butternut, held to the bench by a long screw from underneath.

Next, the bevel is polished on the cloth wheel until the metal burr wears off. This will leave a razor edge. A small amount of buffing compound applied to the cloth will speed the process. A razor edge can be achieved with only a little practice, and the resulting polishing of the cutting bevel to a mirror finish noticeably reduces the friction of the tool as it cuts.

While sharpening is essential, the edge is only a small part of a woodcarving gouge, and many neglect caring for the rest of the tool. A high-quality gouge that fits your hand actually does produce a better carving. I'm not sure whether this is purely a psychological reaction, or if it is because you have better control of a tool that feels comfortable.

Even the best of woodcarving gouges should be carefully checked over for anything that does not feel quite right. It is not unusual for a new tool to have sawdust and splinters embedded in the varnish of the handle. This should be sanded smooth. Also check the metal surfaces of the tool for any rough edges. I am not surprised to find wicked burrs of metal in the brass ferrule on a new handle. These should be filed and sanded smooth, or else some particularly nasty injuries may result.

Many old-timers took the finish right off the handle to prevent blisters and calluses, much on the same principle as stripping an ax handle. The exposed wood was then soaked in oil and wiped clean. The oil not only sealed the wood, but left a porous finish. It also hardened the end grain of the handle as heat was generated by the striking mallet, which helped prevent fraying and splitting.

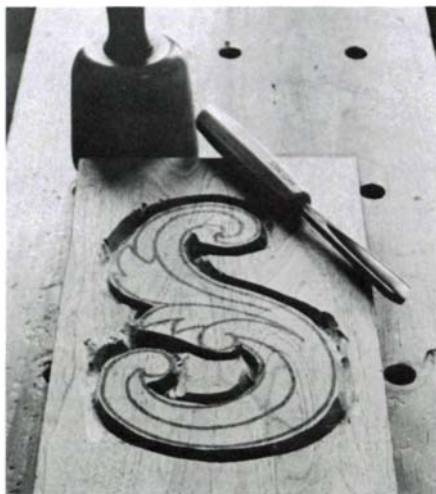
After the wood has been selected and the design accurately marked out, work can begin. Before cutting into the wood, it is helpful to pause for a few minutes and imagine just how the completed carving will appear. With practice this visualizing will not only help solve problems well in advance, but will also create the feeling that your hands are shaping the wood almost without conscious effort. By fixing the image in your mind, your hands will be guided by subconscious mental processes. This is not a new principle, but rather a means of helping to develop a "woodcarver's instinct." This feeling develops naturally after years of experience. However, a little practice will speed the process considerably.

The design I chose for the photo series that begins on the next page is a traditional variant taken from an old family table. It offers excellent practice in all areas of carving.

Rick Butz and his wife Ellen are professional carvers who live and work in Blue Mountain Lake, N. Y.

1 Outlining The first step in relief carving is to cut around the design with a V-tool. Such outlining serves as a starting place for isolating the raised portion of the design from the background. The cut should be made $\frac{1}{4}$ in. to $\frac{1}{2}$ in. out from the edge of the design and must not get too close to any delicate details. These can be shaped later, when there is less chance of damage.

A mallet is often helpful in making the outline cuts, although care must be taken to

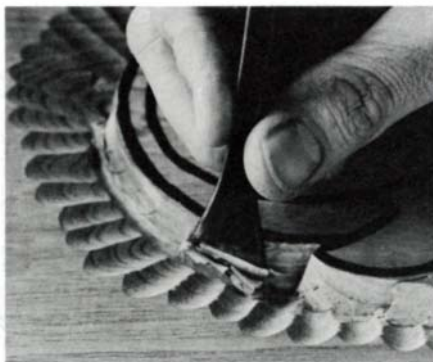


Outline the design with a V-tool.

avoid splinters running into the design. The best way to prevent unwanted splintering is to carve according to the flow of the wood grain. If your tools are sharp and the wood still splinters and tears, try approaching the cut from a different direction.

With a gouge of medium sweep, a series of cuts is made from the waste area toward and meeting the outline cut. This widening of the outline allows enough clearance to trim up the edges of the design. Make the walls of the design vertical by taking a small flat firmer or a gouge whose sweep is similar to the curvature of the design and cutting straight down. This procedure is referred to as "setting-in."

By continually enlarging the outline cut



Trim the edges vertical.

and smoothing down the walls of the design, the background can be sunk as deeply as wanted. A mallet of comfortable weight is helpful in these steps to tap the gouge lightly. However, take care not to drive the point too deeply, or a broken tool can result, especially if the wood is dense. Remember too that up to this point, the raised portion of the design remains untouched. The object of outlining and setting-in is to cut away all wood that will not be included in the raised part of the design.



The design is outlined and set in.

2 The background Once the outline of the design has been clearly defined, work can begin on taking down the background waste areas. When this task is approached in an orderly manner, the grounding out can be efficiently completed strictly by hand. While this work can also be done with an electric router, a good professional woodcarver in times past could cut and clear

a background in less time than most of us could even set up a power tool.

The best technique for cutting out a background, especially in softer woods, requires a firmer and a mallet, although a shallow #3 or #5 gouge can be used. With these tools a series of parallel cuts is made, one in back of the other. These are spaced in rows about $\frac{1}{4}$ in. apart and preferably across the grain. By lightly driving the gouge into the waste wood just behind the previous line of cuts, the waste will chip away. Roughing out should be done layer by layer if the background depth is to be very great. But take care not to drive the gouge deeper

than necessary, or extra smoothing work will be required.

When the background has been completely roughed out, it is worked smooth using a gouge of fairly shallow sweep. Take care to arrange the smoothing cuts in an esthetically pleasing manner, as they form the finished background. Leveling and smoothing are sometimes easier with a bent gouge called a grounder. It is especially useful where lateral clearance is restricted, although in many cases a regular gouge will work quite well.

However, where working room is really cramped, such as inside a sharp curve, a



Remove background waste with closely spaced vertical cuts.



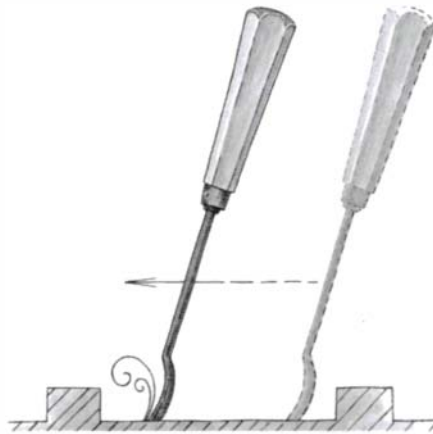
A #5 gouge levels and smooths rough cuts.



Spoon bent gouge works in tight places.

spoon bent gouge can be indispensable. These tools are available in a great assortment of sweeps and widths, yet they are probably the least used tool in many woodcarving sets. Part of the reason for this is the natural tendency of the spoon shape to be used in a scooping motion, which greatly restricts its usefulness.

Instead, the spoon bent gouge should be positioned at the angle where it just begins to cut. Then, carefully but firmly, it should be drawn across the wood without changing the angle. In effect, this produces the same cut as a long gouge. However, instead of beginning the cut at 15° to 30° to the work, the tool can be held at almost 90° to the work. This allows carving background areas inside deep recesses.



Push the bent gouge with both hands, without changing its angle of attack.



The background is now completed, and modeling can begin.

3 Modeling With the previous steps completed, the raised portion of the carving will stand free and clear from a smooth, level background. The design can now be modeled, first by roughly shaping the contours and then by smoothing the shapes with clean finishing cuts.

The roughing out is best done by carefully making cuts that round off sharp angles from the top downwards. For rough-shaping the outer portions of a curve, use a flat firmer or a gouge of slight sweep. For the inside curves, use a gouge of greater curvature or quicker sweep. This will help prevent unwanted splintering. The lines that form valleys between the leaves can be cut to depth with a V-tool and then rounded smooth.

These roughly shaped surfaces are then finished off with long smooth "sweep" cuts. These final cuts distinguished the professional works of old. This technique is used for finishing both the inside and the outside surfaces of the curves. Begin by steadying the blade of the tool with your left hand. The palm rests firmly upon the surface of the carving. By pushing the tool with the right hand and pivoting on the palm of the left, the edge of the gouge can be made to follow a very well-controlled curve. By experimenting with the point where the left hand pivots, a great variety of arcs can be achieved to follow the curves of most carvings. This requires a bit of prac-

tice, and like all carving techniques should be done with either hand. It is a very useful and satisfying technique.

For inside curves with concave surfaces, a bent or spoon-shaped gouge of considerable sweep is useful. On the other hand, a flat straight gouge can be used for convex, outer curves. Be careful to note changes in the direction of the grain so that the cuts will not be fuzzy, but smooth and polished. This will eliminate the need for smoothing with sandpaper, which should be avoided on any fine woodcarving. Sandpaper destroys the

tool marks that bear witness to serious handwork, and in an age of some very good plastic imitations, this is a serious consideration. If esthetic considerations require an absolutely smooth surface, then that is a different matter. But never substitute sandpaper for good technique and discipline.

As a final note, in doing any woodcarving, try not to lose your sensitivity to the nature of the wood. If you find yourself fighting the carving, if your tools produce ragged, splintered chips instead of smooth graceful shavings, then something is wrong. Make sure your tools are absolutely sharp, the wood is correct, and that you are working in the proper direction—with the flow of the grain. □



The waste is gone, and finishing cuts can now be made.



A firmer smooths the outside curves, again with long sweeping cuts.



A quick gouge rough-shapes the wood on the inside curves.



Long sweep cuts leave a smooth finish. A bent gouge or spoon gouge may be best for inside curves. The right hand powers the tool, while the edge of the left hand rests firmly on the work.



The finished carving.



Original 'bureau du roi Louis XV,' 1760-69, was made by Oeben and Riesener. It is now on display at the Louvre in Paris.

Roll-Top Desks

How King Louis hid his clutter

by Alastair A. Stair

Writing desks, whether for business or household, need a larger work surface than one might otherwise desire in the room. They also need some means of rapid closure, whereby clutter and important papers may be concealed from snoops, protected from thieves, or merely swept out of sight when guests arrive. The usual solution, found on all manner of furniture since the 17th century, is a hinged flap that becomes a writing surface when open and a locked door concealing drawers and pigeonholes when closed.

The falling flap (often called "slant top") is direct and straightforward in construction, although a variety of ingenious means of supporting the opened flap have been devised. Its two disadvantages, if such they may be called, are that the working clutter must be cleared off the writing surface before the desk may be closed up, and that the flap is of necessity flat. Many designers would not consider this flatness a handi-

cap, but it apparently troubled the master cabinetmakers at the court of Louis XV (1723-1774) of France.

Their answer, probably the creation of Jean-Francois Oeben (1720-1763), was the "secretaire a cylindre," the cylinder bureau or roll-top desk. Oeben's masterpiece was made for his patron, Louis XV, and quickly became known as "le bureau du roi," the king's desk. The French court at that time was the center of high fashion, and the desk with its broadly curved top receding into a slot above the pigeonholes was widely imitated.

The king's cabinetmaker and the king himself shared a passion for mechanical devices. Typical of Oeben's work are complicated locking devices and mechanisms that release or raise drawers by hidden processes. Louis XV devoted a considerable amount of time to his own workshop and hobby, the then-fashionable practice of ornamental lathe turning. He

had one of the world's first elevators installed at Versailles in 1743, for the convenience of Mme. de Chateauroux. A little later, he commissioned "tables volantes" which, by rising and sinking through the floor, enabled him to entertain without the intrusion of servants.

Whether the cylinder desk was an original idea on the part of Oeben is difficult to answer. The earliest description of such a mechanism dates from about 1760, although something like it can be seen in an engraved design for wall decoration from about 1750. The source may have been Oeben's early experiments, or Oeben may have picked up the idea from elsewhere. In any case, Oeben's work is the first documented example of furniture of this type.

Begun in 1760, the desk took a full nine years to complete. Upon Oeben's death in 1763, Jean-Henri Riesener (1734-1806), his first journeyman or foreman, married Oeben's widow, carried on the workshop and completed the important work left by the master. (It was common in the 18th century for a cabinetmaker's widow to remarry in this way.) Oeben had left the desk in a fairly advanced stage of construction, with the working mechanisms completed. Riesener can be credited with the lavish pictorial marquetry of holly, boxwood, purpleheart and other exotics. He hired specialty craftsmen to complete the clock, Sevres porcelain plaques, gilt bronze sculptural figures and ormolu mounts that unite to make the desk a tour-de-force of French decoration. Its completion in turn established Riesener as a worthy successor to Oeben. His monogram has been found on several other spectacular cylinder desks now in prominent collections. One is at Buckingham palace, another is in the collection of the Duke of Bedford, and two are in the Rothschild collection at Waddesdon Manor.

Desks with fall flaps often had cupboards or drawers above the writing surface and were of architectural scale in a room. The early cylinder desks were often of a similar scale, matching the large writing tables inherited from the first half of the

century. But the fashion soon turned to smaller, less formal furniture, made for wealthy patrons who preferred the intimate life of the boudoir to the formal salons of an earlier generation. Cylinder desks were more suited to the smaller scale, and as they became smaller they also became daintier, more delicate in character.

There were exceptions to this trend, notable among them a large roll-top attributed to David Roentgen (1743-1807), master cabinetmaker to Louis XVI, which was made around 1785 for Catherine II of Russia. Roentgen, like Oeben, was famous for mechanical ingenuity, and his works are full of springs that release panels and uncover secret drawers.

By about 1780, the French fashion had taken hold elsewhere, aided no doubt by warfare throughout central Europe that deposited German artisans at all the royal courts. Many of the prominent cabinetmakers of Paris were German emigrants known for their skill at marquetry, who returned to the small German courts of the electoral princes when hostilities subsided, taking the latest fashions with them. The cylinder-fall writing table became popular in London about the same time, with a number of designs featured in such books as Thomas Shearer's *Cabinet Maker's London Book of Prices* (1788) and Thomas Sheraton's *Drawing Book* (1791-94) and *Cabinet Dictionary* (1803). Sheraton explains that the place of the familiar slant-top desk had been "amongst fashionable people" taken by a secretary or bureau with a roll-top or cylinder front. He uses the term "cylinder desk and book-case" to describe an elegant, light piece mounted on tapering legs, with the drawers and pigeonholes enclosed by a tambour front and supporting a low case of shelves with square doors. A similar piece is illustrated by George Hepplewhite in the *Cabinet Maker and Upholsterer's Guide* (1788), where it is called a "tambour writing table and bookcase."

By the time the design reached Sheraton, the cylinder top had been connected via an iron trammel to the writing surface, which automatically slid out as the top was raised. Sher-



Three roll-top desks of diverse styles: Early tambour desk, above, c. 1760, is attributed to Jean-Francois Oeben. Note elaborate floral marquetry and gilt bronze decoration.



Small Sheraton roll-top desk, about 1790, is veneered in hawewood and has china cabinet on top.



Roll-top, made by David Roentgen c.1780, has several hidden mechanisms and secret compartments. Woods include sycamore, burl walnut, tulipwood, satinwood, white mahogany, ebony and greenheart.



Extremely rare English cylinder bureau with bombe base in the French style, c. 1790, measures 46½ in. high, 34 in. wide, 22 in. deep closed and 32 in. deep open. A concealed mechanism links the writing surface to the cylinder, which opens when the writing surface is pulled out to reveal various compartments and pigeonholes.



Bedside table, c. 1790.

aton supplies the first written description of this mechanism (see p. 65), with clues about how to make it. The plates in his drawing book show great fertility of imagination. Some have a low arched top containing small unenclosed drawers, others retain open shelves with brass galleries and several are surmounted by china or book cupboards with glazed doors. Still others have extra writing slides that pull out from either side of the frame. These desks, lighter and simpler than their predecessors, often had tamboured roll-tops.

The original cylinder was a rigid quarter-round pivoting on a concealed bracket, usually guided by a tongue on the edge, which ran in a semicircular groove. It opened into a slot above the pigeonholes and disappeared behind them. Cylinders were usually made of two or more full-width staves of wood, edge-glued and planed to a circular arc, then veneered. Some were guided by a solid rail tongued across the ends of the boards, a more stable construction, while others had tongues worked directly on the boards themselves. Because it was rigid, the shape could only be an arc of a circle, sometimes a full quarter-circle, more often a sixth-circle, and as much space had to be left behind the cylinder as in front of it. This necessitated a bulky design, and also forced the pigeonholes or drawers to be foreshortened to fit the cramped space. Making a quarter-cylinder is basically the same as making barrels, and the cooper is the likely source of the technique.

It wasn't long before some cabinetmaker, probably in France, observed that the boards of the cylinder didn't have to be glued together into a rigid shape. They would still follow the curve, and other curves as well, if they were glued to a flexible backing ("Tambours," Sept.'78, pp. 52-57). The usual backing is stout canvas, although sometimes a strong wire is threaded through a hole in each tambour instead. The slats could be made very small (and would then follow a very tight curve), they could be molded into an interesting variety of profiles, or they could be left flat and veneered just as if they were solid, and the veneer subsequently slit. Tambours enjoyed great popularity in England (where they were often called reed tops) and gave rise to a welter of new designs.

When used to replace the cylinder fall, the tambour has the advantage of requiring little space at the back, for when opened it will drop behind the pigeonholes in a straight line. Tambours also can be fitted horizontally to cover an opening like shutters, replacing the usual doors. Tambours that slid

sideways were found to be satisfactory on all manner of small pieces other than desks, where no great strength or security was required, including sewing cabinets, the lower cupboard of sideboards and bedside tables. When used on large pieces, however, tambours do have disadvantages: They are insecure, and they are liable to injury, often requiring repair. Both cylinder tops and reed tops in general have suffered the ravages of too-constant use over the centuries. Many French flat desks, according to one antique dealer, started life as cylinder



Sideboard, made in Baltimore c.1795, of mahogany with inlay and silver and glass panels. Tambour hides containers for tableware.

Lady's roll-top writing desk with cabinet on top was made in Baltimore c. 1800 and closely follows patterns given by Sheraton.



desks. They appear in today's shops with their tops removed.

One of the loveliest tambours in existence occurs on an American Federal mahogany sideboard, made in Baltimore c. 1795-1800. This elaborate Sheraton-style sideboard was ordered by David van Ness for his country house on the Hudson and is one of the most elaborate pieces of furniture executed in the United States. Its huge tambour structure conceals elaborately fitted containers for knives and forks.

Baltimore produced furniture that closely followed English precedents because it was settled almost entirely by the English and Irish. Its furniture was based primarily on pieces featured in Hepplewhite's *Guide* (1788) and Shearer's *Book of Prices*. Unknown in other areas of the United States was the highly individual style of lady's writing desk, derived from plates 44 and 47 of Sheraton's *Drawing Book* (1793): Such Baltimore desks were elaborately decorated and always had a folding top or a roll-top.

The cylinder form was also popular in the cabinetmaking centers of Massachusetts. In the Boston Museum of Fine Arts, there is a group of cylinder and tambour desks by John Seymour (c. 1738-1818), an English emigrant whose work owes much to the elegant styles of Sheraton and Hepplewhite. The Winterthur (Del.) Museum houses a group of cylinder desks from Baltimore, Salem, Pennsylvania and New York.

Because the revolving top was a great convenience for hurriedly hiding papers from indiscreet eyes, the appeal of the cylinder desk increased during America's Empire period (1815-1840). In the 1890s, manufacturing firms in Grand Rapids and elsewhere turned out roll-tops by the dozens, some of mammoth proportions constructed for the American businessman. During this "Golden Oak" period, Sears Roebuck catalogs contained ads for "curtain-top desks." These roll-tops had spring locks, with "all drawers locking automatically when the curtain top is pulled down." Such a desk, 5 feet wide, sold in 1897 for \$20. And in the first two decades of this century, even Gustav Stickley, the father of the Arts and Crafts movement in America and a strict individualist in design who despised reliance on traditional forms, made concessions to public taste—he occasionally made roll-top desks for offices. □



Contributing editor Alastair A. Stair owns antique furniture galleries in New York and London.

Roll-top desk by Gustav Stickley, shown open and closed, was made in 1904 of quartersawn white oak and is typical of business furniture of the time. It is 46 in. high, 60 in. wide and 31 in. deep.

Shaped Tambours

by Bob March

Traditional tambours run on horizontal or vertical tracks and they can follow various curves. But they always have a flat back, which make it difficult to do a lot of shaping on the front. While it would be possible to make the tambour thicker, it could become so heavy that it couldn't be opened easily. This can be overcome with a system of concealed counterweights, which I considered for the desk shown here.

A counterweight didn't seem in keeping with the open nature of the desk I was making, so I decided to eliminate the flat backing. The tambour top is 48 in. wide, so I reduced the canvas to two 10-in. strips down the edges. Then, with conventional shaper jigs, I shaped the tambour slats in the center so they would curve back behind the plane of the canvas.

The first problem that arises when you shape a tambour this way is that it will not be able to go around a corner unless you also taper the portion that is behind the plane of the canvas. The amount of taper can be figured by drawing an end view. In this desk I decided to exaggerate the taper, so there would be open slits in the center portion of the tambour. I

felt this would go well with the rest of the desk, which has many open slits in the end and across the back. The slats were tapered with the thicknesser. Then the tambour was hot-glued to the canvas with a veneer hammer.

The handle was attached with hot glue after the tambour was installed in the desk. It was designed with two gripping points, one at each end, which transmit the stress of opening and closing directly to the canvas strips. Its form also seemed to go well with the concave shape of the front.

The additional work this approach requires is well worth the increased shaping possibilities. On this desk the shaping was quite subtle, but the soft curve of the tambour, the top and the back slats made a significant difference. One could also exaggerate the shaping, possibly even making the individual slats from laminations. □

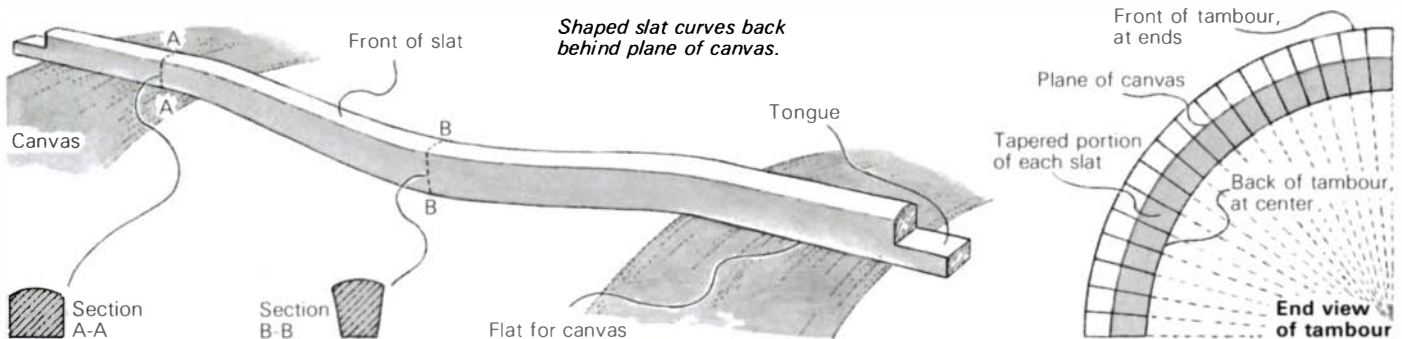
Bob March, 28, a graduate of the School for American Craftsmen in Rochester, N.Y., teaches at the Worcester (Mass.) Craft Center.



Desk, of vermillion, is 58 in. by 26 in. by 46 in.

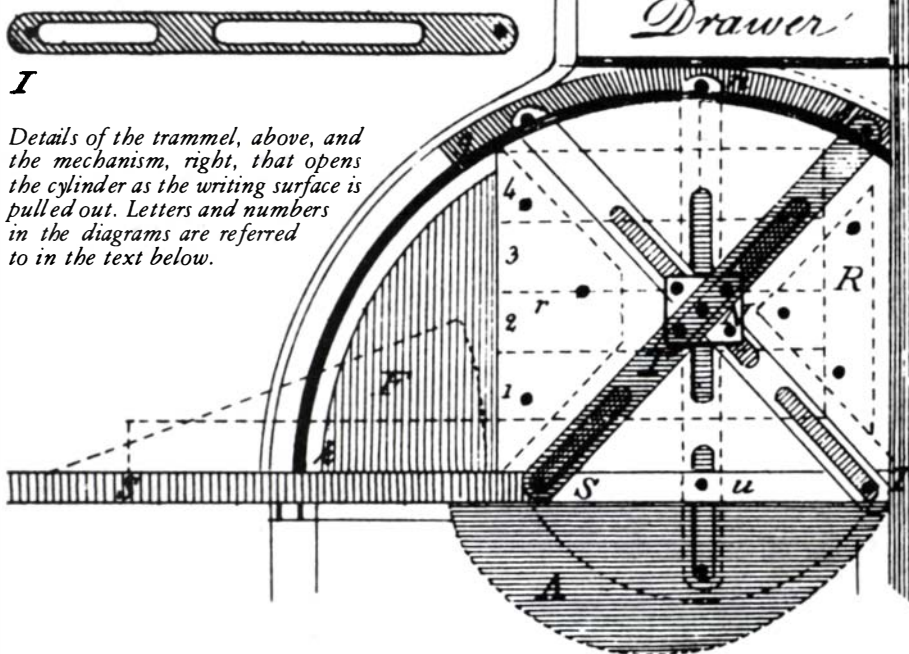


Chinese keyed splice shown in photo and drawings joins leg to desk.



Of the Cylinder Desk and Book-Case

by Thomas Sheraton

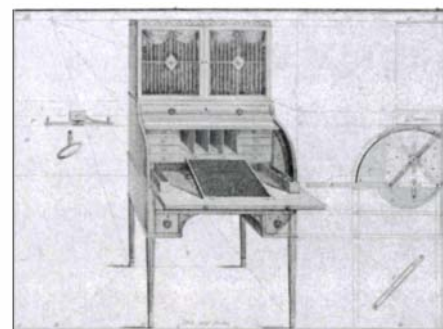


Details of the trammel, above, and the mechanism, right, that opens the cylinder as the writing surface is pulled out. Letters and numbers in the diagrams are referred to in the text below.

EDITOR'S NOTE: Thomas Sheraton (1751-1806) was a cabinetmaker and a cabinetmaker's son, although there is little evidence that he actually built any of the pieces so carefully described in his *Cabinet Maker and Upholsterer's Drawing Book*. He seems to have acted like a freelance designer, noting down what was being made in London, then peddling his drawings and notes to the trade. He died a pauper, little knowing that he would emerge as the namesake and principal chronicler of the furniture of the late 18th century. His drawing book is available as a handsome \$5.95 paperback published by Dover, 180 Varick St., New York, N.Y. 10014, from which the following excerpt is taken. We've modernized the spelling and deleted material extraneous to the cylinder-fall itself.

First, observe the slider is communicated with the cylinder by an iron trammel, as *I*, so that when the former comes forward, the latter rises up and shows the nest of the small drawers and letter holes, as appears in the design. When, therefore, the slider is pushed home even with the front, the cylinder is brought close to it at the same time. In this state the lock of the long drawer under the slider secures both the drawer itself and also the slider at the same time. . . The trammel *I* is a piece of iron near a quarter thick, an inch and quarter broad, with grooves cut through, as shown at *I*. *S*, in the profile, is the slider; and *g*, *12*, *h*, the

cylinder. The trammel *T* is fixed to the cylinder at *h* by a screw, not drove tight up, but so as the trammel will pass round easy. Again, at the slider *S* a screw is put through the groove in the trammel, which works on the neck of the screw, and its head keeps the trammel in its place; so that it must be observed, that the grooves or slits in the iron trammel are not much above a quarter of an inch in width. When the slider is pushed in about half way, the trammel will be at *u* and its end will be below the slider; as the plate shows; but when the slider is home to its place, the trammel will be at *T* and *g*. The center piece with four holes is a square plate of iron, having a center-pin which works in the upper slit of the trammel. It is let into the end of the cylinder and fixed with four screws. To find the place of this center, lay the trammel upon the end, as *T-h*, in the position that it will be in when the slider is out, and with a pencil, mark the inside of the slits in the trammel. Again, place the trammel on the end as it will be when the slider is in, as at *T-g*, and do as before; and where these pencil marks intersect each other will be the place of the center-plate. The figures *1*, *2*, *3*, *4*, show the place of the small drawers. The triangular dotted lines with three holes, is a piece of thin wood screwed



Sheraton's cylinder desk, reprinted from The Cabinet-Maker and Upholsterer's Drawing Book.

on to the end, to which is fixed the nest of small drawers, forming a vacuity for the trammel to work in. *F* is a three-eighth piece veneered and cross-banded, and cut behind to give room for the trammel. This piece both keeps the slider to its place, and hides the trammel. The next thing to be observed is, that the lower frame, containing two heights of drawers, is put together separate from the upper part, which takes the cylinder. The ends of the cylinder part are tenoned with the slip tenons into the lower frame and glued. The shaded part at *A* shows the rail cut out to let the trammel work. . . The cylinder is jointed to its sweep in narrow slips of straight-baited hard mahogany, and afterwards veneered. If the veneer be of a pliable kind it may be laid with a hammer, by first shrinking and tempering the veneer well, which must not be by water, but thin glue. If the veneer be very cross and unpliant, as many curls of mahogany are, it is in vain to attempt the hammer. A caul in this case is the surest and best method, though it be attended with considerably more trouble than the hammer. To prepare for laying it with a caul, proceed as follows. Take five or six pieces of three-inch deal, and sweep them to fit the inside of the cylinder. Fix these upon a board answerable to the length of the cylinder. Then have as many cauls for the outside of the cylinder, which may be made out of the same pieces as those for the inside. Take then quarter mahogany for a caul to cover the whole veneer, and heat it well. Put the caul screws across the bench, and slip in the board with the round cauls screwed to it; and then proceed, in every other particular, as the nature of the thing will dictate. □

Basic Machine Maintenance

Regular cleaning and lubrication are essential

by David Troe

Many people mistakenly expect machines to work perfectly from the time they are unwrapped and think they will last forever with no attention, but the life and accuracy of machines are directly proportional to the amount of care they receive. Thoughtful attention and simple preventative maintenance will ensure accuracy, minimize the need for major repairs and increase resale value.

Woodworkers generally don't maintain their equipment as well as they should, and they often don't understand the relationship between various mechanical components of their machinery. Unlike some furniture these days, machines are designed logically—there is a reason why the components are where they are, and they are all there for some reason. Obviously not all equipment is assembled correctly by the manufacturer, but far more damage is done by unobservant proto-mechanics who fail to recognize the interrelationships of things. If you don't have an exploded assembly drawing of your equipment, try and get one from the manufacturer, or if your machine is an antique, see if a machinery distributor in your area has one on file that you could copy. Assembly drawings are excellent, but often not detailed enough. When you are pulling something apart, if there is any question in your mind about how it goes back together, label the parts, make sketches or take photographs. But before doing any cleaning or repairs, turn off the power or unplug the machine.

Most repairs are not outside the capability of woodworkers. Most of the tools will already be in the shop: screwdrivers, wrenches, pliers and the like. Unlike automobile repair, extremely few specialized tools are necessary. If you should encounter a situation requiring tools that you do not have, do not attempt to use a substitute that might damage the part. Pliers won't replace wrenches, nor will a cold chisel substitute for a spanner wrench. If you cannot completely disassemble a component for repair or replacement, do as much as you can and then take it to a competent mechanic. This will save the mechanic time, thereby saving you money. Ideally you should take the work to a machinery distributor with repair facilities or to the manufacturer's service center, but that is rarely practical. If the job requires more tools, skill or confidence than you possess, it can often be handled by a jack-of-all-trades machine shop, or even by a garage. If the equipment is still under warranty, it will be voided if anyone other than those authorized by the manufacturer works on it.

The regularity with which maintenance should take place depends on how much use the equipment gets. Follow manufacturer's recommendations and establish your own schedule. Unless you suspect a serious problem, such as a new noise or vibration, the only regular maintenance required is to keep your equipment clean, to keep it lubricated, to check for

loose parts and wear, and to check the motor and the power transmission system. Do this at least once a week in a commercial shop, once a month in a one-person shop, and every six to twelve months in a hobbyist shop.

The first rule is to keep your equipment clean. Dust and dirt will accumulate in even the smallest and least accessible places. At the least, brush off your equipment, or better yet, use a vacuum cleaner. Compressed air is effective in blowing out dust from inaccessible areas but caution must be exercised to avoid driving the dust into other components. For this reason a maximum line pressure of 40 psi is suggested. However romantic sawdust and chips scattered around the shop may be, they are harmful both to you and to your equipment. Dust sticking to machine surfaces causes many problems: excessive wear; drying out and premature failure of bearings and ways; sticking of gears, trunnions and all sliding surfaces; V-belt and band-saw tire deterioration. All lead to extensive down-time if the situation gets out of hand. Also, accumulated dust is a very real fire hazard, especially in electrical switches and motors. Clean your equipment and your shop regularly and often.

Lubricate your equipment when and where necessary. Remember that excessive lubrication is at least as harmful as under-lubrication. Over-lubrication in bearings causes the lubricant to churn and heat up, which can lead to early failure. Exposed grease and oils collect dust and chips like a sponge, eventually turning into a gummy blob that restricts free rotation and easy movement. It is safer to under-lubricate frequently than to over-lubricate infrequently.

It is difficult to recommend a lubricant if there are no guidelines from the manufacturer or the distributor, but the following suggestions can be assumed to be safe. For bearings that have oil fittings, use SAE 10 to 20 nondetergent machine oil. The SAE rating refers to viscosity, not to motor oil, which should not be used. For bearings that have grease fittings, use a lithium-soda type bearing grease, NLGI (National Lubricating Grease Institute) Grade 2. Do not oil a bearing designed for grease, and do not grease a bearing designed for oil. For gearboxes, use SAE 90 to 140 gear oil. And on drill-press quill and pinion gears, try SAE 40 oil.

As a general rule, use dry lubricants on any moving part that is not subject to high speeds or where movement is for adjustment, such as on tabletops, dovetail ways, jackscrews, trunnions, fences, miter-gauge slots, tailstock spindles and the like. Wherever possible, use dry lubricants such as hard wax or graphite. Avoid silicone or Teflon-based sprays—they are extremely expensive and adversely affect wood glues and finishes. My favorite is plain old hard wax, which is inexpensive, easy to apply, and as far as anyone knows doesn't cause cancer or affect the ozone in the atmosphere. Wax provides longer service on cast-iron surfaces because it fills up the microscopic pores in the iron. You can use any paste wax or

David Troe, 25, a cabinetmaker, is director of product development at Mason & Sullivan, Osterville, Mass.

liquid wax that does not contain cleaners, because the abrasive action of cleaners would cause lapping and excessive wear. Rub in the wax well and remove any excess.

Another way to lubricate surfaces upon which wood must slide is to apply a Teflon-impregnated tape or adhesive-backed sheet. Thoroughly clean the surfaces with a grease solvent to ensure a strong bond, and extend the Teflon over any edges where it might catch on a piece of wood. The covering need not be solid—several strips of tape running parallel to the direction of feed and spanning the wood are often adequate. Planer beds, saw tables and fences are good candidates for this treatment. Look in the Yellow Pages under “Plastics” for a specialty supply house.

When lubricating with grease or oil, make sure that both the lubricants and the fittings are clean. Often oil cups and grease nipples are coated with gummy sawdust, which must be cleaned before lubricating. Oil levels are generally set by visible marks on oil cups or by the saturation of fiber wicks, but grease levels are more difficult to ascertain. Do not over-lubricate. Common sense is essential in determining the correct amount of lubricant to use. Never force grease into a bearing and its housing more than half full.

Bearings

Bearings cause woodworkers the most confusion and grief. Different kinds of bearings require different treatments. Sleeve bearings, usually oil-impregnated metal but sometimes plastic, rely on a very thin lubricating film to reduce sliding friction. It is interesting to note that sleeve bearings are used both in inexpensive applications and in situations where precision is a prime requirement: at one end the lowly \$9.95 drill and at the other end a metal-machining spindle costing many thousands of dollars. The difference is in the materials used, the precision with which they are made, and the complexity of the bearing lubrication system. Before modern metal-hardening technology and precision machin-

ing, which made the manufacture of ball bearings feasible, all bearings were of the sleeve type. That is why Babbitt bearings are so often found on old machines. Sleeve bearings are either full or split, and worn ones are relatively easy to replace by pushing them out of their housings. Press evenly on the rim of sleeve bearings when replacing and be careful not to roll an edge or raise any burrs. Babbitt bearings can be repoured, but this should only be attempted by someone who knows how to do it properly—it is hazardous.

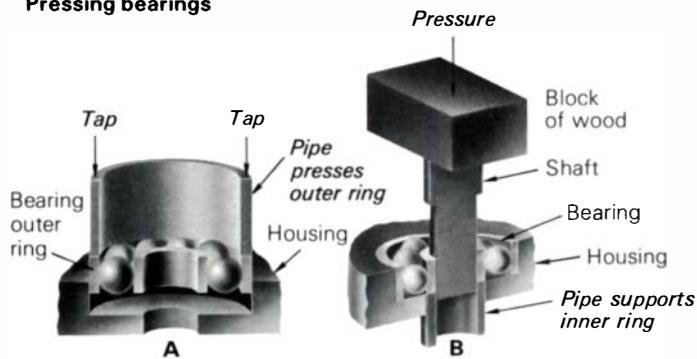
Antifriction bearings are bearings in which rolling members reduce friction. These bearings fall into four categories: ball bearings, roller bearings, tapered roller bearings and needle bearings. Ball bearings are the most frequently used. Needle bearings, because of their smaller size, are used in portable power tools. Tapered roller bearings, because of their inherently high-thrust load capacity, are used in some high-quality portable drills and in lathe headstocks. Many machines have bearings that are said to be “lubricated for life” or “sealed for life,” but this refers to the life of the bearing itself and not to the life of the machine or to the life of the owner. The life of a bearing can be quite short if it is improperly handled during installation, or quite long if treated with care. Sealed bearings are so named because they have a shield that seals the lubricant in and the dirt out—at least that’s the theory. Care must be exercised not to damage the seals in any way. Sealed bearings can be relubricated by prying out the seal, cleaning the bearing, relubricating and replacing the seals, but this requires a bit of expertise to avoid damaging the seal so I can suggest it only to those who have patience, confidence and the skill to be gentle. For the general lot of us, when a sealed bearing needs lubrication (you’ll know by stickiness, roughness or strange noises), it must be thrown out and replaced with a new one.

While most people can replace bearings, care must be exercised not to damage either the bearing or its housing. Any pressure above that which you can supply with your fingers



Rolling members reduce friction in antifriction bearings. Clockwise from above, tapered roller, needle, roller, ball bearing.

Pressing bearings



When removing or replacing a bearing, apply pressure to the ring that is fixed to the shaft or set in the housing, never to both rings at once. To replace a bearing in a housing (A), a pipe the diameter of the outer ring will distribute the force of the tapping evenly over the ring. When the shaft is then set in (B), a pipe supporting the inner ring will prevent distortion of the bearing.

must be evenly applied to either the inner or the outer ring, never to both at the same time and never between the rings. If you don't have a section of pipe, a socket wrench or other suitable cylinder of the right size, you can turn a wooden one on a lathe, but if you are replacing the lathe bearing, you are up the proverbial creek. An uneven force on the bearing can dent the bearing races and/or ruin the trueness of the housing. Don't try to free a stuck bearing from both the shaft and the housing at the same time. If the bearing is tight, try spritzing some penetrating oil around the ring. Or heat the housing to about 250° F—the expansion will usually do the trick. If that doesn't work, the bearing can be removed with a gear puller, but that always ruins the bearing and it then must be replaced. If in doubt, take it to a good repairman.

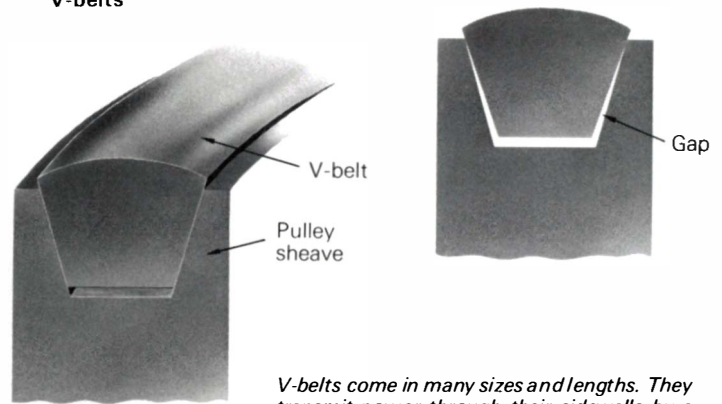
Manufacturers use standard "in stock" bearings whenever possible to reduce costs. Because stock bearing dimensions have long been standardized, a bearing from one manufacturer can replace a bearing of the same series from any other manufacturer. All a supplier needs to know is the bearing identification number, which is etched on the side of the bearing. Tapered roller bearings have two numbers you must know—one on the cup and one on the cone. If you can't find an identification number, measure the outside and inside diameters and the width, get the speed (rpm) and phone a bearing distributor. Check in the Yellow Pages under "Bearings." You will save money by dealing with a bearing-supply firm rather than with the machine manufacturer.

When replacing a bearing, follow the reverse order from that used to remove it. Sometimes bearings are not symmetrical, so be sure to replace it in the same orientation as the original. Keep the bearing wrapped until you install it.

Neither ring on a bearing should fit so loosely as to allow it to rotate independently of its assembly. If the rings are loose, they can be temporarily fitted with an anaerobic sealant, such as Loctite. This delays the necessity of replacing the worn component. Heating to about 350° will soften the Loctite when you want to remove the bearing. Clean off all foreign material from the spindle and the housing before replacing a bearing to prevent scoring them.

Open or unshielded bearings should be cleaned once a year or as your specific situation requires. Some bearings can be cleaned while in place, but usually a more complete job will be had if the bearings are removed from their components. Never use water to clean a bearing: Wash out all the old lu-

V-belts



V-belts come in many sizes and lengths. They transmit power through their sidewalls by a wedging action in the sheaves. A gap greater than $\frac{1}{32}$ " between the pulley and the side of the sheave means that the pulley is worn and should be replaced.

bricant in clean kerosene, degreasing fluid or other commercial solvent, and rinse with fresh, clean solvent. An old soft toothbrush is excellent for scrubbing the parts. After cleaning, allow the bearing to dry dust-free by wrapping it in a clean lint-free cloth. As soon as the bearing is dry, rinse it in a bath of clean, light mineral oil. Until you are ready to replace it, protect it from contamination by putting it in a plastic bag. Never spin a dry bearing, and never use compressed air to dry or spin a bearing. Check the cleaned bearing for any sign of wear or damage, and replace if necessary. When you are ready to replace a grease bearing in the machine, grease the rolling elements by squeezing the correct grade of grease into the bearing with your clean fingers. The housing and the bearing should be packed no more than half full with grease. Check all bearings for adequate lubrication before running.

Unless otherwise stated by the manufacturer, lubricate the components at rest. This is especially true with electric motors, where stray oil can splash into the windings and harm the insulation. More detailed guidelines can be found in the references cited at the end of this article.

Belts, pulleys and chains

If you are experiencing vibration or a loss of power at the cutter, the problem is most likely in the power transmission system. V-belts are the most common means of transmitting power from a motor to a cutter. V-belts transmit power through their sidewalls by a wedging action in a pulley sheave. They are manufactured in standard cross-sectional sizes. It is imperative to replace belts with ones of the same series, because the different series are not interchangeable. V-belts are marked as to their series and length, but sometimes the marking wears off. Some parts lists state what series and length belt to use, though more typically they give only a replacement-part number. If the belt is old and you have no idea what to replace it with, a power-transmission supply house will be able to figure it out. Since there is some latitude in the length tolerances allowed in the construction of belts, it is essential, when replacing a belt in a multiple-belt drive, to replace all the belts, and to replace them only with a matched set of belts guaranteed to be of the same length.

If you have a machine with no belts on it, or if you are replacing a leather-belt drive system with V-belts (which there isn't really any reason to do), you can approximate the proper belt length by adding twice the distance between the

centers of the shafts to half the sum of the circumferences of the two pulleys. Or wrap a steel tape around the pulley rims and give the supplier this measurement. Fractional-hp drives use the outside distance around the pulleys for belt length. Multiple-belt or heavy-duty drives use the pitch diameter. When this yields a nonstandard length, go to the next longest belt and adjust the components for proper tension.

Proper tensioning is important for both maximum power transmission and maximum life of the components. Excessive tension stretches the belts, causes heat buildup that accelerates deterioration and places unnecessary strain on the bearings, leading to premature bearing failure. Insufficient tension results in belt slippage, loss of power, vibration, whip, excessive noise and accelerated wear of the belt and pulley sheaves. Belt tensioning is a matter of feel. One method is to strike the belt with your fist—if it feels dead, it is slack. A properly tensioned belt will feel alive and vibrate. On multiple-belt drives, if you can push down on one belt so that its top face is flush with the bottom face of an adjacent belt using moderate pressure (10 lb.), then the belts are properly tensioned. Ideally belts should flex about $\frac{1}{32}$ in. for every inch of span between the centers of the driving and driven pulleys.

Old belts wear pulleys more severely than belts in good condition, so it is advisable to replace belts that are worn, frayed, cracked or split. Time and money are not saved by trying to get additional service from a worn belt. Dirty belts can be washed with soap and water. Rinse thoroughly and dry completely before replacing.

Flat-belt drive systems are found on old equipment—the trusty old leather belt—or on equipment that is run at very high speeds such as industrial overarm routers and portable power planes, both of which use a belt of synthetic rubber. Only leather belts should be treated with a belt dressing at three to six-month intervals. This dressing keeps the leather reasonably supple and improves the transmission of power. Replacement belts are available from belting suppliers and, if possible, should be purchased already spliced into an endless loop. Splicing a leather belt on a machine is difficult for the inexperienced. If you insist on doing it yourself, go to the library and read all you can about the various techniques.

The greatest problem of belt drives is misalignment of the driving and driven pulleys. Proper alignment is essential to realize maximum power, and the longest possible pulley, belt and bearing life. Angular and axial misalignment and loose pulleys all place unnecessary strain on the drive system. Use a straightedge to line up your pulleys and make sure they are secure on their shafts. If the pulley appears to wobble on its shaft, either the shaft is bent and must be straightened or replaced or the bore of the pulley is worn oversize and the pulley must be replaced. Do not try to shim an oversize pulley bore as it is almost impossible to control the concentricity of the pulley. Pulleys should also be replaced when the sides of the sheave have worn to the point where there is a gap of $\frac{1}{32}$ in. or greater on either side. The belt must not touch the bottom of the pulley sheave.

Pulleys are almost always “keyed” to their shafts, most

commonly with a short piece of square keystone but sometimes with what is called a Woodruff key. Replace missing keys with the same size keystone (available at all hardware stores) and don’t rig a temporary replacement out of nails. When so provided, tighten the pulley setscrew(s) but be careful not to overtighten—it is easy to strip the threads in pulleys, rendering them useless. Unless you are an engineer or a mechanic, replace worn pulleys with ones of the same size. Any variation in size from the original will affect the speed at which the equipment runs.

The same general suggestions regarding alignment, tension and cleanliness apply to variable-speed belt drives. Since these are relatively new, it should be possible to contact the drive manufacturer to get lubrication recommendations. Remember that in drives of this type it is important to change speeds only when the equipment is running, so as not to damage either the belt or the pulleys.

Roller chains transmit large amounts of torque at low speeds and that is why they are often found in the feed-drive mechanisms of thicknessers. The same general suggestions concerning belts apply to chain drives, except that chains must be lubricated to operate freely. Keep the chain taut but not tight if you can adjust it. Make sure the links are free and not sticking to each other, and that the chains are reasonably clean. Since grease attracts dust, I prefer to use a dry lubricant on chains, but this also means that the chains must be lubricated more often. Roller chains, just like their bicycle-chain cousins, usually have a removable master link that allows the chain to be taken off for thorough cleaning or replacement. Chains can be cleaned with kerosene or other degreasing solvent, in much the same manner as bearings. Replace chains that show signs of rust. When the chain is off, check the sprocket teeth for wear. If they are worn, or if one side of the chain is riding on one side of the teeth, most likely the sprockets are not properly aligned. In any case, replace worn sprockets and chains.

Unless you are familiar with electric motors, do not attempt to do anything to them other than to keep them clean and, if fittings are provided, to keep them lubricated. Dust should be frequently cleaned out of motors, electrical junction boxes and electrical switches to minimize the hazard of fire. Repair or replace electric cords that are cut, cracked or abraded. Always make sure that the power is cut off when you are working around electrical equipment.

Regular maintenance need not take a great deal of time, but should be thorough and comprehensive. A little time invested on a regular basis will minimize major repairs and lost time by catching problems before they become serious. □

Further reading

Some useful shop maintenance references:

- Power Tool Maintenance* by Daniel Irvin (McGraw-Hill, Inc., 1221 Ave. of the Americas, New York, N.Y. 10036, 1971).
- Machinery’s Handbook* by Erik Oberg and Franklin D. Jones (Industrial Press, Inc., 200 Madison Ave., New York, N.Y. 10016; 20th Edition 1976).
- Millwrights and Mechanics Guide* (Theodore Audel & Co., distributed by Bobbs-Merrill, 4300 W. 62nd St., Indianapolis, Ind. 46206, 1975).
- Selecting and Using Electric Motors* by L. H. Soderholm and H.B. Puckett (U.S. Government Printing Office, Farmer’s Bulletin No. 2257, 1974).
- Woodshop Tool Maintenance* by Beryl M. Cunningham and William F. Holtrup (Chas. A. Bennett Co., Inc., 809 W. Detweiller Dr., Peoria, Ill. 61614, 1974).

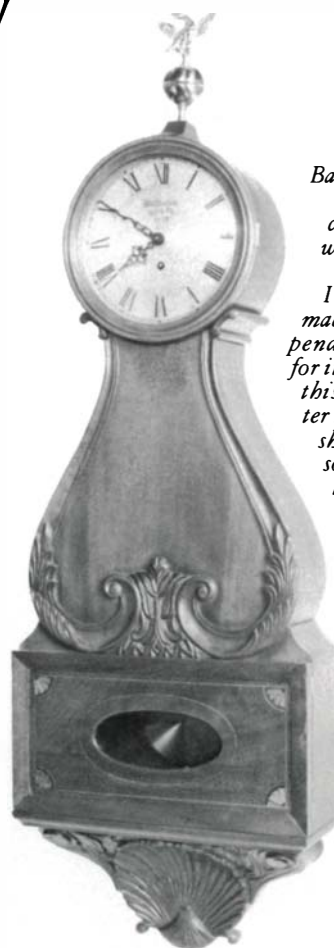
Portfolio: A.W. Marlow

... Museum quality furniture

EDITOR'S NOTE: Andy Marlow of York, Pa., designs and builds period furniture in the classical styles. He writes that when he received our Winter '77 issue (with a Philadelphia highboy on the cover) he thought, "Oh boy! There is a real craftsman. What a letdown when I discovered it to be an oft-photographed museum piece." He therefore volunteered select photographs of his own museum-quality furniture, as an antidote "to the brain-children of contemporary craftsmen." We asked him to add what he recalled about each piece, and those comments appear alongside the photographs.



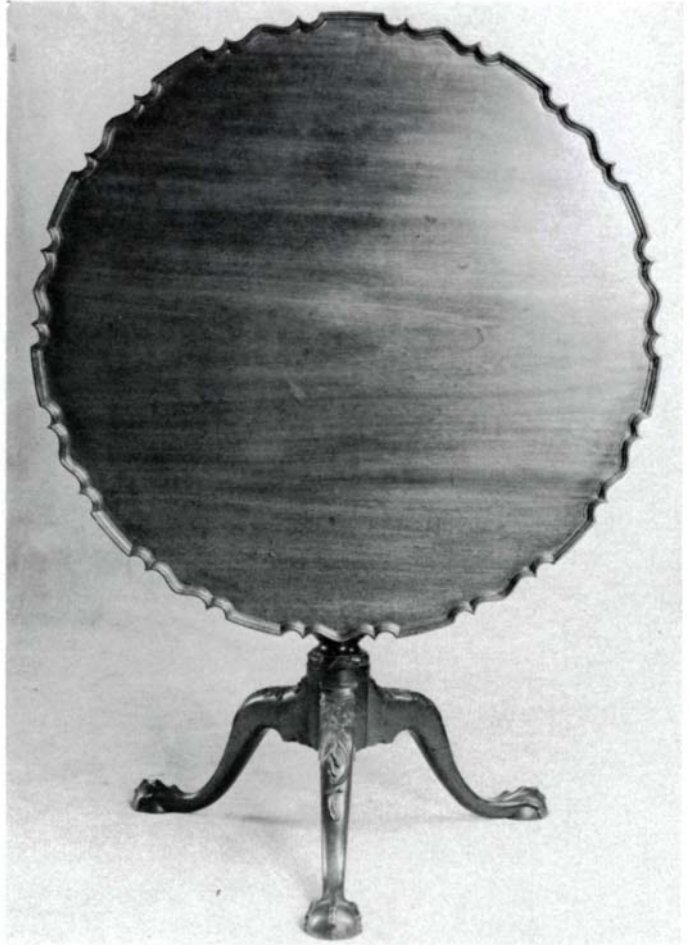
Very early in my furniture-making career, I received a call from a lumber dealer who said there was a carload of curly maple on the way and would I want some of it to fill a back order. This lumber was sight unseen by either of us. On arrival, it turned out to be beautiful 4/4 bird's-eye maple that had slipped past the veneer makers. I used that lumber for many pieces but have only the photo of this flat-top highboy (42 in. by 22 in. by 72 in.) as a reminder. Many of you will say 'amen' to the observation that all one can do with bird's-eye maple is to saw it and sand it.



Back in the 1940s, a telephone-caller asked if I would be interested in a clock removed from an old railroad waiting room. Remembering the kind of timepieces made in those days, I was not surprised to find a well-made trapeze movement with a 19-in. pendulum. So, what kind of case to make for it? Finally settled on a lyre design like this one (42 in. by 14 in. by 5 in.). After hanging on a wall in our home for a short time, it was sold, much to my sorrow. I didn't make another until last year when I bought a few beautifully made trapeze movements of the same size. This new case does not equal the original because the best I can get now is mahogany from Honduras. The old one was made of exceptionally fine dark-brown wood from Santo Domingo. In both cases, the dials were an odd size so I had to make them of spun aluminum.



The coffee-table leg design is a copy of a stool that was displayed in the Metropolitan Museum of Art about 1953. Coffee-table legs must be adapted from stool or chair legs that are the same height, because coffee tables as such were not made at that time. Many cabriole-leg designs are acanthus-leaf patterns, which make this carving design particularly attractive, especially when the legs end in paw feet.



Back about 1953 you could visit a mahogany importer and reasonably expect to find at least one or two 4/4 boards 36 in. wide. That's what happened when I chose to make the 11-section table pictured here (31 in. high, 36 in. dia.). The tops of these tables were always made of one board width (no glue joints). Even though this is a Philadelphia Chippendale piece, the carving deviates from the usual acanthus-leaf motif.

I think the most stately piece of furniture ever designed is the highboy. The last one of the three-finial design that I made was sold on condition that it would not be removed from the premises until I made another to replace it. The replacement shown here is a copy of one in the Winterthur (Del.) Museum. It measures 43 in. by 21½ in. by 90 in.

All these years at our house we have lived with good furniture, so it is probably natural to be careless occasionally and mistreat some of the pieces. The block-front slant-top desk is a case in point: made about 1935, subjected to hard usage for maybe 20 years, shoved aside and forgotten to make room for a replacement. Two years ago we decided to see what would happen if we brought down chairs, tables, desks and mirrors that were made in the 30s and 40s, and the outstanding example was, of course, the block-front desk. After cleaning and polishing, the careless treatment it received was still apparent. I was ashamed to do what I did but thought, 'may as well go for broke.' I put a current price tag on it that was eight times the original cost. What happened? It didn't stay on the floor a week. The New York Chippendale chair made about the same time was priced on the same current basis and quickly sold.



End-Boring Jig

Horizontal crossfeed makes drill press more versatile

by Steve Voorheis

The floor-model drill press is one of the most versatile machines in the small woodshop. A major limitation, however, is its lack of provision for quick and easy end-boring operations. The horizontal crossfeed end-boring jig described here is an effective means of converting a tilting-table drill press into an end-boring machine that will handle workpieces up to 38 in. long. In addition to quick conversion time, the crossfeed action facilitates boring multiple holes without re-

moving the work from the jig and without making multiple setups. Further, the jig may be used horizontally for various housing and routing operations.

The mechanics are simple: The stationary housing mounts to the table of the drill press. Enclosed in the housing is the lead screw/traveler block assembly. Rotation of the lead screw results in the transverse motion of the traveler block, which is fastened to, and in turn moves, the crossfeed table. As the crossfeed table travels horizontally, it is guided and held in the same plane by steel keys in wooden keyways.

The fence is mounted to the crossfeed table so that fine vertical adjustments may be made with the entire jig mounted on the drill press. Finally, there is an adjustable work-stop for rapid setup and repeat operations.

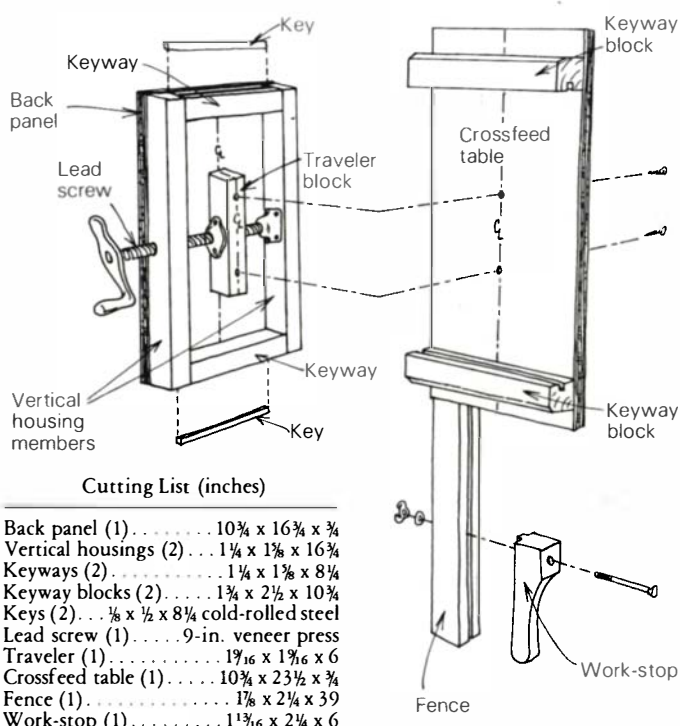
After the cutting list is completed, mount the female collar of the lead screw into the traveler block. Locate the hole for the collar by measuring in from the surface of the traveler block that will mate with the crossfeed table, the same distance that the lead-screw pilot hole is in from the corresponding edge of the housing. This ensures that the axis of the lead screw will be parallel with the crossfeed table, thus preventing binding and stiffness. Mark the vertical center line on the traveler for future reference.

The end grain of the keyways and keyway blocks should be sealed with a coat of varnish before assembly, to minimize future instability. After sealing, work $\frac{1}{8}$ -in. by $\frac{3}{16}$ -in. grooves into the keyways and the keyway blocks. To ensure a proper fit, all these grooves should be located and worked relative to the edges that will face the inside of the crossfeed table.

Begin by gluing one vertical member to the back panel, carefully maintaining alignment. In the same manner, install the two horizontal keyways, making sure that the surfaces from which the keyways were worked are facing away from the back panel. Install the second vertical member, in which the lead-screw pilot hole has been drilled. Again, make sure that the correct face is towards the back panel.

Accuracy is particularly important for smooth operation. Take care to ensure squareness and parallelism. Once the glue is set, true one of the vertical edges on the jointer. Working from this edge, rip the other edge parallel. Trimming the keyed ends of the housing parallel to each other is the most critical operation. By using the table saw and a simple cross-cutting "cradle," this can be reliably done. Trim one end of the housing and then rotate the work 180° in the horizontal plane to make the second trim cut parallel to the first. Clean up these ends with very light passes on the jointer.

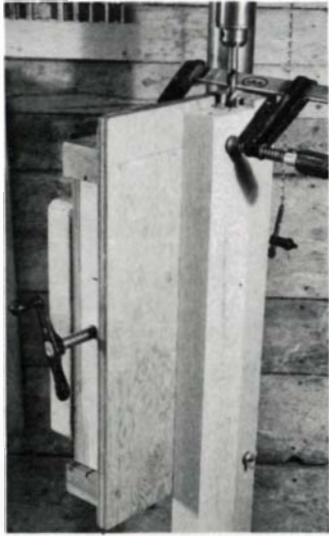
To assemble the crossfeed table, first install steel keys in the keyways of the stationary housing. Position the keyway blocks over the keys in operating position and insert newsprint shims between the mating surfaces on either side of the keys. With keyways and shims clamped firmly to the stationary housing, mount the crossfeed table to the movable



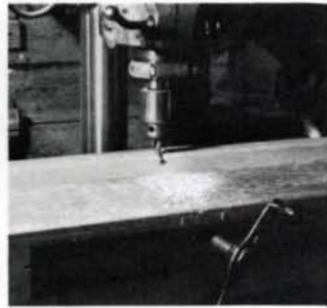
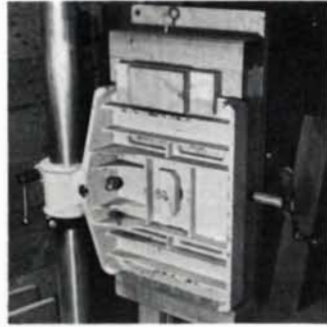
Use any hard, dense wood, such as maple, and birch ply for the table.



Crosscutting cradle guides trim cuts on stationary housing.



Jig facilitates end-boring (above) and routing (right). Top right, jig hooks over table edge and can be bolted through center hole of drill-press table.



keyway blocks with woodscrews and glue. Before final screwing and gluing however, it would be wise to test the crossfeed action. Alternately clamp the crossfeed table to the keyway blocks and then release the original clamps. Remove the shim material to assess the sliding action and adjust as necessary.

Insert the lead screw through the pilot hole in the housing, thread it through the female collar mounted in the traveler block and finally into the mounting base, where it is secured with a retainer screw. If the jig is built exactly as described here, it will be necessary to drill an access hole in the back panel behind the mounting base to lock the retainer screw, because there will not be enough clearance below the crossfeed table. Move the traveler block along the screw all the way in one direction and then project the vertical center-line of the traveler block down onto the back panel of the housing. Move the traveler to its other extremity and project the center-line onto the back as before. Halfway between these two points is the mid-travel position for the traveler block.

With the block at mid-travel position, transfer the traveler-block mounting screw hole locations to the outside of the crossfeed table. Re-install the crossfeed table centered on the stationary housing with the steel keys in place; attach the table to the traveler using screws only, to facilitate disassembly. Mount the fence assembly to the table with hanger bolts and wing nuts. Slightly oversized holes for the hanger bolts will permit fine vertical adjustment, for perfect alignment of the fence with the vertical axis of the drill press.

A wooden bracket attached to the back of the jig hooks over the edge of the vertical drill-press table to hold the jig in place. For extra stability during high-speed routing, add a hanger bolt, wing nut and a large wooden washer, which can be secured through the center hole of the drill table.

A stop collar may be installed on the drill-press column at the height at which the jig will most frequently be used. Then the table need only be tilted and dropped to the collar and the jig put in place. The collar also allows the jig to swing through an arc under the spindle as well as travel in and out on the screw, covering a range of positions. □

Steve Voorheis, 35, designs and builds furniture in Montana.

Scale Models

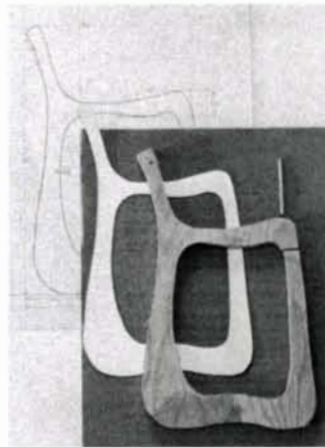
Plywood mockup illuminates design

by Bob Trotman

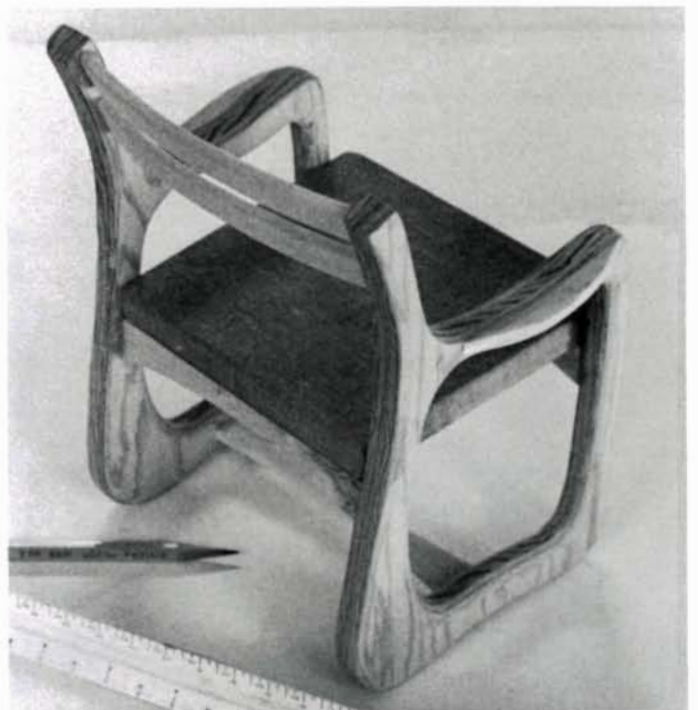
Because even the best drawings offer only an approximate idea of how a piece of furniture will look in three dimensions, it is often desirable to build a model. The models I make are not intended to be fine miniatures, but are built as quickly and easily as possible to see what an idea will look like. It is obviously much easier to make changes in design and proportions at this stage than when the full-scale work is underway.

Working from my sketchbook, I draw out the side view of the design in $\frac{1}{4}$ scale on graph paper, and then transfer it with carbon paper to posterboard (optional) and then to plywood. In $\frac{1}{4}$ scale, $\frac{1}{2}$ -in. plywood will represent $8\frac{1}{4}$ lumber, and $\frac{1}{4}$ in. is close enough to $5\frac{1}{4}$ lumber. Internal openings may be cut

on the band saw (if you don't have a jigsaw) simply by cutting through at a convenient place, then gluing and doweling the cut back together. White pine is suitable for solid members such as stretchers, since it is fine-grained and easily worked. Cushions may be made of wood covered with cloth. □



Bob Trotman, 30, of Casar, N.C., is a professional woodworker.



Finished model of dining chair has fabric-covered wooden seat.

The Purpose of Making

Cultural myths generate motif and meaning

by Stephen Hogbin

People involved in woodworking and other crafts seem to have a fascination with the way things are made. That's natural enough, but this fascination with technique should not exclude attempts to clarify the purpose of making. Technique provides us with a way to bring objects into existence—it doesn't deal with the broader and fundamental questions of conception, perception and expression. Materials and technique are the vocabulary of form and are the means to a more expansive end.

What is it that motivates people to create? I was once told a story about a person visiting a cathedral under construction. On meeting the first artisan the visitor asked, "What are you doing?" "I'm making a living for my family," was the reply. The second artisan responded, "I'm cutting a perfect mortise and tenon." The third answered, "I'm making this chair as quickly as possible so I can knock off for lunch." The fourth pondered for a moment, then said, "I'm building a cathedral." This last person had a well-developed sense of purpose and a broad understanding of why he was working. There is dignity in that fine perception.

Whatever each of us makes, whether it is thoughtfully or intuitively developed, is an expression of ourselves, our environment, our social mores and a belief system. Ultimately the belief system is the rationale for the object. The shapes and forms of Shaker furniture reflect their belief that "beauty rests on utility." Empire-style furniture is quite different, reflecting different aspirations. Any style is a reflection of the political, religious and/or philosophical beliefs of the society of its time—perhaps not as clear a reflection as a mirror would give, but more like the image on the surface of water. This is inevitable and often unconscious.

The importance today of objects from other eras or foreign cultures lies in their symbolism and associative qualities. To

try and copy forms of another period is to take them out of context, thereby reducing their meaning. Nostalgia is a sentimental yearning and an evasion of the reality in which we live. It does little for the development of the human spirit.

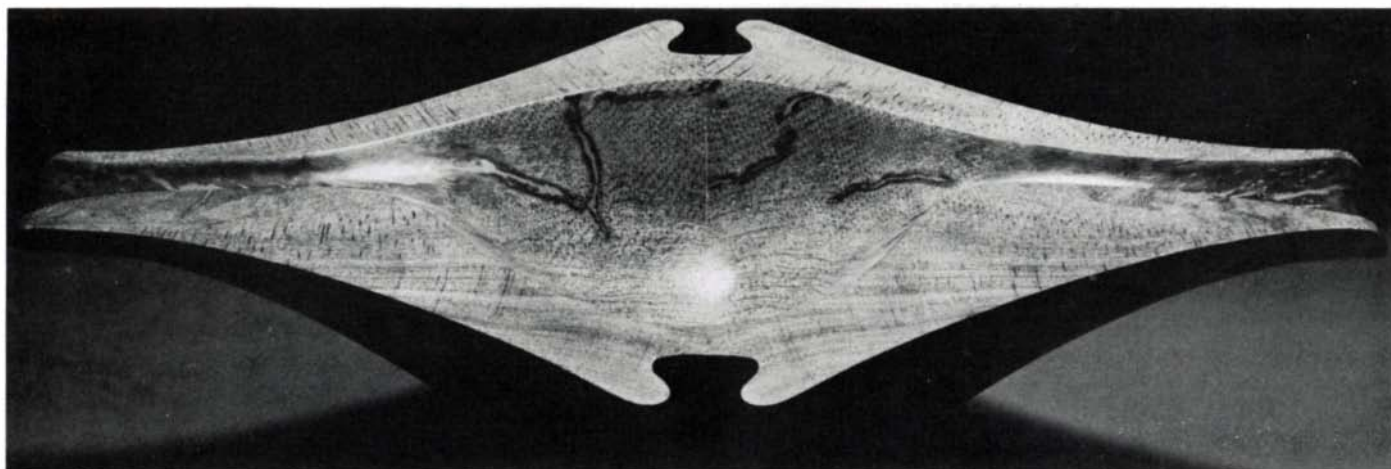
A myth is a narrative that presents part of the beliefs of people or explains a practice or a natural phenomenon. Rituals develop in order to express myths, and people make objects to support myths and rituals. Rarely does the object become the myth and if it does, a dislocation from meaning and purpose results. An example of the relationship between rituals and objects is readily observed in eating habits.

Although all people must eat, eating has become ritualized in different ways, reflecting different social mores and myths. People eat together to satisfy social needs, as well as to survive. Food offers a focal point for family, friends and business relationships. Mealtime is a time for entertainment, learning and sharing, as well as for eating. The objects that are a part of this occasion become tools to develop conviviality.

I've made a number of things that deal with eating rituals. The ceremonial bowl shown below was designed to bring the specialty of the house to the honored guests. The handles of the bowl project from it so that the food is carried to the guest in the upturned and offering hands of the host. The food, the bowl and the gesture combine to create a sense of occasion through theatrical means.

Herbert Read, in *Modern Sculpture*, says of the artist: "Imitation is not his purpose, but always assimilation and regeneration." We absorb history and then interpret it through what we make in the light of present experience. In this way our myths and rituals become defined through the objects that are developed and refined as expressions of our existence.

Albert Elsen, in *The Purposes of Art*, quotes the painter Courbet, who in 1855 wrote: "I have studied the art of the



A myth is an expression of belief; rituals flow naturally from myths to animate the belief. Objects can play a major role in acting out the ritual—the food, the bowl and the gesture combine to create a sense of occasion. Grass-tree wood (Xanthorrhoea) from Australia, 20 in. long.

masters and the art of the moderns, avoiding any preconceived system and without prejudice. I have no more wanted to imitate the former than to copy the latter; nor have I thought of achieving the idle aim of art for art's sake. No! I have simply wanted to draw from a thorough knowledge of tradition the reasoned and free sense of my own individuality. . . . To be able to translate the customs, ideas and appearances of my time as I see them—in a word, to create a living art—this has been my aim.”

While the artist has consummated self-expression, other visual arts have developed differently. Industrial designers, for example, are concerned with function, ergonomics and markets. They have little opportunity for self-expression. Their work can be beautiful, but functioning forms are their primary challenges. Industrial designers often prefer anonymity of form to the intensely personal statement of artists.

Craftsmen have the advantage of being able to slide between the poles of anonymous and expressive form. They may choose to concern themselves with limited-production wares or sculptural pieces, demonstrating either objective, rationalized forms or subjective, empirical forms. Occasionally some objects may appear to dwell at either pole.

The private myth

The substance of the private myth is usually referred to as self-expression and involves personal imagery. It is an exploration by the maker of his or her own beliefs, fears, joys, aspirations and ideas. It is expressed in a form devised by the maker for the maker.

The expression of the private myth through objects is a fairly recent phenomenon. Albert Elsen states that only by the end of the 19th century had the concept of “working directly from private empirical experience in an individual style, personally acquired” been established. Before then the maker was guided by his patrons—leaders, emperors, kings, priests. Interpretation was minimal and had to be approved in relationship to the traditions and beliefs it reflected.

Many craftsmen today make sculpture, objects with little or no function. Their work reflects a recent shift in crafts, away from the function and purpose of the object. These objects reinterpret or regenerate the maker's private myths. The maker, of course, hopes that others will share his life experiences and will choose to contemplate the object, and perhaps even buy it for continued scrutiny and enrichment.

Objects made for use can also reflect personal experience and attitude. A case in point is the dustpan illustrated here, which I made for my workshop. Although mundane, the dustpan reflects my concern with the problem of waste. The dustpan I had been using broke, and I had the choice of replacing it with a new one or making something I would want to use for special and particular reasons. Choosing the latter, I then selected my materials (the rear fender of a junked Karmann Ghia and scrap wood from various sources, including a coffin-maker) and method of construction. Each time I use the dustpan I am reminded of the waste from which it originated, provoking me to think about what I'm scooping up. This supports my concerns about waste in our society and expresses a part of my beliefs.

Interpersonal myths

The interpersonal myth is a narrative that results from the interaction of people at the family and neighborhood level.



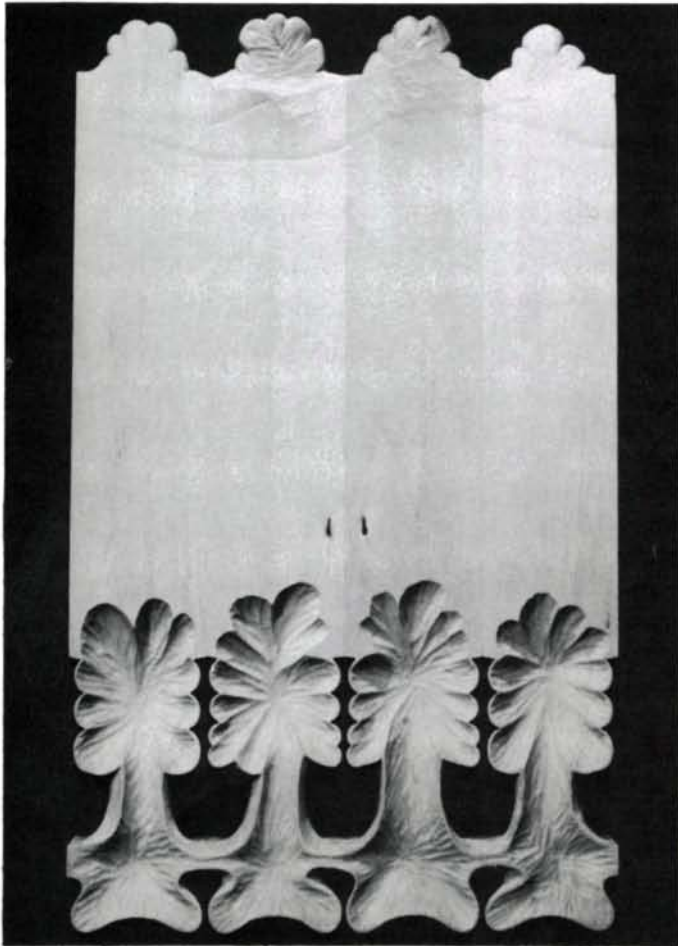
Private myths express the personal beliefs of the maker; objects made for use can also reflect personal attitude. This mundane dustpan itself is made from waste materials.

The concept of the object that becomes the expression of such an interpersonal myth may well have meaning for many people, but it has specific qualities that are intrinsic to and develop from the client's need as translated by the maker.

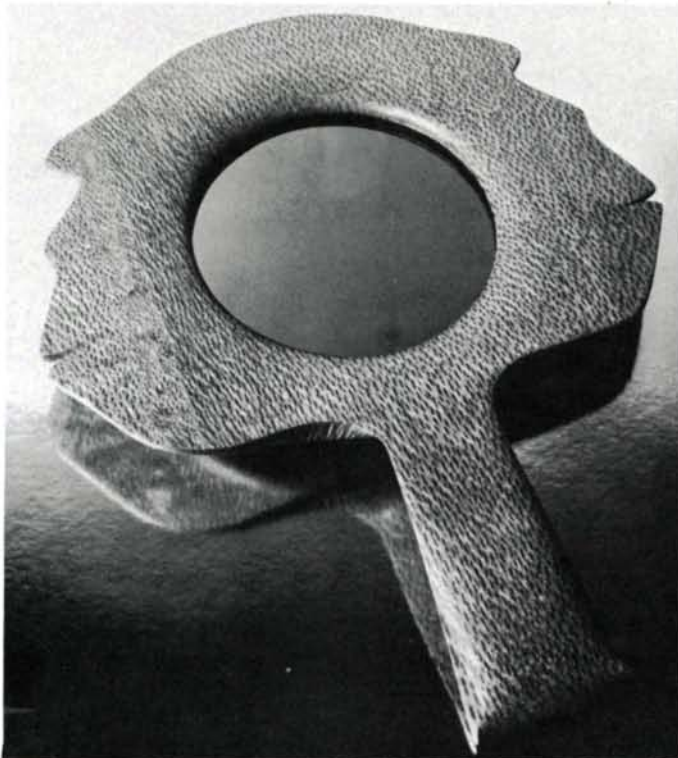
The hors d'oeuvre server shown on the next page is an example of an object resulting from the interaction between maker and client. It was commissioned by an artisan who uses landscape imagery in his work. We traveled many miles together, observing land forms and discussing the role of the craftsman in society. Many of these discussions centered on the role of objects in the development of conviviality.

From these discussions, the server emerged as an object that supports interaction among people: Food is offered as a gesture of goodwill, hors d'oeuvres stimulate the palate, and an array of delicacies enhances the social function of pre-dinner introductions and renewal of acquaintances.

This established, I devised the basic form of the tray to



The interaction of people creates the interpersonal myth, which has qualities specific to the client and maker yet may also have meaning for many people. Hors d'oeuvre serving tray for a person fascinated by land forms, made of huon pine (Dacrydium franklinii) from Tasmania, 26 in. by 16 in. by 2 in.



Collective myths span the consciousness of a culture, dealing with ideas that are felt generically but expressed in local or regional modes. The Bunyip mirror symbolizes an Australian story about an animal that goes in search of its identity. Silky brown oak (Grevillea robusta) from Australia, 10 in. high, 8 in. wide.

complement the client's particular interest in land forms. The server, when not in use, stands on end as a reminder of times well spent, a link between the client and maker.

The object produced as a result of the interpersonal relationship between the client and maker will demonstrate one of the strengths of the work of the contemporary craftsman. Industry can make only for the "average" person. The craftsman can search out the challenges of producing work for those people who choose to select, commission and purchase a definition of themselves.

Collective mythology

Most of the "high" art of a culture stems from its collective mythology and deals with its collective consciousness. Groups of people with common ideas tend to develop rituals to express them. Some examples of symbols associated with collective myths are the processional cross and altar, mace and throne, carnival float, wedding bells and the Christmas tree.

It is important for the essence of one generation to be passed on to the next—whether it is accepted is another matter. The Inuit (Canadian Eskimos) use story-telling to pass on their mythology. The people sit in a group, and a model or sculptural image supporting the idea behind the story is passed from person to person. The image is present as a symbol enriching the spoken word—it solidifies the idea.

A story I was reading to my daughter fascinated me to the point of making me want to interpret it. The book *The Bunyip of Berkeley's Creek*, by J. Wagner, led me to produce the Bunyip mirror, illustrated here. The mirror is my interpretation of the book, which is in turn an interpretation of an Australian aboriginal myth. None of the interpretations copy each other, as copying stultifies. The book is about an animal that goes in search of its own identity. It is a myth known and understood by Australians, yet it has a universal appeal that stretches beyond the originators without, I feel, losing its poignancy. Such is the power of ideas.

An object produced in association with a collective mythology should support that myth. The object should not be an end in itself; rather it should be a carrier, vehicle, supporter—a clarifying and enriching agent. The object becomes a symbol that promotes and stimulates the meaning and purpose of the myth.

Identifying three categories of myths in this simplistic manner is probably dangerous. The private myth, the interpersonal myth and the collective myth are indeed interdependent. In fact, the generalities I have made may obscure a fascinating and complex mix of overlaps. However, all too frequently, clumsy and incongruous juxtapositions can be observed in our daily lives. For example, do we do farmers justice by seating them in Queen Anne chairs? Should the Sex Pistols sit in Shaker chairs? The maker cannot always designate the final use or abuse of the object he makes, but at least he can attempt to design for the aspiration of his clients by being aware of their mythology. The forms resulting from the expression of beliefs reinforce the client's self-definition, and ultimately they will be the visual fabric of our culture. □

Stephen Hogbin, 36, of Caledon East, Ontario, an industrial designer turned woodworker, recently spent a year in Australia as resident craftsman at Melbourne State College. He is the author of Wood Turning, forthcoming from John Ferguson Pty. Ltd., 24 Kent St., Sydney, N.S.W., Australia.

Lumber Grading

A guide for the perplexed

by William W. Rice

When I hear a woodworker exclaim, "How can that board be a Select? It has a knot as big as your fist!" I sympathize with his frustration. But I also know that he, like many, is confused about commercial lumber grading. A bewildering assortment of grades confronts the buyer. There are different standards for hardwoods and for softwoods, and the rules make exceptions for certain species like walnut.

Lumber grading is a way of evaluating the usable lumber in a board. It takes into account the number, size and degree of defects, and the number and size of clear pieces that will remain when the defects are cut away. But not every project needs a perfect board 12 ft. long. Once a cabinetmaker learns his way through the intricacies of the grading system, he will be able to select the most suitable lumber for the job at hand. He may well find that he can cut the size pieces he needs from No. 1 Common as well as he could from Firsts and Seconds—at considerable saving.

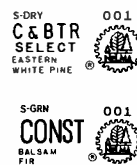
As far back as the early 1700s the need for classifying lumber by grades was recognized. Originally, appearance was the primary requisite, but with increased knowledge about wood properties and methods of utilization, lumber grades now also take into account strength characteristics and yield potential. Modern lumber-grading rules provide standards for the manufacture of the same product by different mills. They also serve as common specifications both buyer and seller can use to determine that full value is received and sold.

In the United States, the American Lumber Standards Committee (ALSC) of the Department of Commerce is responsible for general establishment and administration of lumber grades. Application and enforcement of specific grading rules are the responsibility of various lumber inspection associations. For example, the California Redwood Association has jurisdiction over member mills and dealers handling redwood, and the Western Wood Products Association monitors the standards for several West Coast species, including ponderosa pine and Douglas fir. Some other associations are the Southern Pine Inspection Bureau, the Northeastern Lumber Manufacturers Association and the National Hardwood Lumber Association. Altogether there are about 15 associations that oversee the grading of wood products; each is represented on the American Lumber Standards Committee and all operate under its certification. Grading rules are voluntary standards set by the lumber industry through the ALSC, not dictated by the government.

Lumber grading is judging the surface quality of boards with respect to established standards, which are different for softwoods and hardwoods. Softwoods are graded from the best face, usually as surfaced material, and it is assumed that the piece will be used as is, without further manufacturing. Select and Common softwood boards are graded for appearance from the best face, while dimension lumber and timbers are graded for strength by inspecting all four surfaces, with



Typical grade stamps of the Western Wood Products Association (top: Douglas fir, sugar pine) and the Northeastern Lumber Manufacturers Association (right: Eastern white pine, balsam fir). Stamps indicate the association mark, the species, the mill, the grade and sometimes the relative dryness.



the poorest surface determining the grade. Hardwoods are graded in the rough, from the poor face, and it is assumed that each board will be cut into clear-face parts. Softwoods are generally grade-stamped, hardwoods are not. Both softwood and hardwood grading rules describe the poorest piece permitted in each grade. Softwood Select and Common grades specify a moisture level of 15% or less. There is no moisture-content rule for hardwoods, and generally grading is done while the lumber is green, unless buyer and seller make special arrangements.

Softwood grading

Softwood species most often used for cabinetry and furniture are Eastern white pine and the western pines: sugar, Idaho white, ponderosa and lodgepole. Other species used include Douglas fir, Englemann spruce, Sitka spruce and Western larch. Eastern white pine is graded under the rules of the Northeastern Lumber Manufacturers Association (NELMA). The others are graded under the rules of the Western Wood Products Association (WWPA) and/or West Coast Lumber Inspection Bureau (WCLB). Upper grades are designated Select or Finish and usually are further separated by the letters B, C, and D to indicate descending quality. The exception to the rule is Idaho white pine (IWP), which carries the grade names Supreme, Choice, and Quality in place of B Select, C Select and D Select respectively.

Lower lumber grades are called Commons, and quality within this category is designated by the numbers, 1, 2, 3, 4, 5—with the highest number assigned to the lowest grade. But Idaho white pine Commons carry the names Colonial, Sterling, Standard, Utility and Industrial, with Colonial corresponding to 1 Common, and so on.

While grade descriptions may vary slightly from one softwood association to another, in general each grade describes the type, size and number of defects permitted in the worst board in that grade. For example, the WWPA grade of B and Better Select (B & BTR) for all species permits on the best face: light stain (blue or brown) over not more than 10% of the face; small ($\frac{1}{32}$ in. deep by 4 in. long) season checks, one at each end of the board or 3 or 4 if away from the ends; very light torn grain ($\frac{1}{4}$ in. by 3 in.); two sound, tight pin knots ($\frac{1}{2}$ in. dia.) or slight traces of pitch or a very small pitch pocket ($\frac{1}{16}$ in. by 3 in.); very slight cup ($\frac{1}{16}$ in. in an 8-in. wide board); very light crook ($\frac{1}{4}$ in. in an 8-in. by 12-ft. board). In addition to the above, the poor face may have wane (bark) $\frac{1}{4}$ the thickness by $\frac{1}{8}$ the length of the piece.

As another example, a Premium (No. 2 Common) Eastern white pine board graded under NELMA rules could contain on the best face: medium surface checks ($\frac{1}{32}$ in. by 10 in.);

Bill Rice, 56, teaches lumber grading in the wood science and technology department at the University of Massachusetts.

red knots (2¾-in. dia. in 8-in. wide boards); sound pith; medium pitch (⅓ the width by ⅓ the length of the piece); short splits; medium stain (not affecting a paint finish); one knothole (½-in. dia. in a 6-in. wide board); one ¼-in. wormhole for every 6 lineal feet of board. The poor face could have all that plus wane ½ the thickness by ¼ the width by ¼ the length of the board.

At first glance the reader might think that anything goes as far as defects in a board. In practice the grader exercises judgment about the number allowed and seldom, if ever, do all the permitted defects occur in a single board. In fact, there may be some pieces in a pile that would make the next higher grade except for one unacceptable defect. For example, a perfectly clear board with too much wane on the reverse face grades as C Select instead of B, or a No. 3 Common board misses the No. 2 Common grade because of one oversize knot. The softwood grade is stamped on each piece when it leaves the mill, although retail lumber dealers often cut long boards into shorter lengths and in the process lose the stamp. Inspection by the association quality-control people ensures that the grade is correct on at least 95 % of the pieces.

Hardwood grading

Except for specialty grades such as Factory and Shop or Furniture (NELMA), softwood grading depends on the grader's experience and good judgment and assumes lumber use in full widths and lengths. In contrast, hardwood grading is based on the assumption that the boards will be cut into furniture parts ranging from 2 ft. to 7 ft. long, and that each part should have a clear face. The grade of individual boards is related to the yield of clear parts as determined by a mathematical system called the Cutting Unit Method. In addition, hardwoods are always graded from the poor face.

While there are rules similar to softwood rules for grading hardwood timbers and framing, they are seldom applied commercially. For this reason hardwood grades are usually considered to be furniture grades. There is only one association, the National Hardwood Lumber Association (NHLA), responsible for the grading of native hardwoods as well as many imported foreign and tropical species. Hardwood grading rules define standard requirements for all hardwood species and, in addition, spell out modifications that apply to individual woods. A cabinetmaker who understands the general rules will usually be able to purchase any hardwood species on grade without major problems. An exception might be walnut which, because of the decreasing size of the available trees, has required a number of adjustments.

The standard grades assigned to hardwoods are Firsts, Seconds, Selects, Numbers 1, 2, 3A and 3B Common, and Sound Wormy. Firsts and Seconds are usually combined into the one grade of Firsts And Seconds (FAS). Sound Wormy is essentially No. 1 Common with an allowance for wormholes. As with softwood grades, the more defects in a board, the lower the grade. However, in grading hardwoods the concern is for the yield of clear material, not the number of defects.

A grader spends only 10 or 15 seconds inspecting each hardwood board. In that time, he determines its width, length and surface measure (area in square feet); selects the poor face; visualizes a series of clear face cuttings on the surface; determines the percent of clear material available; and assigns a grade based on board size, number of cuttings, percent of clear area and defect or species restrictions.

The heart of this grading operation is the determination of clear material available and this is done by the Cutting Unit Method. A cutting is a portion of the board that can be obtained by crosscutting, ripping, or both. A cutting must be

MINIMUM GRADE REQUIREMENTS FOR HARDWOODS

Grade	Minimum Board Size width length	Conversion Factor (% clear face)	Minimum Size of Cuttings	Maximum Number of Cuttings for Board SM
Firsts	6" 8'-16'	11xSM (91⅓%)	4"x5' or 3"x7'	1 for SM 4'-9' 2 for SM 10'-14' 3 for SM 15' or more
Seconds	6" 8'-16'	10xSM (81⅓%)	4"x5' or 3"x7'	1 for SM 4'-7' 2 for SM 8'-11' 3 for SM 12'-15' 4 for SM 16' or more
Selects	4" 6'-16'	11xSM (91⅓%) 10xSM (83⅓%)	4"x5' or 3"x7'	1 for SM 2'-3' 1 for SM 4'-7' 2 for SM 8'-11' 3 for SM 12'-15' 4 for SM 16' or more
No. 1 Common	3" 4'-16'	9xSM (75%) 8xSM (66⅔%)	4"x2' or 3"x3'	1 for SM 2' 1 for SM 3'-4' 2 for SM 5'-7' 3 for SM 8'-10' 4 for SM 11'-13' 5 for SM 14' or more
No. 2 Common	3" 4'-16'	6xSM (50%)	3" x 2'	1 for SM 2'-3' 2 for SM 4'-5' 3 for SM 6'-7' 4 for SM 8'-9' 5 for SM 10'-11' 6 for SM 12'-13' 7 for SM 14' or more

The chart gives the minimum requirements a board must meet to merit a particular grade. In general, a high-grade board is relatively long and wide and a high percentage of its area is free of defect. The clear lumber in a high-grade board must be obtainable in relatively few and large cuttings.

To grade a board, first note its dimensions—they will eliminate some grades immediately. For example, a board that is only 5 in. wide cannot be a First or Second. Next, note the board's surface measure (SM)—its area expressed in square feet. Mentally lay out the largest clear cuttings that could be obtained by straight ripping and crosscuts, and measure each cutting in inches of width and feet of length (cutting units). Then total the number of cutting units available, and count the number of cuttings necessary to obtain the total. The last two columns give the minimum size of a cutting and the maximum number of cuttings allowed for each grade.

The percentage of clear face required for each grade can be found by dividing the number of cutting units by the area of the board, but instead, lumber graders use a conversion factor, which is given in the third column of the table. The surface measure of the board multiplied by the conversion factor gives the minimum number of cutting units required for the grade.

For example, the smallest board that can be a First is 6 in. wide and 8 ft. long, or 4 ft. surface measure. If this board were perfect, it would contain 48 cutting units. It must contain its surface measure times the conversion factor of 11, or 44 cutting units, to be graded a First. This much clear lumber must be obtainable in one cutting.

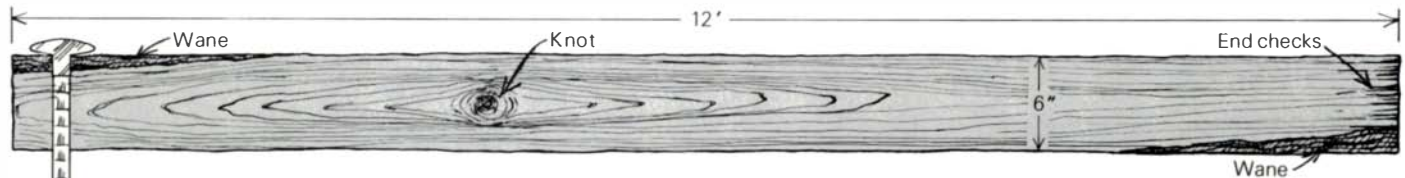
The two examples that follow show how lumber is graded. The diagrams were derived from real boards, but the defects that determined the grade were too small to reproduce photographically.

parallel to the edges of the board. Further, a cutting must be clear of all defects on one face and it must be of a certain minimum size, depending on the grade to be assigned to the board. Based on the surface area of the board, each grade specifies the maximum number of cuttings that can be used in determining the grade. Note that grading does not consider the thickness of the board, only the surface area. The

grader visualizes the various cuttings, but does not actually make the sawcuts. How the buyer ultimately cuts the board may not coincide with the grader's visualization. What is important is that the yield of clear material is mathematically available in specified cuttings and therefore anyone check-grading the inspector should arrive at the same grade.

The mathematics of the Cutting Unit Method are relatively

EXAMPLE 1: RED OAK BOARD



In about 15 seconds, the lumber grader:

1 Measures the length (12') and width (6") of the board, multiplies to get its surface measure (area in square feet): $\frac{1}{2} \times 12 = 6$ SM.

2 Selects the poorer face and visualizes on it a series of clear cuttings, which he measures in inches of width and feet of length.



Board's poor face, above, has wane (bark) along edges; good face, below, is relatively clear.

3 Totals the area of the clear cuttings.

1 cutting @ 5" x 7' = 35 cutting units

1 cutting @ 5" x 4' = 20 cutting units

55 cutting units,

against 6" x 12' = 72 cutting units if the board were perfect.

4 Compares the available clear cuttings with the grade requirements given in the table.

Firsts: $11 \times \text{SM} = 11 \times 6 = 66$ cutting units in 1 cutting.

Seconds: $10 \times \text{SM} = 10 \times 6 = 60$ cutting units in 1 cutting.

1 Com.: $8 \times \text{SM} = 48$ cutting units in 2 cuttings.

5 Assigns a grade. The board contains enough cutting units (55) in few enough cuttings (2) to be graded No. 1 Common. It falls short of meeting the requirements for Seconds because it lacks 5 cutting units and because 2 cuttings were necessary to obtain the units available. This grade was determined from the poor face of the board. If the good face could meet the grade of Seconds, the proper grade would become Select. Select is a special grade, generally used for parts or items that show on one face only. But if the good face of the board grades no higher than No. 1 Common, then the poor face determines its grade.



EXAMPLE 2: WALNUT BOARD

Board size: 2" x 8" x 12'

Surface measure (SM): $\frac{8" \times 12'}{12} = 8$ sq. ft.

Available clear stock:

1 cutting 4" x 4' = 16 cutting units

1 cutting 4" x 4 1/4' = 17 cutting units

1 cutting 3" x 3' = 9 cutting units

1 cutting 4" x 5 1/2' = 22 cutting units

1 cutting 4" x 5' = 20 cutting units

Total: 5 cuttings with 84 cutting units

Grade requirements (from table):

Firsts: $11 \times \text{SM} = 11 \times 8 = 88$ cutting units in 2 cuttings

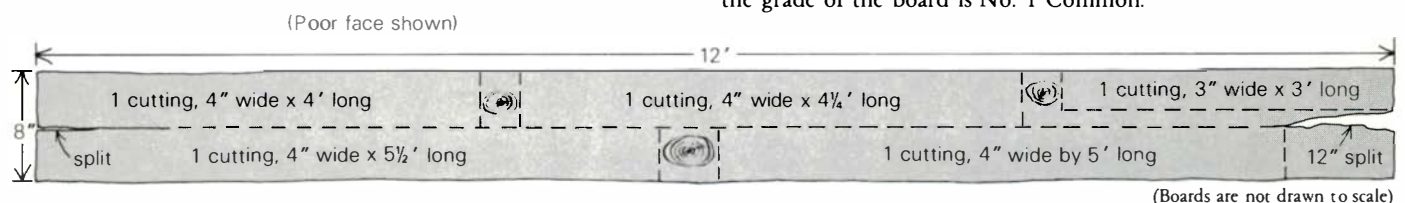
Seconds: $10 \times \text{SM} = 10 \times 8 = 80$ cutting units in 2 cuttings

1 Com.: $8 \times \text{SM} = 8 \times 8 = 64$ cutting units in 3 cuttings

2 Com.: $6 \times \text{SM} = 6 \times 8 = 48$ cutting units in 4 cuttings

Modification for walnut: 1 Common standard, unlimited number of cuttings.

Under standard rules (as for oak), this board would grade as excellent No. 2 Common, with 75 units in four cuttings. (Since only four cuttings are permitted for No. 2 Common, the smallest cutting, 9 cutting units, is not included in the total.) But because a modification to the rules allows an unlimited number of cuttings for walnut, the grade of the board is No. 1 Common.



(Boards are not drawn to scale)

simple. It is a matter of calculating the number of cutting units available and comparing the total to the number required for a given grade. A cutting unit is a portion of clear lumber one inch wide and one foot long. Thus the number of cutting units in each clear portion is determined by multiplying its width in inches by its length in feet. When calculating the total yield of clear material, only those cutting units making up the surface of the clear-face cuttings may be counted. There may be additional cutting units in the board, but in areas too small for furniture cuttings, and thus not available for grade computation. Within each grade there is some leeway because the rules describe the poorest pieces—thus there are both borderline and “good” boards. A good No. 2 Common would be just shy of the total cutting units it would need to qualify as a No. 1 Common. The table lists the requirements for determining standard grades.

As can be seen from the table and the two examples, hardwood grading can be detailed and quite exacting. Grading is a 100% inspection procedure, but in a given pile of lumber an experienced grader can accurately judge whether most boards contain the proper percentage of clear area in the allowable size and number of cuttings without using the complete method. However, for a borderline board he will go through all the necessary measurements and calculations, if the lumber value warrants the effort.

Grading and the woodworker

Although grading rules are of particular use to furniture manufacturers, they can also guide the cabinetmaker in selecting lumber. In sum, Firsts and Seconds are relatively clear boards of good widths and lengths. They yield on the average, 80% to 90% clear material, depending on cutting requirements, and the pieces will be good on both sides. Select boards are about 80% clear on one face and of good widths and lengths. They are often used for items that show only one side. No. 1 Common is probably the best all-around grade, considering both yield (about 65%) and price. This grade can include some long (over 4 ft.) cuttings. If most of your cabinet parts are 16 in. to 4 ft. long, consider the economy of No. 2 Common. Often the grade yield of 50% can be exceeded, especially if the parts are glued into assemblies.

A cabinetmaker who wants to use graded lumber should visit a lumber supplier and look over the available stock in the various grades to become familiar with the typical array of defects (and their spacing) that is permitted. Look for grade stamps on softwoods so you will know you are getting what you are paying for. But most important, try to associate the character and size of the cabinet (or parts) with the appearance of the lumber. Then select the grade that will permit you to cut out the parts with the least waste. Not all parts need to be blemish-free; in fact, defects more often than not add character and interest. The lower grades are less expensive, but figure the waste before buying on price alone. □

AUTHOR'S NOTE: Lumber-grading rules can be obtained from the following associations:

National Hardwood Lumber Assn., 332 S. Michigan Ave., Chicago, Ill. 60604 (*Rules for Measurement of Hardwood and Cypress Lumber*, \$1.00).

Northeastern Lumber Manufacturers Assn., 4 Fundy Rd., Falmouth, Maine 04105 (*Grading Rules for Northeastern Lumber*, \$2.00).

Western Wood Products Assn., 1500 Yeon Bldg., Portland, Ore. 97204 (*Grading Rules for Western Lumber*, no cost).

TAGE FRID

An apprenticeship in Denmark

Last spring, I attended a conference on apprenticeship where craftsmen and educators met to discuss the problems of learning a skilled craft today. I gave a paper on my own experiences as an apprentice in Copenhagen, which I started when I was just 13 years old.

The educational system was quite different from today in that most students finished school after the seventh grade. At that time classes were held six days a week, and the summer vacation was only six weeks, so the school year was about 240 days against the 180 days we have here. I was not very interested in academics, and the schools then, as now, weren't very interested in practical subjects. They were preparing students for college. After the seventh grade, I didn't know what I wanted to do. My father was a silversmith and an excellent craftsman. We had a lot of silver that had to be polished, which was usually my job and I did not enjoy it, so I was 100% sure I did not want to be a silversmith. But I had always worked with wood, so my father asked me if I wanted to apprentice with a cabinetmaker. I had to do something, so I said yes. It was quite by accident, but I am very happy for it today—it was the best thing that could have happened to me. It was a rough life, but when you were finished you had an excellent understanding about wood as a material, its strengths and limitations, and how to put it together. After finishing my apprenticeship and working as a journeyman for several years, I realized that I would have to go back to college. And so, when I was about 25, I did return to college and later to the School for Interior Architecture.

When I began, the master and apprentice signed a five-year contract, which was binding after a three-month trial. The salary was about \$1 a week, plus a lot of slapping if you weren't working hard all the time. The master also paid for medical insurance and tuition for the technical night school where drawing and knowledge of the material were taught.

The work day for journeymen was from 7 AM to 4 PM, six days a week. But the apprentice had to be there a half-hour early to start the wood fire, so the shop and the hot glue would be warm when the journeymen arrived. After the journeymen went home, the apprentice had to clean the shop and lay the fire for the next morning, which usually took about an hour—if he did not get into a fistfight with some of the other apprentices who weren't doing their share of the work. Usually the oldest apprentice was boss, if he was physically strong enough to stand his ground. The youngest apprentice got all the dirty work and ran errands for the journeymen, so during the first year he did not learn much except fistfighting and being persistent. After work we had to rush home, clean up and eat to be on time for night school, which was from 7 PM to 9 PM five days a week, except in mid-summer. Being that young and working that hard, you could stand on your feet and sleep whenever you got a chance.

I remember my first day as an apprentice. I was wearing a

pink shirt and a pair of jodhpurs, and my mother made sure I was washed all over and my hair was neatly combed. I had a new apron with a pocket for a ruler and one for a pencil, both filled. I was very small for my age, so when I was assigned a workbench it was too high. A platform was built so I could reach the bench. The first two or three days, nobody paid any attention to me. So I started making a knife box and was very happy until the master asked me to go to the hardware store. Couldn't he see that I was busy? I told him I was sorry, but I did not have the time—I was making a knife box for my mother. That was a big mistake. He explained very thoroughly who was the master and who was the apprentice.

As my first job, I was introduced to a big pile of mahogany with bark on all the edges, which had to be ripped, jointed and glued together, then flattened and planed to thickness and width, cut to length, and all the edges molded. Everything had to be done by hand. It took about three months. At first my arms hurt so much I could hardly scratch, but after a while I got used to it and developed some arm and shoulder muscles, which came in handy in arguments with the other apprentices. When I was finished I knew how to handle a saw and a plane and how to sharpen both.

The first couple of years I hated every minute and was planning to run away, which, thank heavens, never happened. Today I am very happy I stuck it out, and if I had to do it over again I would. You quickly learn to take care of yourself and stand your own ground, and to put in an honest day's work. I did not learn much about design, except what could be picked up from the pieces made in the shop. But that was as it should be—I can't see how people can design anything if they don't know the material.

In the fifth year the apprentice had to make a journeyman's piece, which was usually not of his own design. First, he went to the school for three days to make a complete set of drawings under strict supervision. The drawings were judged and graded, then the apprentice went back to the shop to build the piece. All the pieces had to be kept around the bench while he worked, and an inspector might walk in at any time to see that nobody was helping him.

Then the apprentices in all the trades who were graduating that year brought their finished work to the town hall, where it was judged and exhibited to the public. The jurors were usually architects, masters from the guild and a representative, in my case, from the cabinetmakers' union. The judging was done very carefully. In the case of furniture, each judge had a mirror on wheels with a long handle so he could see the bottom of the piece. If there were any drawers the same size, the judge might shift them around and turn them upside-down and still they had to fit perfectly.

If for some reason the journeyman's piece did not pass, the case would be taken to court. Several of the journeymen who had worked in the same shop would have to appear, along with the apprentice and the master. If it was found that it was the master's fault, the apprentice would be sent to another shop for whatever time the judge thought necessary to complete his education. The original master would have to pay the apprentice a journeyman's salary while he was completing his education. If it was proven that all the potentials for learning had been present at the shop, the apprentice had to pay for the rest of his education himself. So there was a good guarantee that the apprentice became a skilled workman.

There are a lot of reasons why a system like this would not

work today. First, when a student finishes high school he is about 18 years old and usually not willing to sign a contract for five years. Also, the Labor Relations Board would insist that the apprentice be paid the minimum wage. I think five years was too long and four would be enough, but I would never take any apprentice for less than four years. In the first year or two the master, if he is honest and not just looking for cheap sanding labor, would have to spend a lot of time with his apprentice plus pay for the materials the apprentice ruined. So the first year or two are usually quite a loss to the master. The third year the apprentice might be able to pay his own way, and in the fourth year he might begin to pay back what the education had cost the master. So some form of contract is necessary to make sure the apprentice doesn't walk out after the first year.

Today we seem to have too many over-educated people and not enough jobs to go around. I get a lot of letters, phone calls and people coming to see me who have a very high college degree but have found that they do not want to continue in the career for which they were educated. Many would be willing to work for nothing as apprentices. But they quickly discover that few craftsmen can afford to take on an apprentice, especially one who is likely to leave after one year. A few colleges have started apprenticeship or intern programs, and many universities have added a craft program to their curriculum ("Woodworking Schools," Spring '77, pp. 62-63 and Summer '78, p. 83).

Yet there is a great need for highly skilled craftsmen, not so much for designer/craftsmen, but for people who enjoy and are proud of making a beautiful thing even if they did not design it themselves. There are very few places today where a person can learn a skilled trade. I think that some kind of apprenticeship program is needed for these people. And this doesn't mean that a person going through such a program couldn't later become a designer/craftsman.

One way an apprenticeship program could work in our society would be for the apprentice to pay a small tuition while learning, and the time might be cut to two years if everything he makes belongs to the master and is of the master's design. To guide an apprentice to a master capable of training him, some organization like the American Crafts Council might inspect the shops that wish to start a program. The qualified shops could be given certificates. A book of guidelines for apprentices, listing all the certified shops, could be made available and kept up to date.

As I write I realize that this is not a new idea, but actually the way the old craft and art schools started. An established artist or craftsman would take in apprentices, who usually lived with him and did a lot of labor to pay for their keep and education—in effect, tuition. Sometimes a master would accept too many apprentices and would have to hire a book-keeper or administrator to keep track. The thing would grow, more administrators would be added, but the master was still the teacher and the backbone of the program. Out of that grew what today we call schools.

The conference I attended last spring was held at the State University of New York at Purchase, sponsored by the American Crafts Council and the Daniel Clark Foundation. The foundation, with funding from the National Endowment for the Arts, plans next year to publish the proceedings in a book. I don't think they solved the problems, but they might start some people thinking. □

EDITOR'S NOTEBOOK

Of oil finishes, clocks, meetings and machines

by John Kelsey

The solvent benzene (benzol) enters the body as fumes inhaled along with air, and also directly through the skin. It has been found to be a long-term carcinogen that attacks blood cells and can cause leukemia. The U. S. Department of Labor has testified that there is no safe level of exposure. An emergency regulation issued last spring (and now embroiled in the courts) limits industrial exposure to an average of one part per million of air over eight hours, with a ceiling level of 5 ppm for any 15-minute period during an eight-hour day. These limits are so low that by the time you smell the solvent, you are overexposed.

Several readers have asked whether the popular penetrating oil finishes contain benzene. We therefore wrote to the presidents of the companies that make Watco Danish Oil, Minwax Antique Oil, Constant Penetrating Finish, Sealacell and Waterlox Transparent Oil. We asked them to list the ingredients in their finishes and to give safety advice to both the woodworker and the owner of a finished utensil for food.

One of the products (Minwax) definitely contains benzene. The Minwax people said only, "... we are well below the limits of benzene as stated by the Consumer Product Safety Commission." We don't know whether Waterlox and Sealacell contain it, because the manufacturers didn't answer our letter. Watco Danish Oil and Constant Penetrating Finish do not contain benzene, the manufacturers say, although Constantine does not recommend its varnish-based product for food utensils, suggesting instead its lacquer-based Wood Bowl Seal.

Watco-Dennis Corp. went on to say that food utensils and children's toys or furniture finished with Watco should not be used until "the polymerization process is completed, which requires about 30 days. . . . At the end of this period evaporation of certain ingredients has been completed, leaving a solid, nontoxic surface about 25% harder than the original wood." We asked what those "certain ingredients" are, and why this caution isn't printed on the label. Watco replied that it is a "petroleum distillate—the vehicle which enables our solids to penetrate into wood pores. . . . If we tried to cover every eventuality and every possible use, we would hardly have room for our name." They also said, "Since it is rarely less than 30 days from the woodfinishing process to the sale at the retail level, there is really no problem."

Dr. Derek J. de Solla Price, professor of the history of science and medicine at Yale University, contributes a footnote on wheel layout for clocks and other jobs requiring exact division of a circle or cylinder. Simply wrap a paper strip once around the wheel blank and mark the circumference, then unroll the strip and divide the circumference by dropping parallels from an angled line of known length, as in setting out dovetails. Reader Raymond Levy of Mountain View, Calif., also notes that *Machinery's Handbook* (Industrial Press, 200 Madison

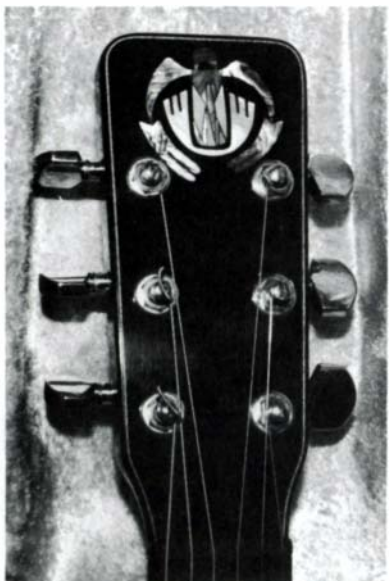
Ave., New York, N.Y. 10016) contains tables called Grant's Odontograph for laying out gear profiles of both cycloidal and involute teeth. Says Levy, "The tables were derived many years ago for making wood patterns for cast gears and are entirely adequate for wooden clocks."

Three interesting and timely meetings were held in September: an annual convention of guitar-makers, the first meeting of a regional woodworker's association, and an organizing meeting toward a woodworkers convention. Details on these three meetings follow; if woodworkers elsewhere are organizing, I'd like to hear about it, to inform our readers.

About 200 of the 850 members of the Guild of American Luthiers met for five days in Winfield, Kansas. Most of them are professional builders of guitars, mandolins, banjos, dulcimers, lutes and harpsichords, men and women of all ages from everywhere in North America. I stopped there for a day and a half and was able to hear a harpsichord concert and lectures on how the maker can control the tone of an arch-top guitar and on violin harmonics and acoustics, to tour a small guitar factory, and to see a movie on guitar making. I missed sessions on shell inlay, commercial guitar manufacture, classic guitar design principles, soundboard theories, carving, and fretting. Each afternoon about 50 of the luthiers spread their work around an auditorium and everyone mingled—comparing techniques and results, playing and listening, arguing and inventing. Next year's convention will be in Boston, probably during August, and any Guild member can attend. A \$10 annual membership includes a subscription to their quarterly journal. Write G.A.L., 8222 South Park Ave., Tacoma, Wash. 98408.

About a dozen Vermont and New Hampshire craftsmen met in mid-September to organize the Northern Woodworkers, an educational and marketing association. They agreed to meet monthly and to bring their friends, to develop discussion/workshops on such technical topics as adhesives, jig-making and bookkeeping, and to investigate such ideas as juried group shows, sales catalogs of members' work, cooperative buying of tools and wood, and cooperative sharing of big jobs among several small shops. The first meeting was held at the shop of Charles Herman, 250 Bank St. Extension, Lebanon, N.H. 03766, and you can write him there for more information.

A group of East Coast woodworkers held a preparatory meeting in September to plan a conference for next spring called, "Wood '79: The State of the Art." Organizers Andrew Willner and Lester Rishel say the focus will be on topics of concern to professional woodworkers, although serious amateurs may also attend. Subcommittees have been formed to develop programs on marketing finished products, health and safety, design, tools and techniques, and wood as a material. Within each area, the organizers hope to have large



Left, abalone shell and mother-of-pearl inlay, in a Hopi Indian design, by David Russell Young, shown at Guild of American Luthiers convention. Young, like most contemporary luthiers, cuts his inlay material with a fine-blade jeweler's fretsaw, then scribes its outline on the ebony guitar headstock. He routs the recess with a small Dremel grinder, using $\frac{1}{32}$ -in. end mills, and sets the shell pieces in a bed of epoxy glue dyed black. This beautiful arch-top guitar, right, was made by Bill Collings of Houston, Tex. The arch-top is built like a violin or cello, although it is not played with a bow. It was originally developed to increase loudness, so the guitarist could be heard amidst a dance band. By 1935, the electric guitar had solved that problem, but the arch-top continued to find a market among jazz musicians because it produces a warm, balanced sound.

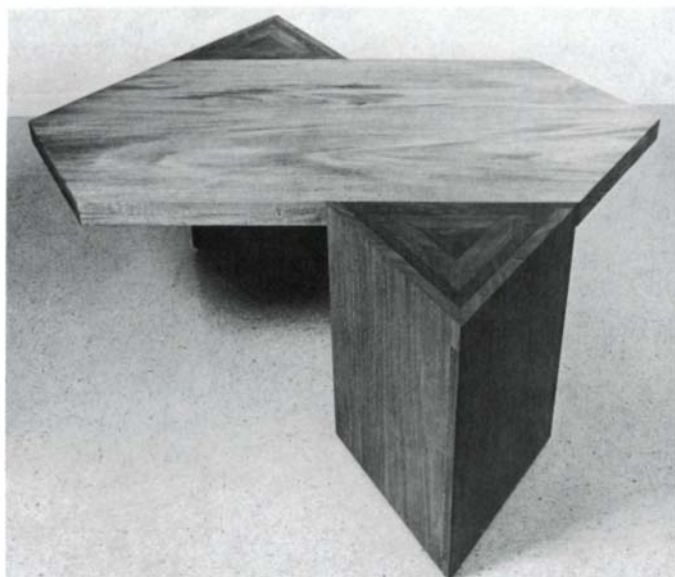
This mahogany dining table made by John Bryan of the University of New Hampshire won the \$1,000 best-in-show award at the annual student furniture design competition during the International Woodworking Machinery and Furniture Supply Fair in Louisville. The two triangular pedestals are cabinets with shelves for tableware; each measures 24 in. on a side, as do the short sides of the hexagonal top. The grain runs vertically in the top, bottom and shelves of the pedestals, so the visible surfaces are end grain. Bryan made them by assembling a large triangular prism of solid mahogany and slicing off the sections he needed.

panel discussions, small seminars and hands-on demonstrations and workshops. There will also be manufacturer's displays and an invitational exhibition of first-rate contemporary woodworking. The conference is scheduled for the weekend of May 31 to June 3 at Pennsylvania State University in State College, Pa., the cost will be \$50 or less, and there will be room for about 500 people. For more information as the planning proceeds, contact Lester E. Rishel, 112 Forest Resources Laboratory, University Park, Pa. 16802.

The International Woodworking Machinery and Furniture Supply Fair held every September in Louisville, Ky., is the world's largest industry show and truly mind-boggling. The 700-plus exhibitors manufacture and sell every imaginable sort of woodworking machinery, tool bit and cutter, upholstery material, furniture part and piece of hardware—and they roll it all out for the five-day extravaganza. The only hand tools I saw were wrenches wielded by mechanics, but there was power machinery for every woodworking application,



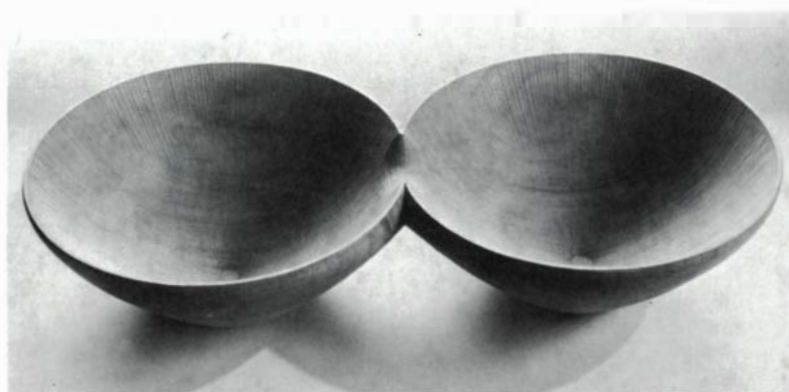
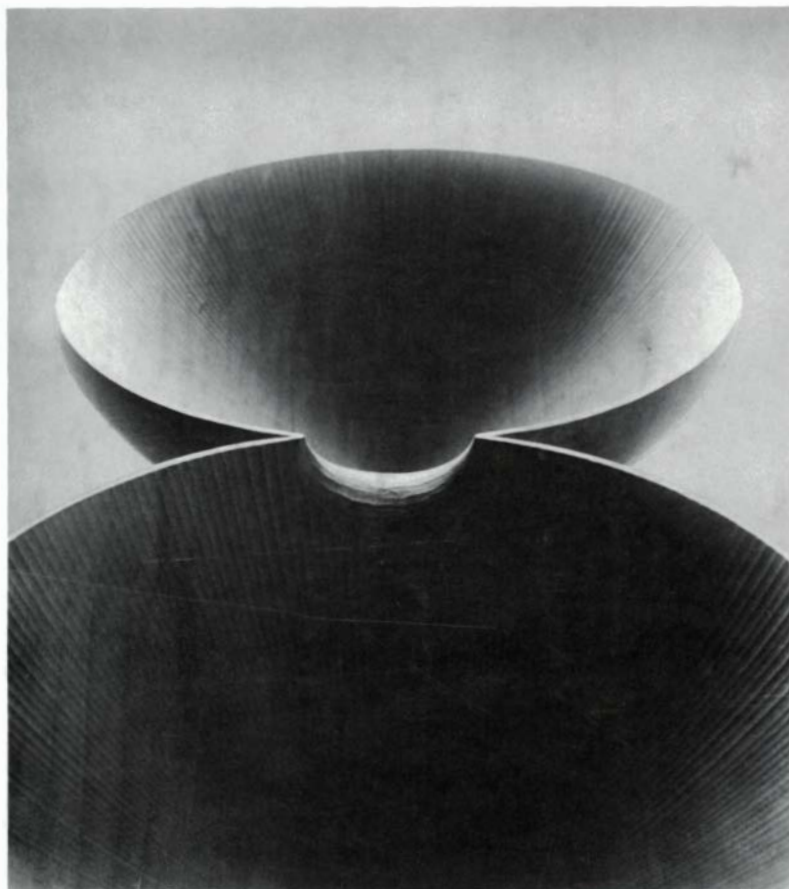
Dean Santner of Emeryville, Calif., displayed his giant rocking serpent at the annual Pacific States Craft Fair in San Francisco in August. Santner stacked the beast from 300 layers of Russian birch plywood, roughed out the shape by chain saw, then finished off with mallet and gouges. The 7½-ft. rockers are laminated walnut cut from a 4-in. plank. Santner has donated it to Aid to Adoption of Special Kids, an organization which tries to place normally unadoptable children, and it will be the prize in a raffle to be held in December. About 400 craftsmen—32 of them woodworkers—had work for sale at the fair, an offspring of the American Crafts Council.



from the production-line behemoth that takes boards in one end and spits finished cabinet parts out the other, down to the stationary machines an independent cabinetmaker needs.

The innovations the industry enjoys rarely reach the consumer tool market. I was particularly impressed by the enormous variety of air-powered tools, from routers, grinders and sanders (including a pneumatic rolling-pin sander that looks like it would follow almost any contour) to clamps, nailers and staplers. I saw a Japanese surfacing machine that works like a hand plane, taking a single shaving the length and width of a board. And the Italian SCM firm, which makes the shaper mentioned by Jim Krenov in his books, has merged with Rockwell International.

The fair is sponsored by the National Association of Furniture manufacturers and the Woodworking Machinery Manufacturers of America. It's not for the faint-of-wallet, unless you'll be in Louisville anyway and want only to be overwhelmed. To find out about next year's fair, write to the fair office at 600 Talcott Rd., Park Ridge, Ill. 60068. □



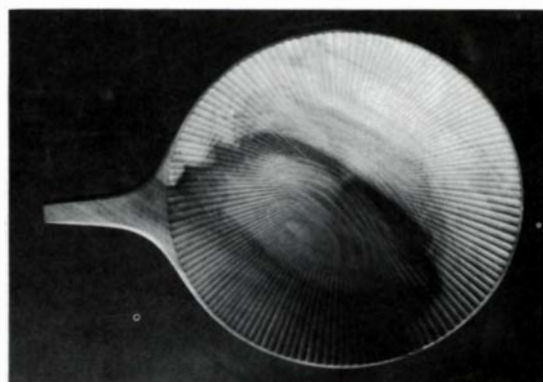
On Workmanship

David Pye, retired professor of furniture design at the Royal College of Art in London, recently showed an assortment of turned and carved boxes and bowls at the British Craft Centre. He has written two remarkable books about design and workmanship, which are reviewed on page 24 of this issue. The work shown here is a small part of his effort, in his retirement, to explore and illustrate his concepts of workmanship.

Pye rejects as futile the usual distinction between handmade and machine-made, proposing instead the distinction between "workmanship of risk" and "workmanship of certainty." In the former, the result is constantly at the mercy of the maker, and a single careless move will spoil it. In the latter, once the tools are properly set up, the result is guaranteed. Most woodworking, whether with hand tools or machines, is workmanship of risk.

Pye further distinguishes a spectrum of workmanship: from highly regulated, through free, to rough. In highly regulated work, there is no evident disparity between the idea and the result, as in most mass-produced goods. Most fine cabinetwork would be defined as moderately free—there are always slight discrepancies between the idea and the reality—and most carving, where precise repetition is avoided, is free workmanship. Rough work is just that, although rough isn't necessarily bad.

The small turned boxes shown below are highly regulated, but were nonetheless produced by the workmanship of risk. The pattern is made by ornamental turning attachments to the lathe, but these jigs still must be used with enormous dexterity, gradualness and care to yield the flawless surface. The carved bowls, on the other hand, exemplify moderately free workmanship. Once the bowl has been formed with conventional carving tools, Pye uses a levered arm to guide the gouge through its arc. This jig hardly reduces the risk of spoiling the surface pattern at any moment.



Fine Woodworking® Index

This index covers the first thirteen issues of *Fine Woodworking*: Winter '75 (No. 1), Spring '76 (No. 2), Summer '76 (No. 3), Fall '76 (No. 4), Winter '76 (No. 5), Spring '77 (No. 6), Summer '77 (No. 7), Fall '77 (No. 8), Winter '77 (No. 9), Spring '78 (No. 10), Summer '78 (No. 11), September '78 (No. 12) and November '78 (No. 13). The issue number is listed first, followed by a colon and page references.

The index is divided into one main section, *Information*, and three supplementary sections: *Authors, Makers and Personalities*; *Photographs*; and *Books Reviewed*. Bold-face page numbers in *Information* refer to major articles. For easy reference, many of the entries in this section are grouped under the following general subject headings: carving, design, finishing, joinery, planes, tools, wood. For example, look for dovetails under joinery.

We've printed this index as a center insert so you can remove it, if you wish, for ready reference. Hold the magazine firmly on the table with one hand, and with the other grasp both index pages firmly. Sharply yank them straight up, the way you would remove a Band-aid.

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