Fine WoodWorking

Edward Barnsley

MAY/JUNE 1979, NO. 16 $2.50

Fine WoodWorking®

MAY/JUNE 1979, NUMBER 16

DEPARTMENTS

ARTICLES

Cover: Jubilee writing cabinet, designed by Edward Barnsley of Froxfield, England, and made in his workshops for the 25th anniversary of Queen Elizabeth's coronation (1977). The wood is English walnut, a lighter, warmer brown than the American species with more variety in its color. The flame-figured panels are book-matched from crotch wood. More about Barnsley and this cabinet on page 38. Cover photos: Harold Lowenstein.

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I was interested in Rick Silberman's letter ("You get what you pay for," Jan. '79) and until recently would have said Amen. After fighting with a medium-priced power saw, jointer and sander for years, I decided to invest in the reputed top-of-the-line equipment. So out went Sears and in came all new Powermatic tools. I've now got the same old problems in cast iron, instead of die castings. The saw didn't tilt to 45°, because the trunnion hit the cabinet and table, the fence is warped, the blade isn't parallel to the table at 45° and 90°, etc., etc. Oh yes, the manufacturer is sympathetic and the dealer hopes I'll go away, in vain I might add.

My most satisfactory tool is a 40-year-old Yates-American lathe I've refurbished to a smooth-running, versatile unit. My advice to purchasers is to look for the old gear and plan on reworking it, then you'll get something for your money. If you cannot buy the old pieces, save yourself some headaches and money and buy new with the resignation the tools will be unsatisfactory until you rebuild them.

I would like to see a column devoted to tools for woodworking. You cover the area of the material we use, now we need a no-holds-barred, from-the-user section. For example, it's getting fairly common that many are buying used metalworking tools for woodworking. The accuracy left in a worn-out metalworking tool will far exceed any current crop of new woodworking tools and give accuracy far beyond the stability of our favorite material. . . .

—Lawrence Churchill, Mayville, Wis.

I am a bit surprised you published "Stalking Mesquite," (March '79) by Stanley T. Horn without checking. . . . First, the wood he refers to is not mesquite, nor does mesquite have the alternate name for ironwood. His wood could only be desert ironwood *(Olneya tesota)*. Mesquite is an entirely different species, though related *(Prosopis juliflora)*. Mesquite is relatively light in color, and lighter in weight than ironwood. Also it is much easier to saw.

The area Horn refers to has many dead ironwood snags. . . . Ironwood will stand frosts, but not a heavy freeze. It is obvious that this desert area at one time years ago suffered a hard freeze which killed the majority of the ironwoods.

As to the carvings he attributes to Navajo Indians, very possibly they were the work of the Seri tribe from Northwest Mexico. The Navajos may do some carving, though I have never seen any. But we have seen hundreds of Seri carvings—all made of ironwood. . . .

—Ron Brown, Prescott, Ariz.

. . . They are really two distinct species: Desert Ironwood and mesquite, with the latter being divided into two subspecies, the straight bean and the screw bean. . . . So if anyone cuts the green, hand-staining mesquite and expects it to harden into ironwood I'm afraid he will be disappointed. Both woods are beautiful and mesquite has the quaint quality of being worked up from a new planed surface to a rather blah grey tone. Expose the finished surface to a hot California sun for three or four days and it darkens to the most beautiful black walnut color you've ever seen. Ironwood, on the other hand, defies the plane but when worked to a smooth finish has a dark chocolate finish with fine gold flecks. . . . As a substitute for ebony, ironwood has life and lustre to its surface in con-

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43-927	¾" Bead
43-928	¾" Flute
43-929	1" Bead
43-930	1" Flute
43-931	6" Hor. Panel Raiser
43-932	Stair Nose Cutters
43-933	Drawer Joint
43-950	½" Cove—5/16" Qr. Rd.
43-951	5/16" Cove—⅜" Bead
43-952	⅛" and ⅜" Qr. Rd.—¼" Bead

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trast to the dull tone of even true Gabon ebony. Too bad there isn't more of it left.

—Donald A. Cook, Harbor City, Calif.

I would like to congratulate *Fine Woodworking* for printing the words of George Nakashima. . . . He is truly a man involved with the nature of life itself. The philosophy of a woodworker is just as important as his product because a product made by hand reflects its philosophy. In that sense woodworking is more than just the technology of assembling wood just as life should be more than working, eating and sleeping. George is so right when he says there is another dimension, a spiritual one, and for true accomplishments it does come first. *—Pete Bruce, Johannesburg, Calif.*

As students of the Upper Bucks County area Vocational-Technical School cabinetmaking shop, we take issue with the opinions put forth (ed. note: by George Nakashima) in the Jan. '79 issue of *Fine Woodworking* concerning the quality and worth of American training and skills. We feel that it is in poor and prejudicial taste for craftsmen to scoff at others merely because craftsmen disagree with one another as to what constitutes esthetic values. . . . If older craftsmen were not so egotistical and looked beyond their acreage, they would realize that the rest of the world still exists and that this country is pretty well saturated with modern vocational schools, staffed with professionals that do a fantastic job of teaching everything conceivable from cabinetmaking to practical nursing, from auto mechanics to agriculture to welding and lots more. This is hardly lip service or a romantic approach to our need for skills. . . .

Try scoffing at the fact that our graduate employment has always run between 90% and 100%, and that we have girls who are equally as good. . . . Youth should get their due for a change, after all, we are the future.

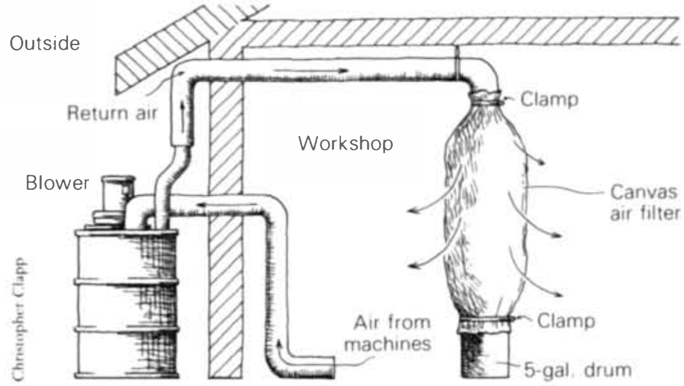
—Timothy K. Mulhall and 36 others, Perkasie, Pa.

There are several of us in this area who subscribe to *Fine Woodworking*. We all agree that you are emphasizing too much of what we call "art" and not woodworking. We strongly believe that this modernistic and impressionistic furniture has no lasting appeal and we feel it should be shown in an art magazine and not one published for a craft. . . .

As much as I enjoy your other articles I will not renew my subscription if you continue to pursue these articles. I believe you have the finest magazine going for the craft of woodworking and you are striving to destroy this image by opting to please the artists and not the craftsmen—there is a fine difference. Please show more and write more on any period furniture, but please stay away from the gaudiness.

—Mel R. Bird, Huron, Ohio

In response to building a dust-collecting system (Sept. '78) and the letter by Ron Ginger (Jan. '79), I would like to explain a system of recycling the 450 cu. ft. of warm air per minute that the blower moves to the outside of the shop. The system is similar to one manufactured by large companies, but is very simple and can be built at a very small cost. Using the same type of materials as used in piping the dust out of your basement, force the air from the exhaust outlet of the blower back into the basement and into the top of an air filter bag. The air filter can be made from heavy material found at most fabric stores, making sure the material is heavy enough and fine enough so dust particles can not travel through it. Sew the material to form a cylindrical shaft about 7 ft. long and with enough diameter so with the help of a strap clamp



the bottom will fit tightly over a 5 gal. drum. Hang the top of the filter bag from the ceiling in an out-of-the-way place in the shop and pipe the exhaust from the blower into the top of the bag. Clamp it securely so air is filtered through the material back into the shop. Shaking the bag once in a while will clean the cloth and let the dust fall into the 5 gal. drum at the bottom, which when full may be dumped outside.

—Leonard Schoettmer, Jr., Greensburg, Ind.

I was happy to see you "plug" Sam Willard at Willard Brothers Woodcutters (Trenton, N.J.). Never mind his prices, it's the spirit of the endeavor that matters. I have been doing business with him for a couple of years and have not complained once. . . .

About the article by Steve Voorheis (Nov. '78) on the End Boring Jig: Anyone who has been taken with the notion as I was, and has tried to build up this piece, has doubtless come up against several shortcomings the article failed to mention. Firstly, a 9-in. veneer screw is too short for the dimensions given. A 10-in. model is essential for that size back panel. I shimmed mine out with a 1-in. liner to avoid starting all over again (which I'll have to do anyway), but that only further restricts the travel or throw of the table to about 1⅝ in. Use of a 10-in. press would give you a little over 2½ in. Even at that, the rearwards motion is halted by the swing of the press handle and I question the time it took to build versus the limited table travel. Beginners will also be chagrined to discover that. . . the press hardware does not fit within the housing members, and much grinding and filing is required. . . .

—H. Ivan Hentschel, Kingston, N.J.

In Nov. '78 you ran an article concerning the grading of lumber. As an author's note you show the *Rules for Measurement of Hardwood and Cypress Lumber,* which we publish, at a price of $1.00. For several years now the price has been $2.00.

—S. Carroll White, National Hardwood Lumber Association
332 S. Michigan Ave., Chicago, Ill. 60604

Re the article by George C. Gibbs (Jan. '79) on restoring Bailey planes that have the wood bottoms. The article is full of very fine information on how to restore one of these old type planes but I would like to give a word of caution: If you do wish to restore one of these planes do some checking first, because some of these planes are quite rare and should not be changed in any way. I am a collector of old woodworking tools and also of Stanley-Bailey planes, and to a collector some of these are worth more than others. Just throwing away the old wood bottom that has the plane number stamped on the front of it could be a mistake. This old bottom can never be replaced or duplicated and its loss makes the plane worthless. Some of the numbers, like Nos. 21, 25 and 37, are hard to find and a tool collector would trade several of the more common types in fine condition for just one of them. Stanley-

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Bailey made 23 different kinds of wood-bottom planes and there are still many around. Just save all the old parts. . . .

—Ivan. E. Bixler, Goshen, Ohio

. . . on page 17 of your Jan. '79 issue there is an item by David Raynolds illustrating a rather cumbersome method of attaching clamping blocks to pipe clamps. A much simpler method is to simply glue—with epoxy glue—the blocks, be they cork, leather or wood, to the clamp faces.

—Paul Liechdy, Albuquerque, N.M.

Using an old shoe to store files (Methods, Mar. '79) is the worst thing for files. Files are very hard and the best way to ruin a file is to bang it against another file. If you store files properly they will last a lifetime. Nothing is worse than a dull file. Also, they should never be oiled. If oiled they will slip and hurt the hand. Also, all files should be handled. A tang through the hand is horrible. . . . The best way to store files is in a flannel cover just like a precision instrument. If they are stored in a drawer, like chisels, use a slotted board to keep them separated.

—Douglas R. Smith, Miami, Fla.

Reference has been made. . . to the use of compressed air for blowing the sawdust and shavings out of woodworking machinery. As an amateur home-woodshop practitioner for some 50 years, I have always had the feeling that a blast of compressed air in a woodworking machine could force foreign material into machine and motor bearings. Instead, I have always used a hand bellows, as found in early blacksmith shops or as used to start a fire in the fireplace. It is adequate for removing dust. Also, when in use you do not have to pull along an air hose.

—Frank L. Sahlmann, Erie, Pa.

In Nov. '78 I note your suggestions as related to photographing wood or items produced from wood.

As a retired photographer please allow me to comment. Exposures should be "full" or in other words, according to the readings from a proper light meter and read under "incident" light. If "reflected" readings are used, a standard gray card is recommended.

A very important factor in black-and-white photography of woods or wooden items is to absolutely utilize a filter approximating the color or shade of finish of the wood. That is, pine through light oak calls for a light yellow filter. Mahogany and lighter walnut, stained birch, etc., an orange filter. Dark woods call for the use of a red filter. The proper adjustment of exposure factors is of course necessary. Literature accompanying filters will supply this information.

Normal processing is ample to utilize the full tonal range of the films and. . . the proper filter will show the grain detail as our eyes see it. . . . Eastman Kodak publications concerning studio-product photography are highly recommended. . . .

—Robert Osbahr, Tucson, Ariz.

Re "molding shapers should run over 10,000 rpm," it would be more accurate to say the surface speed in feet-per-minute should exceed 10,000. For example, a portable router with a 1 in. diameter, 2-blade cutter, at 25,000 rpm, is moving around a 3 in. circumference for 75,000 inches/minute/blade or 18,750 blade-feet-per-minute: a fixed shaper with 1 in. diameter, 3-blade cutters, at 9,000 rpm is moving around a 6 in. circumference for 54,000 inches/minute/blade or 13,500 blade-feet-per-minute. Finally, the molding attachment for a radial arm saw is 5 in. diameter, 3 blades, 3,600

rpm, 54,000 inches/minute/blade and 13,500 blade-feet-per-minute. . . .

All my chisels, plane irons, planer and jointer beds are free of rust, by converting the surface of the steel to iron phosphate, which cannot rust. This is done by the same process used on auto bodies under the paint, called "phosphatize." One is made by DuPont Automotive Refinishing Products and sold through auto-paint stores as a concentrate, No. 5717S. Add distilled water per instructions, store in another bottle, and simply wipe on clean metal, wait a few seconds, and wipe off. . . .

—R.A. Sykes, Thousand Oaks, Calif.

. . . William Woods (Nov. '78) ably discusses the virtues of pure, untreated tung oil as it comes from the tree much like raw linseed oil. However, he quickly dismisses the qualities of processed tung oil as "commercially thinned" oil that is useful but somehow less desirable than untreated or "pure" tung oil. Processed oil, though a treated oil, remains tough and durable. It is available to the woodworker in two forms: tung seed oil and polymerized tung oil. Tung seed, a natural, refined oil, and polymerized, a heat-treated oil, have volatiles and drying agents added to give them more stability and fluidity. Tung seed gives maximum penetration, and its fluidity makes it easily worked to set up a strong base that becomes part of the wood. I often use it for the first two coats in the finishing process and follow it with polymerized, a harder, more concentrated oil. Polymerized yields a greater sheen, more depth and extra protection as a result of heat-treatment, which causes a cross-linking of molecules. . . .

Another bonus that I have found in processed tung oil is its guaranteed shelf life when stored properly. Woods' storage suggestions are excellent. However, I use tung oil in large quantities and in cans which, of course, can't be squeezed to rid them of air. To raise the oil level, one can add clean rocks or marbles, but in most cases I add water, which sinks to the bottom of the can.

I agree with Woods as to the rapid drying qualities of tung oil. However, experience has taught me that drying time also plays an important part in obtaining a desired sheen. At least eight hours or more, depending upon weather conditions, should be allowed between coats. . . . I have also found, contrary to Woods' findings, that tung oil can seep out and bead and thus should not be left directly in the sun. When beading does occur, simply dip steel wool in tung oil and rub the beads off, being careful to wipe off the excess.

...Woods and I also differ as to tung oil's effect on wood graining. Tung oil will raise the grain of the wood. In fact, that is one of its beauties, because this allows it to be steel-wooled wet or dry, depending upon how much of a burnished look one wants. Furthermore, steel-wooling is the most important step in finishing with tung oil, not only to control the sheen but also to create a hand-rubbed look. The first coat should be thoroughly steel-wooled, and each succeeding coat also, though one does not need to steel-wool as thoroughly....

—Frank Welles, Sutherland Welles Ltd. Woodbury, Conn.

...It would be a disservice if I didn't rebut the Wendy Hays letter (Jan. '79) warning readers away from potassium lactate as a leather preservative. Ms. Hays says that it is not well known or generally recommended. The facts are:

As a result of concern about deterioration of modern leathers, the British Museum, in connection with the Printing Industry Research Association, conducted a series of experiments. It was discovered that leather picks up sulfur dioxide (which is to be found in sufficient quantities in the atmosphere even 50 miles from cities).

While lac, cellulose and acrylic finishes are effective barriers, they keep all effectiveness only so long as the film does not crack but cannot arrest chemical decay even when intact. Neat's-foot oil makes leather supple but likewise does not arrest decay. Some decay is caused by the natural action of the leather, which forms sulfuric acid by absorption or oxidation.

Only potassium lactate 7% aqueous solution has been found effective in arresting the formation and accumulation of acid in leather.

—Sandy Cohen, Albany, Ga.

Re reader Theodore Romaine's query about stocking a gun (Q&A, Nov. '78), Monty Kennedy has written an excellent book on the subject, entitled *Checkering and Carving of Gunstocks* ($14.95 from Stackpole Books, Cameron and Keller Sts., Harrisburg, Pa. 17105).

Checkering is not accomplished with chisel-type carving tools but rather *V* and *W* rifflers, which are commercially available or easily homemade. Ninety percent of the job is done with the *W* riffler, which automatically spaces the new groove from the previous....

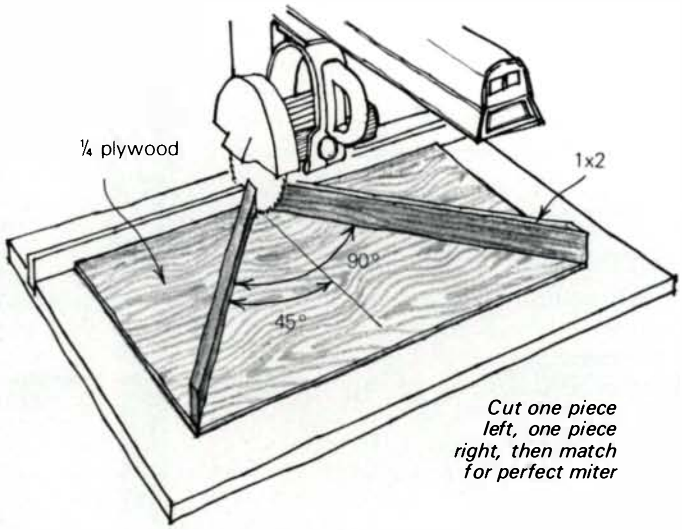
—A. E. Motzer, Bellows Falls, Vt.

Methods of Work

Miter jig

With this fixture I can make tight, clean production-run miter cuts on my radial arm saw. Those of us who can't always take time to readjust and tune our saws realize they work out of true. The miter jig overcomes this because any error on one piece is compensated by matching error on the other.

To make the jig, glue and screw two 1x2s to a sheet of ¼-in. plywood about the size of the saw table. The 1x2s are fastened 45° from the line of the saw cut. Care with the orientation of the miter fences improves the device—a 45° plastic drafting triangle will be helpful. The fixture can be clamped to the saw table or made as part of a permanent fence.

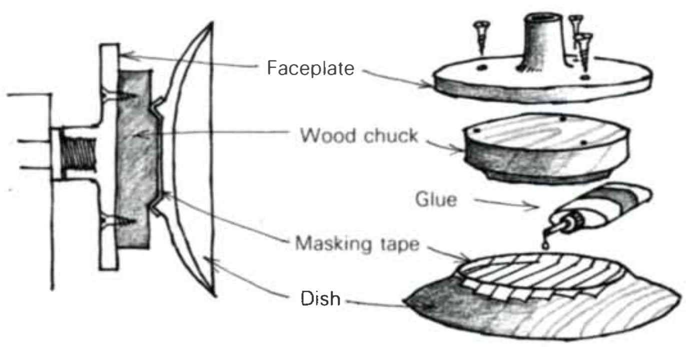


To use, clamp the fixture on the table (or in the fence channel if the fixture has a permanent fence). Cut one piece left and one piece right. Match these cuts and a perfect fit will result. —*C.H. Dimmick, Sparta, N.J.*

Taping bowls to faceplate

I use a faceplate-fastening method for shallow bowls or dishes for faster and cleaner separation of the finished piece from the faceplate. There is no glue and paper to remove as when the work is glued to a piece of scrap wood with paper between. Nor are there any screw holes to fill as there are when the faceplate is screwed directly to the turned piece.

Screw the top side of the turning blank to the faceplate and turn the bottom of the dish with a recess to accept a wood chuck. After the bottom of the dish is sanded, I apply a polyurethane finish. Next, attach a scrap block of wood to the faceplate and turn it until it fits snugly into the recess on the bottom of the dish. Apply masking tape to the bottom of the dish over the recess in a single layer. Rub the tape with your fingernail to remove air bubbles. Now glue the scrap wood



chuck (which should fit snugly in the recess) to the taped recess in the bottom of the dish. When the glue is dry, mount the dish-faceplate assembly on the lathe and finish turning.

To remove the dish from the scrap wood chuck, place the chuck in a vice, and, using both hands, gently twist the dish until it separates from the chuck. Alcohol will remove any adhesive left from the masking tape.

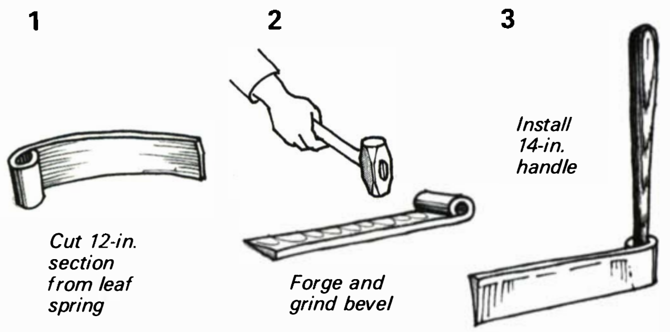
—Dennis Castagna, Southfield, Mich.

Homemade froe

The froe is a traditional tool for cleaving green wood that's enjoying a revival due to a renewed interest in "country" woodcraft. But the tool is rarely found through antique tool sources (I've never seen one) and new froes cost $23. Fortunately, for those of us with more time than cash, an excellent froe can be forged from a discarded auto spring.

Old leaf springs are easy to find behind auto garages and in junkyards. The springs are about the right thickness and width for a froe and are excellent steel. The bottom leaf of the spring cluster has an eye on each end. This is the leaf you're looking for—the eye serves as a ready-made handle socket.

To make the froe, cut a 10-in. to 12-in. section off one end of the leaf, straighten the curve, and forge or grind in a knife-



like bevel on one edge. Lacking blacksmithing tools, I cut the spring with an oxyacetylene cutting torch (an abrasive cut-off wheel would have worked as well). Then, with a helper to hold the torch, I heat the blade red hot, forge a bevel on one edge and straighten the curve on a makeshift anvil. The bevel is completed on a grinder. Next, I harden the blade in oil and temper to light blue. A 14-in. black locust handle driven in the handle socket completes the froe.

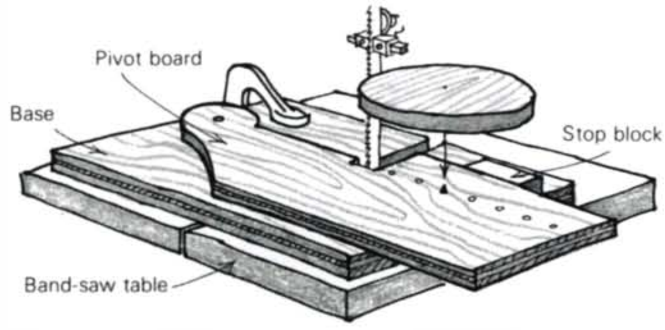
A more skillful blacksmith probably would have enlarged the smallish socket and bent it to be in line with the blade. These operations seemed beyond my skill and equipment. But, in using the froe, the socket size seems adequate and the offset increases splitting leverage in one direction.

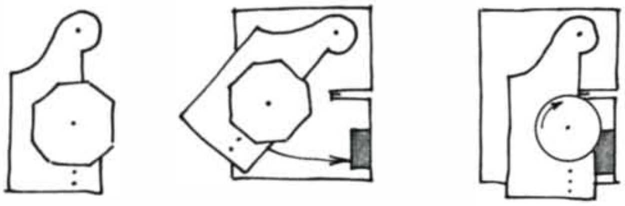
—Larry Joseph, Alva, Okla.

Cutting circles—revisited

I made Larry Green's band saw circle-cutting jig as described in *Methods of Work* (Spring '77). I found it was difficult to set blanks on the jig in the desired center. So, I built a pivoting jig that solves this problem and has other advantages.

The jig, made of plywood, has a base, a pivot board and a stop glued to the base. To use, clamp the base to the saw table so that the pivot pin and the circle holes are lined up with the front of the saw blade. Pull the pivot board off the base, install a pin in the desired circle hole and center a blank on the pin. Fit the pivot board back on the base, swinging it back clear of the saw blade. Now start up the saw and swing the pivot board into the saw blade, which will cut a reverse circle in the scrap area of the blank. When the pivot board hits the stop, rotate the blank to cut the circle.





Place blank on pivot *Swing pivot into saw* *Turn blank*

An advantage of the jig is the ease of changing circle diameters. Just pull off the pivot board and reposition the circle center pin—there's no need to remove the whole unit.

—*Jerry Elvin, Nezperce, Idaho*

Setting a saw fence

I have always found it awkward to set the rip-fence of a table saw parallel to the blade using a ruler or tape measure, because I have to crane my neck over the saw table to read the measurement at the back of the blade. Also, using both edges of the tape or ruler, which may not have the same unit of measurement, can cause confusion. I now use a large set of inside calipers with a maximum extension of 12 in. for cuts within that range. I have ground the tips of these calipers to give a minimum reading of 1/4 in. The calipers are set to the desired width of cut, and by alternately placing them between the fence and the front and rear of the blade, I can not only see any necessary adjustment but also feel it.

—*Kent McDonnell, Newcastle, Ontario*

Sheet metal screws faster in wood

As builders, "time is money" to my brother and me. We've discovered that replacing standard wood screws with Phillips-head sheet-metal screws results in a faster and stronger job in building applications. I have never felt the standard wood screw had the strength we needed. So, we started using pan-head sheet-metal screws which, because of their deep thread and straight shank, had greater holding power, but couldn't use them for all applications because of their appearance.

Sheet-metal screw Wood screw

Then by accident, one of our carpenters brought a box of flat-head Phillips sheet-metal screws on the job. Since then we've used nothing else. On an average house we use 2,000 screws. We fit a commercial-duty 3/8-in. variable-speed drill with a Phillips Yankee Screwdriver bit and start plugging away. This approach is fast, easy and gives strong results.

I don't understand why sheet-metal screws aren't a standard in woodworking procedure—perhaps it's because many

lumberyards and supply houses don't carry the screws. Sheetrock screws are similar (they have a finer thread) but are also relatively hard to find.

—Jeff Tallman, Weston, Conn.

EDITOR'S NOTE: Screw manufacturers and fastener suppliers echo Tallman's observation. A representative of a Chicago-based company commented that sheet metal screws are made of stronger, case-hardened, medium-carbon (1022) steel. The threads are "rolled," which results in denser, stronger work-hardened threads. Metal screws typically have one or two more threads per inch and are threaded right up to the head. On the other hand, wood screws are made of soft, low-carbon (1010) steel. Threads are "cut," which "opens the pores" of the steel and results in weaker threads. The representative felt the unthreaded shank was more of a nuisance than a benefit. His personal opinion was "wood screws are inferior—the only reason they continue to be used is ignorance."

One disadvantage of metal screws is that, in continuous use, the case-hardened heads eat up the drivers, but the case-hardening step can sometimes be skipped on special request to reduce driver wear.

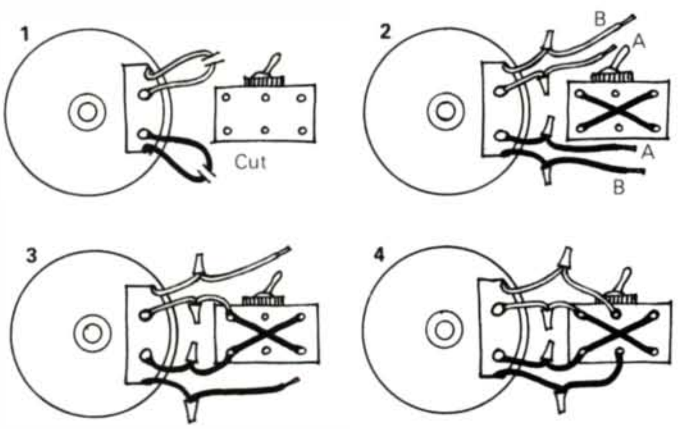
Shoe-polish stain

Ordinary wax-based shoe polish makes a good stain and filler for open-grained woods such as walnut and oak. In a small jar, mix a chunk of polish with enough turpentine to liquefy, then rub the liquid in and wipe off as you would with regular stain. Several shades are available—I like the black with walnut. The coating won't interfere with subsequent finishing.

—Carl R. Vitale

Reversing switch

Occasionally I find it necessary to reverse the motor on my Sears shaper and other tools. But reversing switches are expensive ($39 for the one Sears sells) so here's how I made my own for $1.59. Buy a 10 ampere, 125 volts a.c. double-pole, double-throw switch from an electronics supply house (I used Radio Shack Cat. No. 275-1533). Refer to the motor instruction manual to locate the wires that can be switched to reverse the motor. You'll splice the switch into these so cut them and add 6 in. or 8 in. of #16 wire to each end. This gives you two sets of wires which are labeled set A and set B in the diagrams. Cross-connect opposite end posts on the switch. Then connect set A to one set of end contacts on the switch and set B to the center set of contacts on the switch.



The whole project takes only about 45 minutes. The 10 amp switch is really overrated—but safe.

—Jon Gullett, Washington, Ill.

Methods of Work is a forum for readers to swap tips, jigs and tricks. Send details, sketches (we'll redraw them) and negatives with photos to Methods, Fine Woodworking, Box 355, Newtown, Conn. 06470.

Q & A

How dangerous are chemical products used to strip old finishes? Many over-the-counter stripping mixtures contain toxic chemicals, and a flood of mail shows that readers are concerned about possible risks to their health. Generally, commercial strippers are available in two types—nonflammable (usually based on methylene chloride), and flammable (usually a mixture containing benzene, toluene or methylene chloride). We recently suggested methylene chloride as a safe replacement for benzene, but readers (some enclosing clippings from *Consumer Reports* and the *Journal of the American Medical Association)*, say otherwise. We put the question to Dr. Michael McCann, president of the Center for Occupational Hazards in New York City, whose reply appears below.

When using any volatile compound always keep safety topmost in mind. Wear gloves and goggles. Follow instructions on containers to the letter. Make sure your work area is well ventilated, or work outdoors.

Although benzene (benzol) has been known for decades to cause aplastic anemia (destruction of the bone marrow) and leukemia, it has been a common component of paint strippers (often more than 50% of the mixture). In recognition of these hazards, the Consumer Product Safety Commission proposed last year to ban benzene from consumer products on the basis that there is no safe level of exposure. Most companies have removed benzene, but some paint strippers containing it may still be on store shelves and in workshops. Don't use any paint stripper containing benzene (or benzol).

Many people get confused between benzene and benzine. Benzene is extremely toxic. Benzine, on the other hand, is a petroleum distillate similar to naphtha, mineral spirits, gasoline, paint thinner, etc., differing only in its boiling point. It is also called VM&P naphtha (varnishmakers' and painters' naphtha). Benzine is moderately toxic; it and the other petroleum distillates can cause skin irritation and narcosis (dizziness, fatigue, loss of coordination, nausea) from inhalation. Ingestion is more serious and one can die if any of the solvent gets into the lungs (e.g., from vomiting). This is particularly hazardous with children.

Toluene (also called toluol), al-

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

though related to benzene, is much less toxic. It does not cause aplastic anemia or leukemia. In the past, toluene was thought to cause these diseases, but this is apparently due to the presence of benzene as a contaminant. With the much lower levels of contamination that will be permitted by the Consumer Product Safety Commission, and with better industrial practice, this problem should be eliminated. Toluene itself can cause narcosis, skin irritation, and liver damage. It has also been implicated as a cause of menstrual irregularities. Toluene was the solvent most commonly involved in glue-sniffing illnesses of the 1960s.

Because of the proposed ban, manufacturers have been replacing benzene with other solvents, mostly toluene and methylene chloride. Methylene chloride has been implicated as a cause of heart attacks—including one known fatality—because the body converts it into carbon monoxide. This can tie up the blood's hemoglobin and deprive the heart of oxygen. Methylene chloride is also a lung irritant and narcotic, and, in the presence of a flame or lit cigarette, can decompose to phosgene, a poisonous gas.

• • •

I have a 20-year-old Craftsman 8-in. table saw. It works great after cleaning the mechanism but after a little use, the tilting gears get clogged with sawdust, and it's almost impossible to tilt. I've tried to get parts but Sears doesn't carry them any longer. Secondly, I'm looking for a 12-in. or 14-in. band saw. I've never used a band saw and don't know what to look for.

—Mike Townsend, Canton, Mich.

To keep the worn trunnion working freely, try silicone spray, floor wax or "moly" lube, which is available in a dry powder. Keep the dust blown out with an air hose. For parts, try to locate a used saw. Possibly, a vocational school could cut the necessary gears.

I would not consider a band saw smaller than 14-in. A 14-in. saw will take a .025 blade, standard on most saws, including the 30-in. size. The blades are rigid enough to saw a straight line through 10-in. stock without wandering. If you try to run a .025 blade on a 12-in. saw, the extra flexing will cause the blade to break. A thin blade, as used on 12-in. saws, does not do a good job on 1-in. stock unless everything is adjusted perfectly.

I would use a saw such as the Rockwell Delta (Rockwell International, 400 North Lexington Ave., Pittsburgh, Pa.

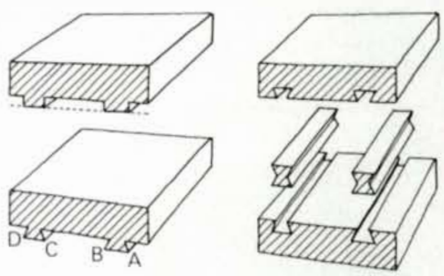
15208) as a guide when comparing other makes. What to look for when buying a band saw? This brings to mind the old saying, "Just as good for less money." I haven't found that it works that way. Look for a standard or reputable brand and stick with it if you aren't experienced in a particular area.

—*Lelon Traylor*

I have been asked to build a butcher block table and have seen some with blocks locked together by dovetails. How does one go about cutting dovetails down an 8-in. to 10-in. long block so that the whole thing can be laid out and done reasonably simply?

—*George Selfridge, Mosier, Ore.*

Joint and plane the wood and be sure all pieces are straight. For the male part, remove most of the wood using a hand router or dado blade. Use a router table with a fence and cut A in all the



pieces. Then reset the fence for B, C and D. Be sure to have the same edge against the fence for each cut. For the female part, remove most of the wood with a straight cutter. Use the router table with the fence, as when making the male joint.

It is easier to make all the joints female and then make a loose feather on the router table, using the same cutter. This wastes less wood and can be more decorative, especially if you use contrasting species.

—*Tage Frid*

I would like to get information on how to make line inlays such as "satinwood-ebony-satinwood" inlays used by early cabinetmakers, which are much thicker than present-day inlay strips.

—*Ralph Flowers, Pittsfield, Mass.*

Let's say you have wood ¾ in. thick and you want white-black-white. Dimension two pieces of white and one piece of black to an exact width. Use a ten-point hollow-ground saw blade (be sure the throat plate fits close to the saw), and set the fence so the fall-off strip is the width you want for each color. Pass over the saw for a slice from each piece. If you want more, reset the fence for another pass. For one set, glue one side of two white strips and both sides of one black. Have two wider straight-edged pieces with paper on the straight edges, and place them on each side of the glued assembly and clamp. After drying, you will have a laminate the desired width by ¾ in. high. Joint a narrow surface for a straight edge to start sawing the line thickness you want.

—*A. W. Marlow*

I am currently repairing a turn-of-the-century maple rocking chair. It suffered through a drunken brawl a few years ago, and was broken apart. The owner reglued the whole chair with epoxy glue. My problem is knocking the chair apart to repair and reglue. My approach, knowing the low shock resistance of epoxy, has been to try sharp blows with a rubber mallet. I tried using a small drill bit in a Dremel drill motor. Laying in to the side of the spindles as flat as possible, I drilled holes all around—no good.

—*David J. Wood, Sterling, Colo.*

Your approach is right, but you cannot deal a "sharp blow" with a rubber mallet. Go for broke. Use a steel hammer.

—*George Frank*

I found a red oak that must have been struck by lightning. It was split open and the center was eaten out by insects. Why only the heartwood? Is it because heartwood is dead and sapwood is growing? What kind of disease does this to trees? The tree is 2½ ft. in diameter and still living.

—*Terry Trudell, Saginaw, Mich.*

In freshly sawn lumber sapwood is usually more vulnerable to attack by fungi than heartwood; in the living tree, however, certain fungi can attack the heartwood, while leaving the sapwood untouched. The heartwood serves only to support the tree, and therefore can be slowly and totally destroyed without outward symptoms. The affliction is usually revealed when external mechanical stress exceeds the strength of the sapwood shell. Different rots attack different species. Infection usually enters through injury.

—*R. Bruce Hoadley*

How does one keep dark-colored dust from getting into the pores of light-colored wood? How can dust be removed from gaps between veneer-thin, fairly tightly packed, small wood squares?

—*Randy Evans, Whittier, Calif.*

Dark dust may get into the pores of a light wood, or vice versa, but there is no reason why such dust must remain there, unless some adhesive, such as improperly cleaned off glue, is involved. It can be simply blown or sucked away, or brushed off. Compressed air may be needed, but a good vacuum cleaner ought to do the job.

—George Frank

Follow-up

If George Frank has any sensitivity to the use of wood, it is not apparent when he suggests that kitchen countertops be covered with plastic laminate (Jan. '79). Solid spruce countertops ¾ in. thick and 26 in. wide in one piece were in the house where I grew up, and these were treated periodically with linseed oil and are still in good condition after fifty years. Two houses I had built had no plastic laminate anyplace. In one I used glued-up birch for counters, in the other, alternating strips of walnut and maple. Both were treated with linseed oil. My only suggestion is to avoid mitering corners and to detail the installation to accommodate the almost continuous expansion and contraction, a measurable quantity in a board 2 ft. wide.

-Wesley V. Korman, Beaverton, Ore.

...For finishing a wood kitchen countertop, how about using moisture-curing urethane such as is used on bar tops/bowling alleys/gymnasium floors? Wood must first be sealed properly with a compatible lacquer sealant. Check out products of Hughson Chemical Company, Erie, Pa. 16512. They're tough but flexible and the glass-like surface does not mar easily. Alcohol resistant too....

—C. Haber, Huntington Beach, Calif.

Re: Finishing kitchen counters, I have found that household paraffin wax is a super finish for breadboards and butcher blocks. The secret is to heat the item to be coated to just above the melting point of the wax. Then rub the piece with wax; as the piece cools the wax will be drawn into the wood, darkening it and leaving a low-gloss sheen. I heat small items in the oven and larger items with a heat lamp.

I would never use boiled linseed oil with Japan driers on anything that might come in contact with food. Warnings on containers caution against ingestion. A customer deserves the highest possible consideration; it is not ethical to do anything that has even a remote possibility of causing harm.

—Mike Graetz, Lakeland, Minn.

In reference to your list of scarce items (Nov. '78), I have some suggestions. Silverleaf maple *(Acer saccharinum)* is just plain old soft maple. Around here it is also known as fast-growing maple. If you are an urban dweller and can't cut your own, find a supplier of firewood anywhere east of the Mississippi and north of Dixie and you'll find plenty of soft maple.

Blue beech *(Carpinus caroliniana)* is a little tougher to find. The average blue beech doesn't get more than 6 in. or 8 in. in diameter. Usually, it is left to rot in the woods because it is considered too small even for cordwood. Your source might be a walk in the woods wherever hardwood timber is being cut. Quite often you can pick up all you want merely by asking for it.

The State of Ohio recently carried out a program of girdling trees supposedly detrimental to "money trees." If you live in a state where such a program has been carried out, contact your county agent for information on "improved" lots. By asking the landowner, you may be able to acquire not only blue beech but other "hard to find" woods.

For oak dowels, drive a square peg through a round hole in a steel plate. It works. *—H. Izenour, Ashtabula, Ohio*

Supplies

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

—Pure oil of lavender: Caswell-Massey Co., Ltd., 575 Lexington Ave., New York, N.Y. 10022 (½ oz. $5.80). Reader Earl Solomon writes: "This can be had from any china painting supply store. It is used to mix ceramic oxides in hand-painting chinaware."

—Traditional inlays in the Hepplewhite style: William C. Bader, 177 Elk Mtn. Rd., Asheville, N.C. 28804.

Readers can't find:

—A source for wooden casters.

—Hardware for an adjustable piano stool top.

—Plans for a master craftsman tool chest.

—Cheval glass hardware.

—A pine stain with a honey-tan finish or information on mixing one.

—Plans for a baby's crib.

—A source for brass nozzles for fireplace bellows.

—Hardware for a desk chair that swivels and tilts back.

—A source for interlocking compression rivets, such as are used to attach knife handles.

—Information on laying out and cutting a billiard cue splice. □

Books

Dictionary of Tools Used in the Woodworking and Allied Trades c. 1700-1970 by R. A. Salaman. *Charles Scribner's Sons, 597 Fifth Ave., New York, N.Y. 10017, 1977. $47.50, cloth, 545 pp.*

Raphael Salaman states in his introduction that his purpose is "to describe every tool used in the woodworking trades from about 1700 to the present time, and to explain its purpose." In what is the definitive book on the subject to date, he succeeds admirably. The entry for each tool follows a consistent pattern: entry word, followed by alternate English, local, popular or American names as applicable, and by a reference to the figure number of its illustration. Salaman's textual description almost invariably gives a dimension and a concise explanation of function. Illustrations are generous: The 740 numbered figures include literally thousands of individual tool illustrations. Many are taken from nineteenth and twentieth-century trade catalogs; hundreds are drawings made for this book and illustrate tools from the author's collection.

The book is a dictionary in its alphabetical arrangement, yet it takes on an encyclopedic character by the length of many of its entries. In this, it is reminiscent of Knight's *American Mechanical Dictionary* (c. 1872-76). The descriptions are more substantial than those of Graham Blackburn's attractive, but much less ambitious, *Illustrated Encyclopedia of Woodworking Handtools, Instruments & Devices* (1974). Salaman's generous use of cross references, from synonyms to regional vernacular tool names, lead the reader to the English term chosen for a particular tool. Thus, the reader who may look for "howel" is referred to "plane, cooper's chiv." For most tools, of course, the English and American names are identical. In addition to an alphabetical approach, on pp. 16 and 17 is a list of some 55 "Trades Included." Under the entries for these trades—such as cooper, mast and sparmaker, plane maker and turner—the author gives an account of the trade and its products, in addition to a list and description of the tools associated with each trade.

Salaman writes that from boyhood he observed tradesmen at work—in a country where the hand-woodworking trades and traditions persisted, in small shops, longer than in North America. Through the years he visited (in the manner of Joseph Moxon three centuries ago) more than four hundred shops, "most of which have now disappeared." This independent observation and research at the source lends authority to the work. The bibliography lists not only published sources, but makes note of Salaman's visits and personal correspondence with individuals and firms. References to these primary sources are found throughout the text.

The *Dictionary* makes no pretense of being a "how-to" book for the hand-woodworking craftsman of today, but contemporary woodworkers whose primary implements are the band saw, the table saw and the rotary rasp will find it an invaluable source of methods and tools. Although essentially a reference book, the material is so interesting—both in content and informed presentation—that one can read it with enjoyment from beginning to end.

—*Paul B. Kebabian*

American Woodworking Tools by Paul Kebabian. *New York Graphic Society, 11 Beacon St., Boston, Mass. 02108, 1978. $22.50, cloth, 213 pp.*

American Woodworking Tools is the most coherent overview of the subject in print. It takes the tools out of isolation and places them within the framework of American material culture. Kebabian assumes that the reader, whether woodworker or collector, already has rudimentary knowledge of the subject, and the text concentrates on the settings, both shop and technological/social, within which the tools were used, rather than on the uses of individual tools. Later chapters explain tools used in separate trades within the framework of each trade.

But a larger historical context, detailed in the earlier chapters, gives the book its uniqueness. The reader is brought from the stone age through the bronze and iron ages to the technology of the first settlers of America. Basic metallurgy and toolmaking are explained, and a group of tools common to all trades is introduced. Gradually, one sees how the American advances in tool manufacture in the 19th century and the decline of the hand-woodworking tradition interrelate, and can clearly distinguish the woodworker of, say, the mid-18th century from the woodworker of the late 19th century.

Dudley Whitney's photographic work is excellent. No attempt is made to romanticize the tools, in the black and white photographs, that is. Most of the color plates ("stunning," according to the dust jacket), are downright garish, and the publisher, The New York Graphic Society, deserves the blame. Something went wrong in the printing such that beech often looks like mahogany, steel becomes brass, and brass becomes gold.

—Rob Tarule

Old Ways of Working Wood and The Tools that Built America by Alex. W. Bealer. *Barre Publishing Co., Inc., distributed by Crown Publishers, Inc., One Park Ave., New York, N.Y. 10016, 1972. Each book is $12.50, cloth; 231 pp. and 212 pp.*

Old Ways of Working Wood surveys, in historical perspective, a plethora of old hand tools and primitive machinery plus the techniques for using them, and does it well. Incisive chapters cover ways of felling a tree, splitting, the workbench, sawing, hewing, boring, chiseling, shaping, planing and turning. The tools and techniques dealt with were used by millwrights, carpenters, cabinetmakers, chairmakers, carvers, wainwrights, housewrights, sawyers, coopers, carriagemakers, turners, wheelwrights, axmen, hewers, shipwrights—in short, the whole gamut of professional woodworkers before the industrial revolution changed the one-to-one relationship of man with his handiwork. The author's knowledge is formidable; he knows these tools because he has made the effort to learn their proper use and care. He is a sensualist, refreshingly so. That he tries to convey the pleasure afforded the workman by the sights, rhythms, sounds and fragrances accompanying many woodworking operations and includes this together with more practical information is a literary extravagance many will appreciate.

The contemporary woodworker depends largely upon power machinery, but ought to pay attention to what came before it, if only for one important reason. Too often we design around the capabilities and capacities of our machines without being aware that hand tools open vistas impossible to approach even with power tools. Of course, the time-and-effort savers will not be concerned with this fact, but the uncompromising craftsman who sights on the best possible esthetic solution needs to know about every conceivable method.

The Tools That Built America follows the same general sequence as *Old Ways of Working Wood,* but instead of organizing tools according to function, the author regroups them under three generalized professional categories: tools used by the frontiersman to build log cabins and other primitive structures, tools employed by the house carpenter and tools for making cabinets and furniture. Written several years after *Old Ways,* this book appears to be little more than a rehash. Very few of the facts contained in it add to what may be gleaned from the first book, and great quantities of pertinent information are deleted. What we have here essentially is a popularized abridgement with a more marketable, national-nostalgic approach. The craftsman will want to read it in the unexpurgated version.

—*Alan Marks*

Antique Woodworking Tools, by Michael Dunbar. *Hastings House, 10 E. 40th St., New York, N.Y. 10016, 1977; $12.50, cloth; 192 pp.*

Michael Dunbar's book, *Antique Woodworking Tools*, is an attempt to convince the modern reader of the value of using what he calls "pre-industrial" tools. It is not a scholarly history or a book of nostalgic anecdotes but a practical guide for the use of old planes, saws and boring tools.

The chapter on molding planes may be an eye-opener for some readers. Most of us see molding planes as useless artifacts from a time when woodworkers had to put up with clumsy tools. Dunbar reveals them to be sophisticated and sensitive instruments, and the reader begins to understand why the finest craftsmen needed hundreds of them. The author explains how to use molding planes and how to shape a replacement cutter for a particularly valued tool (though he neglects to give clear directions for sharpening it). Dunbar compares the wooden molding plane to heavy and overcomplicated modern planes like the Stanley 55. For its given job, the wooden plane is clearly the superior tool.

Dunbar evaluates his old tools against 20th-century power equipment but seems hesitant to compare them to the modern hand tools developed in the late 19th century. Though some of the later innovations were complex and impractical, like the Stanley 55, many had definite advantages over the older tools. Woodworkers did not buy adjustable metal planes, for example, because they were cheaper, but because they worked better, more easily, or solved some of the problems that were chronic with wooden planes.

The author's mission is to convince

craftsmen that the old methods are best. He regularly expresses his conviction that the woodworker who uses power tools can't turn out good work. He believes that today's craft is so easy that we are all bored silly for lack of challenge, and that the only skill required in today's woodworking shop is the ability to avoid a gory accident. His foremost argument in favor of the old tools seems to be that they required much more skill to use, not necessarily that they worked better. It is to Dunbar's credit that he buys 18th-century craftsmanship whole-hog. But by expressing his contempt for the modern woodworker in this book, he is likely to be turning off the very people who could make use of his knowledge.

From his earlier book, *Windsor Chairmaking* (Hastings House, 1976), we know one side of the author's craftsmanship. In order to understand the tools he has written about, Dunbar must have done work other than chairs, but there are no photographs of his finished pieces in *Antique Woodworking Tools*. The reader is at a loss to explain how Dunbar gained his expertise.

In spite of its flaws, *Antique Woodworking Tools* manages to convey a sense that the almost forgotten early methods have some wonderful things to offer today's craftsmen. It supplies enough information to help the woodworker get started. There is a great deal left to be written on the subject, and I hope that Dunbar's book is only a beginning.

—*Richard Starr*

Wooden Planes in 19th Century America (2nd edition) by Kenneth D. Roberts. *Ken Roberts Publishing Co., Fitzwilliam, N.H. 03447, 1978. $28 cloth, 324 pp.*

Of all the woodworking tools at the craftsman's disposal, surely the wooden plane is one of the most pleasing, both from an esthetic standpoint and from the sheer nostalgic enjoyment of manipulating a sweet-working instrument with such an impressive heritage. In this second edition, profusely illustrated with drawings and photographs, Kenneth Roberts has done a creditable job detailing the history and workings of a fascinating array of wooden planes for cabinetry, shipbuilding, house construction and cooperage.

For craftsmen, *Wooden Planes* offers easily duplicated cross sections and diagrams of planes used in making moldings, panels, barrel staves and cabinet parts. With the renaissance of these crafts, artisans who find it incongruous to build 18th-century pieces with 20th-century tools can make the appropriate tool, or, by using the diagrams and lists of manufacturers, can reliably determine the authenticity of found tools. In addition, a section from Nicholson's *Mechanic's Companion* (1858) is reproduced, detailing 18th-century joinery techniques.

Roberts has carefully articulated the evolution of the wooden plane in its various manifestations. He traces the patents, products and developments of companies both large and small, noting short-lived and unique editions such as instrument-maker's planes only fractions of an inch long, Colonial crown molding planes up to 6¼ in. wide designed to be used by two men, and cooperage planes up to 6 ft. long.

Roberts devotes an entire chapter to museums where wooden planes and other tools of the Colonial, Victorian and other periods may be seen. This reviewer, having seen several of the displays, can recommend these and similar excursions to enhance the knowledge and insight gained from Roberts' excellent book.

—*James W. Fiddes*

Paul Kebabian is director of libraries at the University of Vermont, Burlington, and an authority on old tools. Rob Tarrule, of Plainfield, Vt., is a self-employed woodworker and a student of early technology. Alan Marks and Richard Starr are correspondents for Fine Woodworking *magazine. Jim Fiddes, Danbury, Conn., is a summertime builder who also teaches high school English.*

Events

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

Northeast Craft Fair—all media. Open to trade June 19-20, open to public June 22-24. Dutchess County Fairgrounds, Rhinebeck, N.Y.

New Handmade Furniture: American Furniture Makers Working in Hardwood—featuring original work of 35 craftsmen including Sam Maloof, Wendell Castle, Judy McKie, Jere Osgood, Michael Coffey and Peter Danko, May 3 through July 15. The Museum of Contemporary Crafts, 44 W. 53rd St., New York, N.Y. 10019.

Young Americans: Fiber, Wood, Plastic, Leather—through May 20, Botanic Hall & Art Gallery, Nashville, Tenn. 37205; June 17 to July 29, Brunnier Gallery, Sheman Bldg., Iowa State Center, Ames, Iowa 50011.

The Chair: Antiquity to Contemporary—May 18, and **Chairmaking: Aesthetic and Technique**, May 19-20, lectures by Robert Whitley. Renwick Gallery, Smithsonian Institution, Washington, D.C. Contact Greenwood Gallery at (202) 381-5811.

Selections 1979: Wood—through May 25. Julian A. McPhee Gallery, California Polytechnic State University, San Luis Obispo.

Workshop with Stephen Hogbin—May 23-25. Carleton University Students' Association, 4th Level, University Centre, Room 301, Colonel By Drive, Ottawa, Ontario K1S 5B6, (613) 231-5507.

Professor's Choice—Student Honors Show, May 6 through summer. Rochester Institute of Technology, Bevier Gallery, 1 Lomb Memorial Drive, Rochester, N.Y. 14623.

Third Goodfellow Catalog of Wonderful Things, mail-order crafts catalog to be published Spring 1980, accepting applications through July 15. Contact Goodfellow Catalog, P.O. Box 4520, Berkeley, Calif. 94704.

The Harmonious Craft: American musical instruments—through August 5, Renwick Gallery, Smithsonian Institution, Washington, D.C.

One-Man Show with Jon Brooks—May 5-31, Richard Kagan Gallery, 326 South St., Philadelphia, Pa. 19147.

3rd Annual American Crafts Festival—June 30, July 1, 7, 8, Lincoln Center for the Performing Arts, New York. Contact American Concern for Artistry and Craftsmanship, Box 20, Hasbrouck Heights, N.J. 07604.

International Craft Show—Sponsored by New York State Craftsmen, June 14-17, New York Coliseum, New York City.

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Oscar Hadwiger and the Miraculous Staircase

In 1873, construction of the Loretto Chapel of Our Lady of Light in Santa Fe, N.M., was begun. Legend has it that about five years later, when the chapel was almost complete, the sisters realized that the design had one major flaw—there was no way to ascend to the choir loft from the chapel floor. Carpenters and architects suggested they either rebuild the loft or install a ladder to reach it, neither of which was satisfactory to the sisters. Installing a large conventional staircase in the small chapel would virtually eliminate group worship. So the sisters turned to prayer, and embarked upon a nine-day novena to St. Joseph, carpenter of Galilee.

On the last day of the novena, a gray-haired old man riding on a donkey arrived at the chapel. His kit of tools was simple—saw, square and hammer—but he offered his help to the sisters and was accepted. About four months later, the quiet carpenter completed the 33-step staircase, which is assembled with wooden pegs instead of nails, and spirals through two complete circles without a means of central support. He left as mysteriously as he had come, without finishing the railing, and before he could be paid. The Miraculous Staircase still stands in the Loretto Chapel today, though now it is off limits to sightseers who would climb it. Architects and engineers still can't explain how it endured 85 years of use.

Tony O'Brien

Loretto Chapel staircase, held together with wood dowels and lacking central support, has endured over 85 years of daily use.

Oscar Hadwiger, 89, of Pueblo, Colo., has made about a dozen models of the Miraculous Staircase. His first was also his first woodworking project, made in 1955 after retiring from his job as a carpenter. Then, Hadwiger's arthritis was so severe that he could hardly walk, and a friend suggested that he "better get a hobby or surely die." Ten-hour days in his shop creating intricate inlaid projects (now totaling over 700) made him forget his pain, and soon he was walking without crutches. His hobby has had another unexpected bonus. The model of the staircase and two years of research have led to what Hadwiger believes is the identity of the mystery builder of the Miraculous Staircase.

Hadwiger completed his first model in about three months. When it was done, he took it to the sisters of Loretto, who told him the legend. It sounded familiar and when some ten years later Hadwiger inherited an ancient toolchest belonging to his grandfather, his memory was sparked even more. In the toolchest he found a detailed sketch of a spiral staircase, dating back to 1878, and a homemade metal die, a type that could have been used to make dowel-like pegs identical to those found in the Loretto Chapel staircase. Hadwiger began his research in earnest.

He learned that in 1872, his father, John, then a boy of 12, fled Germany for the American Wild West, eventually settling in Pueblo. Oscar's grandfather, Yohon, a master carpenter who specialized in staircase building, heard of John's whereabouts in 1877, and journeyed to Pueblo to persuade him—unsuccessfully—to return home. Yohon stayed on, making his way to Santa Fe when he heard that a workman was needed to build a staircase. He was gone about four months, and when he returned told his son that he had built a chapel staircase, without handrails, and without waiting to be paid. Shortly thereafter, Yohon left his donkey and tools with John and returned to Europe. The pieces fit. Oscar was convinced his own grandfather had been the mysterious carpenter.

Still there were puzzles. Where did the wood come from, and how was the spiral constructed? Hadwiger went to Santa Fe again, to talk to the nuns who

Intricate inlaid objects are a sampling of Hadwiger's more than 700 creations. Staircase model has over 25,000 pieces of wood.

might remember. Some remembered wood soaking in tubs full of water; some remembered the strong smell of glue made on the site from cowhide. Hadwiger believes that Yohon used native pine or fir, woods that bend without breaking, carefully spliced to form the spiral, and held together with the wooden pegs and hide glue.

There is one mystery that Hadwiger hasn't solved: Do the 33 stairs in the staircase each represent a year of Christ's life, or is it purely coincidental, the number of stairs needed to fill 25 ft. of space? ☐

—*Laura Cehanowicz*

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Working With a Handicap

'You have to adapt your life to tighten a screw'

BY MAURICE HOPE-THOMPSON

Photo: Jim Dennis

Dr. Albert Ritterson

A tiny wooden amoeba sits on a shelf. Beside it is a bird carved from wood and close by, a parasite fashioned from plastic. It's the stuff of the "Ritterson Museum" at the University of Rochester (New York) Medical Center, the result of a severely handicapped man's efforts to push his talent for working with wood, plastic and metal in the service of science.

The study of parasites has not gained wide popularity. For parasitologists like Dr. Albert Ritterson, this has put a premium on the ability to construct specialized lab equipment for his own experiments and to display the results so that students, scholars, physicians and others can easily identify the material and study it. "Oftentimes in laboratory work," Ritterson says, "you'd come across a need that wasn't commercially available because there is little demand for it. When this happens, you either have to have it made, which is extraordinarily expensive, or you make it yourself."

Ritterson decided that he would make it all himself and as a sort of "thank you" to the University of Rochester for encouraging their work as scientists, he and his wife, Phyllis, a University of Rochester microbiologist, decided to build the museum under the theme "Parasitism: A Life Style." She would do the drawings and charts and he would make the cabinets and carve out the tapeworms, hookworms, blood cells, the wooden microscope—elements that would demonstrate how parasites exist, get around and are seen by man.

In a way, the project represented a search for affirmation. It was to be a pilgrimage down a path Ritterson hoped would sustain his confidence and keep him unafraid. Now 54, Ritterson had been struck with polio myelitis (infantile paralysis) at age five, which robbed him of the use of his upper and lower left arm. And while he can still give a strong handshake with his right arm, the upper muscles don't function, which means he has no real lifting ability.

What this means in the woodworking shop is that he has had to make special adjustments and devices to use conventional tools effectively. "There is virtually nothing that I do that doesn't require some considerable deviation from what is standard procedure," he said. "For example, cutting something with a saw. I had to build a saw-holding device. You become accustomed to circumventing; you have no choice. It's a constant problem and it's extremely time-consuming."

The sander, lathe, circular saw, band saw and a whole range of hand tools which Ritterson puts into action for about 10 hours each week all have special braces, extensions, clamps and fixtures so that he can grasp easier, sand easier, cut easier. "The work goes very slowly," he said. "You have to adapt your life for such things as tightening a screw. It infuriates me that I can't do it faster. In three or four seconds I'm in a violent rage." As he works, everything is brought into play—hips, shoulders, chin, knees, elbows. "Like a belly-dancer," he said, "you've got to use all you've got."

Some of the things that Ritterson has made are a direct result of his irritation with how the "conventional world often excludes the handicapped, the aged and the small—in terms of architecture and access to things." When he drives to work at the University of Rochester, where he is an associate professor, he must insert a plastic card at the gate of the parking lot in order to drive in. "Since I am totally paralyzed in the left arm, I would have to get out of the car each time to stick the card in," he said. To combat this, he invented a device—a card holder made from a wooden pole. On one end is a metal clip with a screw to grasp the ID card. Each time he drives up to the lot, he just whips out his pole, sticks the card in and drives through.

For the museum Ritterson has made a special biological clock with polar coordinates to represent the growth of the malaria parasite. The face of the clock is mounted on the hour-hand post and instead of the hour hand telling the time, the face of the clock revolves and functions as the hour hand. There are four 15-minute markers to help the novice orient himself for reading the clock.

No time is set for the completion of the "Ritterson Museum," which occupies the walls of a large section of the multidiscipline lab at the medical center. "It's like the Catholic Church," Ritterson said. "I tend to think of the museum in terms of decades." ☐

Maurice Hope-Thompson, of Newton Center, Mass., is a law student at Boston College and a freelance writer.

Planning and Design Reduce the Risk

BY ALBERT RITTERSON

My disability would be described as 100% immobility of one arm and 50% of the other. This requires that two basic needs be met in order to do most woodworking. First, work must be firmly held in place. I clamp any stationary work to a bench, sawhorse or whatever is truly stable. This can be accomplished with conventional screw clamps, but, to me, the *sine qua non* is cam-operated wooden Klemmsia clamps sold by Woodcraft Supply, 313 Montvale Ave., Woburn, Mass. 01801, or Garrett Wade, 302 Fifth Ave., New York, N.Y. 10001. These clamps can be applied quickly with one hand and their utility can't be overstated. Substitute designs have been on the market, but I have found them unsatisfactory. Temporary holding operations are anatomical—a knee, a foot, chin, cheek, teeth, all will stabilize material for light operations or until it can be properly clamped. Workbenches must be designed with the latter in mind—they must be of proper height to permit easy use of the foot or knee and must have edges to clamp to. The Old World type of workbench such as Lervad (Leichtung, 701 Beta Drive, #17, Cleveland, Ohio 44143) or Ulmia (Woodcraft Supply) is a luxury, but exceptionally useful. I have two.

Second, work or tools to be moved in operations such as cutting require the application of simple body physics. In my case, all power of movement must come from the body itself. Therefore, body force must be directly applied to the arm. This is awkward, but manageable. Brace the arm to the body, which is moved to apply the needed force. Safe position and balance are essential here; every action must be planned with this in mind. One's body must never be out of control. This may mean that an action has to be interrupted to resume a safe position relative to the work. One with full power in one arm is in a better position here and his gyrations needn't be so complex.

There are other points to consider when working with wood. For example, never get splinters. I use a lightweight goat-skin work glove. Heavier work gloves are too restricting and should be avoided. I wear out a glove a year.

Don't work in the presence of visitors. One's difficulties and contortions send most of them into uncontrollable paroxysms of assistance that might get you both killed. If you really can't figure a way of doing a part of a project, don't do it, or, better still, redesign the project. Detailed advance planning and design, with difficulties in mind, are essential for all projects. Use a helper, reluctantly, only after giving careful, detailed instructions of just what is expected—and when.

Don't use lack of patience as an excuse for not getting involved with woodwork. (I hear this all the time from persons with no handicap other than laziness or indifference.) Few, if any, have any real patience. Frustration and tedium will drive you up the wall, but, if the goal is important, you will find that self-control and discipline are the actual ingredients of "patience."

Be especially aware of the usual safety rules and devise means to modify them. Example: My stationary power tools are double-switched so they can be turned off by foot, in case I'm in trouble and letting go is impossible.

Never let your attention wander or be distracted while doing potentially hazardous work. Discipline yourself not to be jumpy.

Use all conventional jigs that will suit your needs—refine them.

One can fail or even get tragically hurt, but this also applies to taking a bath or crossing the street. In woodwork, planning, design, acting out each step will reduce the risk to an absolute minimum. The most trivial injury is a disgrace—planning has been faulty. Getting a project done is anticlimactic when compared with the feeling one gets when it is clear that it can be done. □

Edward Barnsley

The grand old man of English furniture design

by Harold Lowenstein

Barnsley

In England many people consider Edward Barnsley to be the grand old man of furniture designers. What category of designer? Well, clearly far outside the furniture trade. Let's say he works in what has come to be known as the "English handcraftsman's tradition," which has roots threading back to both 18th-century folk or farm furniture and (I would reckon more importantly) to the neo-Classical strictness of spare, unadorned pieces by Sheraton or Hepplewhite. "Designer and craftsman" is how Barnsley defines himself. I illustrate the point with two pieces (next page) of which I think he is modestly proud, one from 1924 and one from 1965. He designed and made both.

To our restless age Barnsley does his best not to belong. He has made but one major geographical move, across southern England from the Cotswolds where he was brought up, to Hampshire, where he settled half a century ago. His work and life appear to be inextricably fused—the pedigree of the mix goes back to the Victorian craftsmen-philosophers John Ruskin and William Morris.

Like many lesser and forgotten men, William Morris cold-shouldered the Victorian industrial scene. He took off for the unspoiled Cotswold countryside and became what is today called a guru. But unlike Morris, Barnsley had no pressing need to rebel. In 1900 he was born into a tradition that suited his temperament and his talents. His destiny (a hard one) has been to remain faithful to that position, as far as possible.

At the center of that tradition is Ernest Gimson, "a craftsman endowed with the ability of a designer," who brought an individual genius to furniture making that had been lacking since the death of Sheraton. Gimson, who had met Morris in 1884 and had been fired by his luminous vision, passion and practical drive, was the leading spirit in the Gloucestershire villages where Barnsley's father, Sidney, and his uncle, Ernest, both qualified architects, had put down roots. Gimson took on a pupil named Geoffrey Lupton, and in the course of time, Lupton, initially a trained engineer and an able craftsman, began running a small furniture workshop at Froxfield, a scattering of houses and farms above the market town of Petersfield (about 60 miles southwest of London). After working alongside his father and spending a year at the Central School of Arts and Crafts in London, Barnsley, in 1919, was apprenticed to Lupton at Froxfield. In 1923 he rented the shop from Lupton and three years later, backed by his father, bought the place. Since that date, Barnsley has enlarged it. Over the years Barnsley in his turn has taken on many pupil-apprentices and worked closely with several craftsmen. The number has fluctuated—as I write, three craftsmen and one apprentice remain.

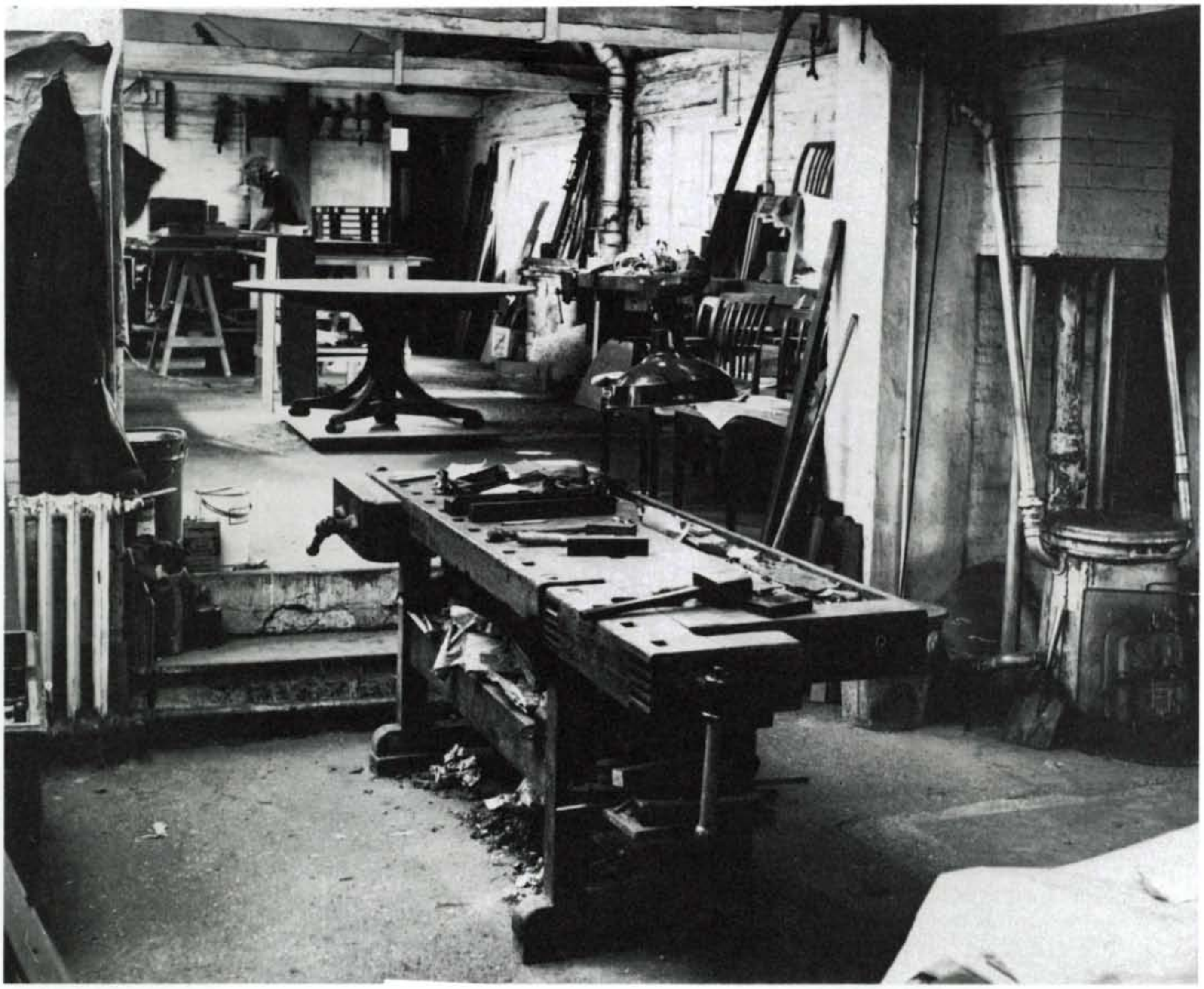
This lumber shed was built by Geoffrey Lupton around 1900 on what is now the Barnsley property; Barnsley has since added four more sheds of similar size. The locally cut wood is stickered to air-dry for five years per inch of thickness.

The Barnsleys' home and the shop are as good as joined one to the other, although to enter the shop you walk through the open air, over a gravel path on the garden side. A sizeable vegetable garden, industriously cared for, some beautifully kept herbaceous borders and an uneven lawn slope down to a retaining wall. At a man's height below lies a narrow terrace where fruit trees in summer shade the rough grass. Beyond these limits, the land plunges and funnels toward Petersfield. Looking back uphill, house and workshop sit comfortably just above the rim of the escarpment.

Lupton designed the Barnsley home, which from the outside looks much larger than when you go indoors. A compact kitchen huddles next to the living room, a plain, all-purpose space—the mood set partly by the satisfying volume and partly by the subtle tones of the woods used for furniture, doors and floor.

Several focal points compete mildly for one's attention: a portly oak sideboard dresser made by Barnsley's father. Below a bowed lintel, a finely proportioned main window. The generous open hearth, rebuilt by Barnsley and probably as efficient as an open fire can be. A walnut bookcase-cabinet rests unobtrusively between massive doors.

On either side of the hearth you might notice a couple of walnut burls, those fascinating and freaky things sliced from outgrowths at the base of some walnut trees, in section well above an inch thick. The convoluted swirlings evoke for me those patterns of human lungs seen in medical textbooks. Some years ago Barnsley held them up for my wife and myself



Top, the bench room at the Froxfield workshops is an L-shaped building with machine room to the right of this view. The bench in the foreground has a clear view of both arms of the L and belongs to foreman Herbert Upton; in the left background is cabinetmaker Oskar Dawson, who has been at Froxfield since 1947. The two chests alongside were both designed and made by Barnsley. The one at left, of English walnut with Macassar ebony detailing, was completed in 1924 and shown at the Wembley exhibition of that year; the one at right was made in 1965 as a wedding gift for Barnsley's daughter Karin. The sycamore stringing set into the drawer fronts and around the pulls has become a Barnsley trademark.

Barnsley's chairbacks (these were made in 1964 of rosewood for the dining room of the Courtaulds Company in London) have an agreeable orthopedic quality—a faintly convex profile that supports well-worn vertebrae. Their graceful arms are reminiscent of some 17th-century Windsors. The table top is veneer on plywood, with sycamore inlay around the perimeter.

A partially complete set of dining chairs, with dovetail ways cut before assembly in the seat rails and mortises in the back posts. The arms can still be wiggled into place, since the tenon will enter the mortise before the dovetail is tightly home.

to look at: He studied our faces as if to discover whether we shared the awe he seemed to feel. They must represent a deep involvement with the organic and reflect his philosophy of wholeness. They can also be thought of as the raw nuggets from which walnut figuring is mined.

From the desk by the wide living-room window, as well as from the windows by Barnsley's drawing table, the eye travels over the treetops towards a distant patchwork of husbanded land. The views encourage the mind to loosen up and stretch itself. "Could anything be more beautiful?" Barnsley asks rhetorically.

On a clear day I unwind as I gaze beyond Barnsley's desk at those views. My gaze on a mournful day turns indoors and down at the floor. Great broad oak boards, mellow and burnished. Timeless impregnability—unless the air and sky are ripped open by a low-flying jet.

Despite his 78 years, Barnsley is still an active man who knows how to recharge his batteries with effective catnaps. At the proper season he may be up before six. Compost to be moved. Garden timber to be felled and bow-sawn, split, then stacked in a measured manner for hearty winter fires.

You pass on one route to the shop a high and meticulously ordered wall of logs. Barnsley leads the way. Saunters into the main *L*-shaped shop. Moves with the firm, composed, relaxed motions of an open-air man. A fluent, witty and entertaining host he can be. Also a thoughtful-complicated talker ready to ruminate on his attachment to nature, or rake over the embers of the independent designer-craftsman's predicament in a philistine world. But here in the shop there are long speechless intervals, ample pauses for one to relish the textures and tones of walnut, oak, cherry, cedar, elm, yew, rosewood or mahogany. Beech and ash are not for him. Time to appraise a chair, a secretaire, a cabinet or bureau or sidetable, whatever piece or set of pieces is nearing completion or, if complete, awaiting delivery.

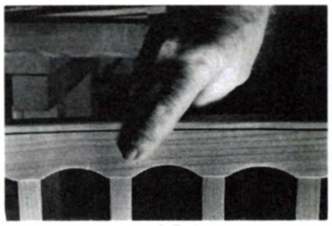
Two craftsmen are using their practiced hands; another concentrates over a machine. A machine? That's the word the Froxfield craftsmen use. But Barnsley insists we shall talk of tools or powered tools.

"Essential to call these things tools, not machines. The word tools conveys something different from the word machine. Great skill is still needed to use 'power' tools but in a different form to handwork." So much for semantic niceties. Young apprentices coming to Froxfield learn to do things the hard way. This allows them to understand the problems they face. Says one of the craftsmen, "Later on when they'll be using machines, having learned the basic way with tools, they'll use the machines more sensibly."

These machines were brought in around 1950. Somewhat earlier came the first arrivals, first of all a treadle circular saw. All hands aboard if anything of any thickness had to be cut. Later, a mortiser was bought. "You heaved on the handle to cut out the mortise. You turned a handle to move the bed along to cut longer mortises. Not a very successful device." (Now they're on their second hollow chisel mortiser, "a beautiful thing. Cuts truer than a man could ever cut.") A circular saw driven by a gasoline motor next appeared. Later, electricity found its way in: A jointer and thickness planer "took the hard graft out of planing"; a band saw, panel sander, spindle-molder and the modern mortiser found space.

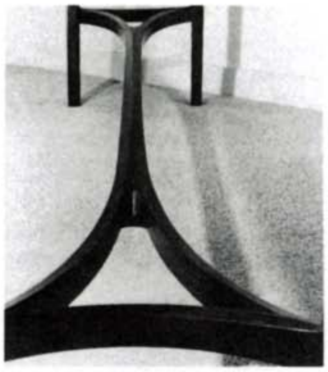
"It is possible," Barnsley now says, "in a day of eight hours to carry out with extreme exactitude as much work as could be carried out in two or three weeks by hand." The voice, I suspect (perhaps wrongly) is that of a reluctant convert. There must have been much heart-searching before the powered tools, not to mention blockboard and synthetic glues, forced their way into the Froxfield workshop. Plywood still sticks in Barnsley's throat, although his craftsmen don't mind it. The techniques of bent lamination, where you resaw your own laminates, are very much in favor.

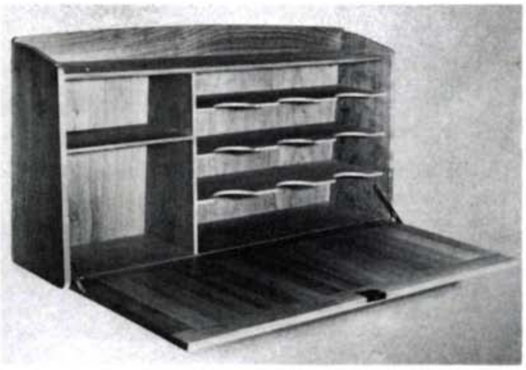
We are standing close to a set of chairs and the way they are stacked makes a fascinating pattern. Barnsley rests a forefinger on the cherry top back rail of one of the chairs.



With the help of machines, the scallops cut in this chair rail can all be identical.

Indian rosewood sideboard (1969), with gently curving front edge, was designed to fit into a narrow hallway: It measures 84 in. long, 20 in. deep and 39 in. high. The drawer bottoms are cedar of Lebanon; drawer sides are English oak. The molding at the back of the table surface is grooved to accept plate glass. Barnsley thinks of this table as "one of our best pieces."





Left, stretcher detail from rosewood sideboard. The long rail is assembled from four curved rails (bent laminations), spliced via wedge-shaped fillets into two straight pieces glued face-to-face. The end rails are also bent laminations and the whole structure is tenoned into the legs. Center, hanging desk made in cherry by Barnsley's current apprentice, Mark Nicholas. The bottom is joined to the ends with a decorative through dovetail whose broad tails are broken by small, rectangular pins. The top joins the sides with four through wedged tenons at each end. Shelves on the right are adjustable; the left shelf is fixed. Right, Barnsley at his drawing board, with the model for a ceremonial chair to be made for the council chamber of a local town.

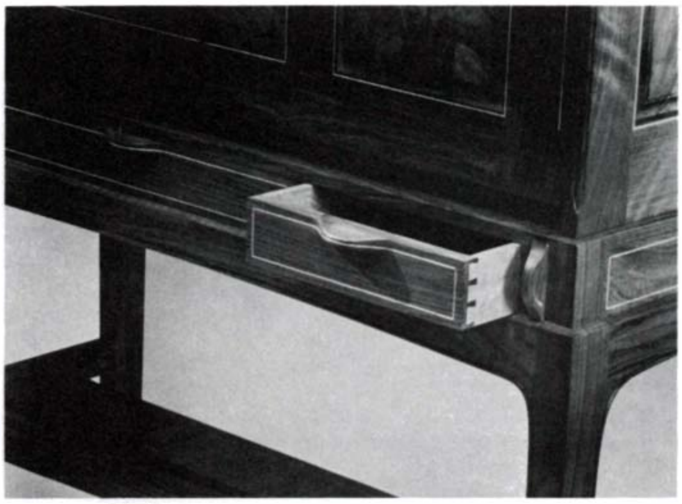
"Just look at this—" Barnsley marvels, so it seems, that any man should possess the unfaltering ability of producing identical curves. His tone also conveys unstinted praise for the patience, dexterity and accuracy of his craftsmen.

A form for the back rail is made, set out and molded on a jig. A fine band saw speeds replication. Before you sandpaper back to the line by hand, a sanding block revolving at about 1,000 rpm is used. Do I only imagine that an undertone of regret or nostalgia weighs on Barnsley? Shouldn't each chair present a barely visible flaw to differentiate it from the next?

The stack of chairs that seized my eye awaits the fitting of their arms. Joints on the seat rails have already been prepared; this overcomes some of the awkwardness of coping with a job that doesn't sit on the bench very well.

A private dining room may require four chairs and two armchairs. For a boardroom of Courtaulds, a leading British company, Barnsley's shop produced two dozen identical chairs. In the same year, 1964, Froxfield made dining room furniture for the same firm (photo page 40). The shop occasionally produces ceremonial chairs too—one, with a prayer-desk, was commissioned by Canterbury Cathedral.

We have now left the main shops and linger in a backwater off the passage leading to Barnsley's design room. I find myself looking at a simple, practical piece which might be called a hanging bureau (above center). Five of these utilitarian paper-tidies, in cherry, are destined for the sons and daughters of one of the many Barnsley clients. The shelf fronts are scooped to give easy access to papers and docu-



Matched pieces of crotch-sawn English walnut enhance the interior doors of the Jubilee cabinet (cover). Note that the doors and panels are slightly curved. Pulls are turned ivory: herringbone inlay is sycamore and ebony. A fine point: the midpoints of the inlay around the paneled doors and top drawer are black. But the midpoint on the bottom drawer is white. Drawer handles, right, are formed from separate pieces of wood mortised into the fronts. The quartersawn drawer sides are about ⅜ in. thick, too thin to be grooved for the solid bottoms. Therefore, a separate drawer slip is glued to their lower edges to house the grooves.

ments. The design conforms to a Barnsley maxim: Fitness for purpose and pleasure in use. Not only the specific needs of customers but the site or probable site of a piece is taken into account. A long rosewood sideboard (page 41) was initially planned for use in a narrow corridor, though it is now at home in a spacious living room. Barnsley thinks of this particular sideboard as "one of our best pieces." Nearly all his furniture is made to measure.

On turning around, there staring at me is an exceptional artifact—a no-money-spared writing cabinet that could make a reputation all by itself. It has attracted a well-favored name, the Jubilee writing cabinet or the Jubilee Piece. Jubilee refers to the 25th anniversary of Queen Elizabeth II's coronation. The cabinet went up to London and was shown there in 1977 at a Masterpiece Exhibition mounted by the Crafts Advisory Committee. Some admirers of Barnsley's work have used the word "ornate" to describe this piece, which certainly may go beyond his usual sober austerity. A matter of taste; for me "ornate" is a bit too strong.

After I have studied the cabinet from a multiplicity of angles, Barnsley, who is given to understatement, says, "I think we've got it about right." Half assessment, half interrogation. There is an unspoken question concerning its undoubted excellencies and possible infelicities. The underneath stretcher has been a great headache.

Bottom structures can be a fascinating challenge. How to prevent knees colliding with essential parts? How to make it easier to sweep underneath or allow chairs to be placed below a top? In the case of tables, Barnsley has produced some eloquently functional ideas, for example, the pedestal supports with quarter-legs soaring upwards from low-pitched straight feet.

The Jubilee writing cabinet made its debut with a framed-up structure comprising three panels, raised and fielded, with the end stretchers mortised and tenoned into the legs. Corner brackets have been tongued and glued into the corners of the framing—in this way the long, broad rail swells at both ends.

Several experiments led to this solution. At one stage, a borrowing from one of Barnsley's well-tested designs went forward into the shop. A hooped stretcher was to sweep upward, vaulting beneath the center of the underside of the carcase. The end stretchers were made and the rail was laminated. But Barnsley was not happy with the effect. The next move included making a back stretcher and clamping it to the rear legs of the stand. The hooped stretcher rail was tipped into the horizontal plane and its ends set against the front

Edward Barnsley

In the early stages of construction, the Jubilee cabinet had an upward-sweeping hooped stretcher, and then a horizontal hoop, as in the tables shown here. The elliptical dining table (1970), left, is English walnut with sycamore and ebony inlay. It measures 84 in. long and 42 in. wide. The bow-front sidetable (1962), center, is rosewood inlaid with sycamore, and measures 42 in. long and 33 in. high. Right, a typical laminated table understructure. The curved legs are attached to the feet and top bearing rails with splines instead of mortise-and-tenon joints, with the grain of the spline crossing the line of the joint.

legs of the base. The geometry now was similar to that of a small rosewood sidetable (page 42) made in 1962.

Again Barnsley was dissatisfied. Perhaps the sweeping curve clashed with the strict classical lines of the cabinet as a whole. For whatever reasons, the seduction of a curving stretcher was abandoned.

The change between visualization on the drawing board and the setting out of the shaped parts is all in the day's work. What happened next was less predictable, given the patient thought and infinite care taken over procurement and storage of timber at Froxfield: The woodworker's nightmare—twisting.

Barnsley shakes his head and mutters darkly, "Central heating has a way of shrinking panels disastrously. Disastrously." Somehow, for the cabinet's fall-front or flap, as well as for the rest of the carcase, shrinkage was to be outmaneuvered, despite its being made of solid wood, not veneer. Seasoning, perhaps kilning, and exacting acclimatization surely would do the trick if the right timber were selected. "There's a place for every piece of wood and a piece of wood for every job. If you can find it," Barnsley says.

Barnsley and his foreman-manager, Bert Upton (at Froxfield since 1924), are great squirrels when it comes to timber hoarding. This goes back to the days when everything was cut from the solid and it was necessary always to have ready a supply of naturally curved pieces appropriate for a repertoire of predictable shapes. Nowadays, off-cuts are likely to serve for outside laminations or solid fielded panels and hoarded for use on special occasions. Making the Jubilee writing cabinet was just such an occasion.

For the cabinet's fielded panels, a type of figured walnut spoken of as "flames" or "feathers" was used. Flames are taken from the junction where the tree forks (see page 49). To come up with matching flames was a teasing demand, but the large front and rear central panels and the end panels of the cabinet all have matching figure.

But I anticipate. The English walnut earmarked for the job had been stored in 1-in. or ¾-in. boards for the past 20 years at Froxfield. For the bureau's internal parts, wood that had reached Froxfield 30 or maybe 40 years ago was drawn upon. The particular oak log that was used came quartersawn, allowing the interesting rays which appear as a silvery splash to be displayed to best effect. Upton, who actually made the base with its three drawers and the unusual stretcher rail, declares that this oak was "wonderful stuff"; wonderful, although the sawyers had done their worst and the worms had added theirs. One edge of the boards, whose thickness tapered from ½ in. to ¼ in., had been completely eaten away. Nonetheless, excellent oak lining was produced. As part of Barnsley's fining-down policy, the lining measured no more than ⅛ in. thick. This raised peculiar difficulties. Keeping it out of winding during gluing wasn't easy. Had the oak been a hair's-breadth thinner, traditional joints in all probability could not have been used.

The oak, like the rest of the timber selected for the job, came indoors some months before reaching the planer. This permitted moisture levels to drop as low as possible. George Taylor (at Froxfield since 1937) made the top carcase incorporating the bureau and the bureau's front flap. He set about producing the frame and the solid panels with their exotic flame figuring. The flap lay around for some months and gradually there was no denying that the frame rails had moved. "They took this curve on. They were taking on this set," Taylor recalls.

A blow. No option but to backtrack. The flap was made up again in the solid. Yet again the walnut frame twisted. "Part of the cussedness of the wood," Taylor comments, with a smile. "You see, the flap is hinged only at one side and there's nothing to hold it except the frame. And the panels were so strong they pulled the frame out of true."

Retreat to lamination. A thin marine ply had to be sandwiched up and faced with walnut. So the frame of the flap is, to quote Taylor again, "impervious to all the curious queer creepies you get in wood."

Drawer detail from tall chest (shown on next page). The serpentine front is laminated from four layers of ⅛-in. oak, with thick rosewood veneers front and back, for dimensional stability. The back veneer is apparent at the wide end of the dovetail pins. A slice of rosewood was glued to the top edge of the oak core stock before the plank was resawed into laminates for bending—a nice solution to a difficult problem.

Now open the flap of the completed cabinet and take a long careful look at the solid panels of the bureau doors. These too have flames which come from single pieces of walnut cut through and opened up like the leaves of a book. From the two fields that face one another come different reflections. One face reflects more light, the other absorbs more light. A negative-positive effect results: Grain on the left-hand panel goes mainly downwards, grain on the right-hand panel mainly upwards.

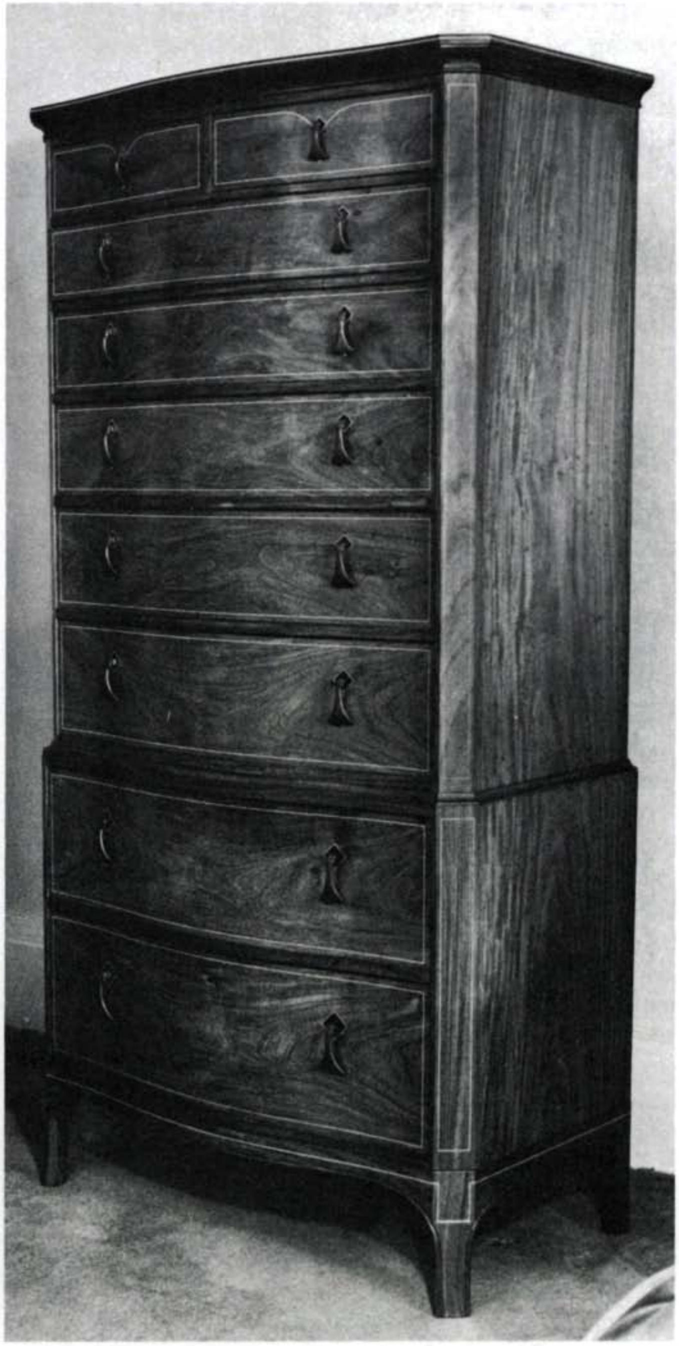
Some scraps and shavings in close-up: On the bureau doors there is a little step between the fielded surface and the curved shoulder, then a further step that goes into the groove of the frame. The stringing of sycamore with ebony diagonals is what Barnsley calls a "dark-light-dark-light inlay." Its purpose is to outline or contain given areas of work. "Like Picadilly at night," people used to say. "My mother-in-law as well as my wife expressed criticism of these intermittent inlaid lines," Barnsley recalls. He listened. His most characteristic signature today is unbroken white stringing.

Barnsley sums up the Jubilee writing cabinet as an explicit "second attempt to move beyond a 1905 design" of his father's. This, above all, involved general fining down. Sides of chests which used to be ⅞ in. are now ⅝ in. Legs of cabinets are down from 2¼ in. to 1¾ in. The dimensions of the stringing were "thought to make the inlays too prominent." Heeding critical voices, Barnsley says he came to reduce the width of such decorative elements by "50% to 65%, according to the overall dimensions of a piece."

A lesser signature is the design of Barnsley's delicate, elegant and practical handles. On the Jubilee writing cabinet these have been let in, but they appear to have been carved from the solid. His contemporary handles are placed at the front tops of the drawers. Earlier they were sited at mid-level. The upper surfaces are gently dished. The inlay of sycamore flows through the swell of the handle. It is formed by dry heat or perhaps a little steam. The grooves are cut with a fine circular saw, except where corners or shapes are involved. Then a scratch-stock is used by hand.

Photo courtesy Phillips and Harris, London/Ramond Fortt Studio

China cabinet (1958) is Indian rosewood with sycamore inlay and measures 78 in. tall, 36 in. wide. The front has a very slight serpentine curve, while the sides are concave—and the glass is curved to match. Note also the carefully shaped feet.



Serpentine front tallboy, in rosewood, was made in three parts—upper chest, lower chest and base—united by moldings. Wooden buttons, each in its own mortise, fasten the base to the lower chest. Drawer detail on previous page.

As a rule of thumb, each craftsman makes a piece from start to finish. "It's yours and you can stand by your own work," says Barnsley. But for bigger orders everyone in the shop may get involved. The boardroom pieces for Courtaulds were made by Oskar Dawson, Upton and Taylor. The Jubilee cabinet is the work of Upton and Taylor. Dawson tooled the ivory knobs: "Nice soft stuff to turn." Mark Nicholas, the apprentice, cut recesses to receive divisions forming the pigeonholes, and did other odd jobs. Barnsley added finishing touches to the hinges—filing and rounding and incising delicate lines on them.

Barnsley sums up the past 55 years: "Most of the work from 1924 until 1945 followed closely on Gimson's and the brothers Ernest and Sidney Barnsley," (his father and uncle). "Developments as from 1945 have mainly taken the form of lightening the work and introducing curves." Powered tools and lamination made curved work practical and economic. Slimming down included the elimination of stretchers to brace chair legs, use of the sturdy gun-stock joint, and diminution of wood thicknesses.

Barnsley, I feel, was never drawn towards the imaginative flights of British innovators such as Ambrose Heal and Gordon Russell. He dismisses much of contemporary furniture design as ephemeral. But words, his or mine, simply offer a faint shadow of the man. The most authentic of Barnsley's many selves can only be recognized by those exposed to the impact of his work. □

Harold Lowenstein, Aylesbury, England, is a cinematographer and has known the Barnsley family for years.

Locking the Joint

Tenons tusked, draw-pegged or wedged will hold without glue

by Ian J. Kirby

This article is about three variations on the mortise-and-tenon joint: draw-pegging, tusk tenoning and wedging. All exhibit a lively and creative mind on the part of their originators. Each has been in use for a long time and examples may be found in building construction, using material of very large section, as well as in the most refined cabinetmaking. The important lesson is that once the nature of the material is understood, and the principles of woodworking are applied, all the rest is wide open to the imagination of the maker. Superb execution of the work plays a supportive but secondary role in achieving a fine result.

The notion of a square peg in a square hole—the mortise-and-tenon joint—has been with us for thousands of years. Many woodworkers seem inhibited by this history and feel there must be a set procedure, developed over centuries, for any given joint. But joint design should not be looked upon in this light. There are two separate considerations.

One is, exactly what form shall a joint take? The maker must analyze the work the joint has to accomplish. He must consider gluing surfaces and strength of tissue on each member being joined. The second consideration, which usually gets seriously entangled with the first, is, does the workman have the skills and tools to make the joints he designs? The available tools at times can have a most consequential effect on the final outcome. Between these two considerations lies one of the more serious issues in teaching and learning to design. Our usual reaction as woodworkers, when we have to design anything, is to discard all those things lying outside our manufacturing ability. This tendency creates a form of tunnel vision. On the other hand, the serious design student without much woodworking skill is unfettered by tunnel vision. If he understands the principles, a creative solution is frequently the outcome. Conversely, the woodworker who has the skill to do the work but who ignores the principles is quite liable to make the thing in an accurate manner, while making it fundamentally bad. Fortunately, neither extreme is usually the case—we are mostly somewhere in between.

The idea that superb craftsmanship is the necessary springboard for all other areas of knowledge can thus be seen to be questionable. Indeed, the reverse is more likely to be the case—I would encourage any woodworker, beginning or advanced, not to feel inhibited by a lack of specific information about joints and other woodworking details. Knowledge of the principles involved is the salient factor—specific detail can usually be found in books and magazines and applied as the need arises. When a ready answer is not available, an intelligent application of the principles will normally solve the problem. We have access to a great deal of knowledge by studying the work of our predecessors, but that is not to say there is no room left now for the design of new joints and new systems by the individual woodworker. It is simply a question of the combination of basic principles with creative thinking, brought to fruition by excellent workmanship.

Most joinery in solid wood offers the choice of hiding the structural nature of the work, or of putting it on view. We have through dovetails and secret mitered dovetails, through tenons and blind tenons. Exposed structural elements may be embellished, usually by carving in various ways or by the introduction of alternate woods for wedges and pins. This type of joint may have such an effect on the visual quality of a piece of work that its whole nature is dramatically changed. A similar effect can be seen on a large scale in architecture, in such things as hammer-beam roofs and exposed girder work, and on a small scale in furniture joints. The drawings on the following two pages show the basic forms of these furniture joints and the basic procedure for making them.

These joints have the unusual characteristic of being able to function well without glue. Two of them—the tusk tenon and the draw-pegged tenon—can be disassembled without too much trouble. All three, once made, can be put together and worked on immediately—they are mechanically locked. The tusk tenon and the draw-peg tenon need no clamps at all, and the wedged mortise and tenon can be clamped until the wedges are driven, and then the pressure can be removed.

Good examples of draw-pegging can be found in old-style post-and-beam houses, and the joint is of course used by enthusiastic builders today. It is traditionally made by off-setting the drilled holes so the entry of the peg draws the structure tightly together. But I don't think it is cheating too much in cabinet work to put the work into clamps, apply normal gluing pressure, and drill through both parts all at once. For that matter it can be done at the time of gluing (unless of course you want the joint to knock down). If you draw the joint together in a small cabinet, don't overdo the off-centering. The result might be an unsightly mess on the emerging side of the peg hole, and excessive strain along the shear lines of the tenon.

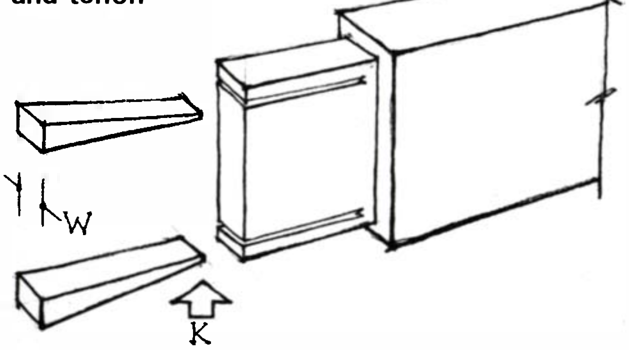
In the wedged joint, be accurate when setting out and sawing the wedges. If they are too small the joint will be loose, and if too large the wood fibers of the tenon will be crushed and broken. Don't make the tenon any more than 1/16 in. longer than the depth of the mortise. It is a total energy waste when it comes to cleaning up the joint—unless you intend to carve and feature the protruding tenon.

When tusk-tenoning, the critical points are an accurate match between the slope of the wedge and the hole through which it passes, and enough space inside the mortise for the wedge to do its work. This joint, more than any other, can be tightened almost indefinitely to accommodate wood movement. *(please turn page)*

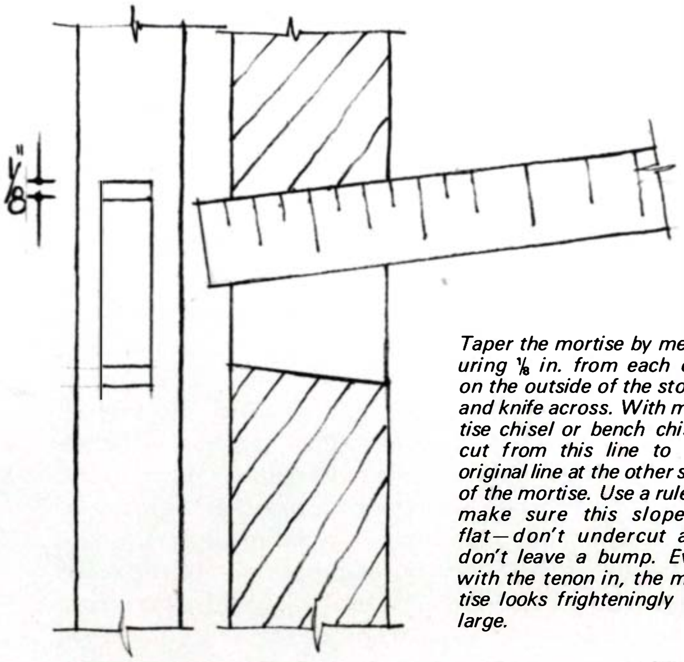
Ian Kirby directs his own school, Hoosuck Design and Woodworking, in North Adams, Mass. This is the second in a series which began with The Mortise and Tenon Joint, March '79.

Illustrations by author

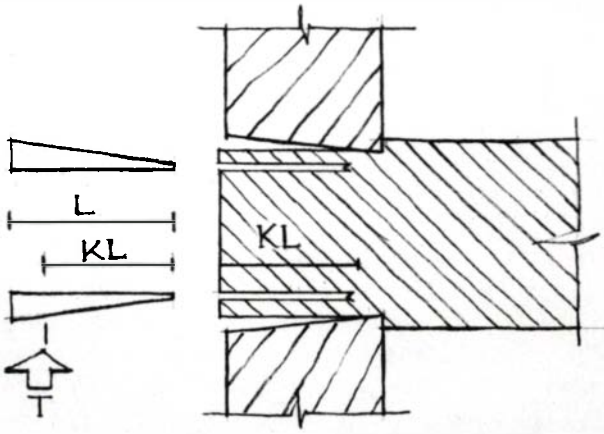
Wedged through mortise and tenon



The wedged tenon may be through or blind, using one wedge at each end of the tenon, as shown here, or two wedges at each end. Wedges are frequently made out of a different wood than used for the main work. If the color contrast is dramatic, accuracy at each stage is all the more necessary, for when the work is cleaned and polished, a narrow band of wedge at one end and a wide band at the other transmits an extraordinarily loud message. The thickness of the saw kerf is of little importance—use a tenon saw or a dovetail saw. Saw down the tenon 1/16 in. to 3/16 in. from the edge—the exact distance varies according to the pliability of the wood. Stop the cut 1/8 in. to 1/4 in. from the shoulder, to give the wood a better chance to bend.



Taper the mortise by measuring 1/8 in. from each end on the outside of the stock, and knife across. With mortise chisel or bench chisel, cut from this line to the original line at the other side of the mortise. Use a rule to make sure this slope is flat—don't undercut and don't leave a bump. Even with the tenon in, the mortise looks frighteningly too large.



KL *is the length of the saw kerf.*

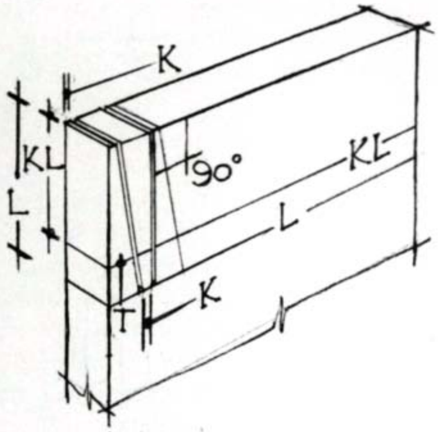
L *is the length of saw kerf plus 3/8 in.*

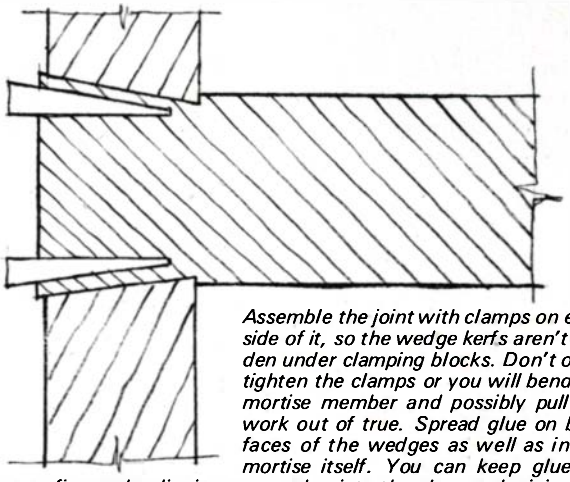
W *is width, same as width of mortise.*

K *is wedge thickness at tip, which is thickness of the saw kerf.*

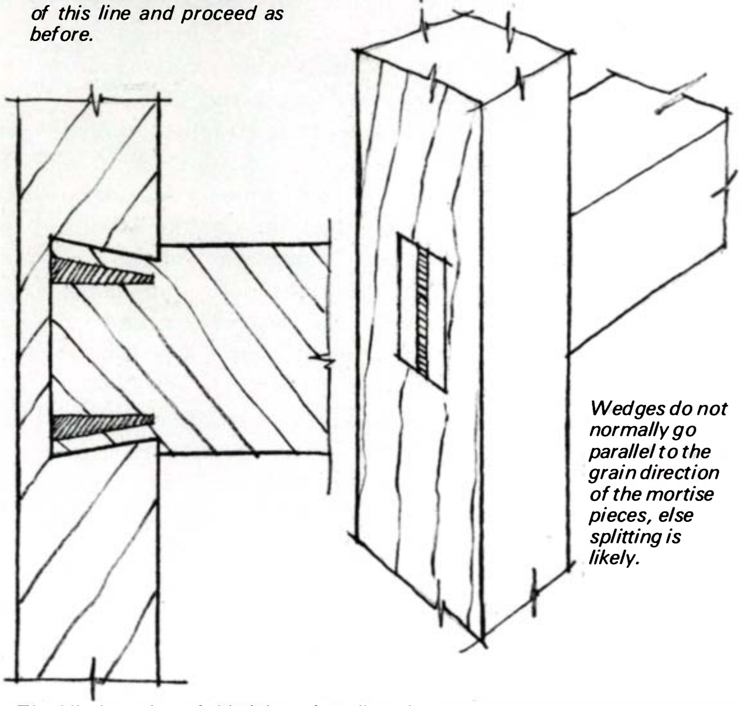
T *is the thickness at length* KL, *which is the tip thickness* K *plus the extra opening at the outside of the mortise, usually 1/8 in.*

To make wedges, prepare stock with grain lengthwise, as thick as the mortise width. Square one end and square round at length L. Also square round the wood at length of kerf KL. Measure kerf thickness K from the edge at the top, square across. On line KL measure in from the edge T. Connect points and saw down the outside of this line. To make the second wedge, measure K along line L from the edge of the first kerf, and with try square mark to the end of the wood. Saw the outside of this line and proceed as before.





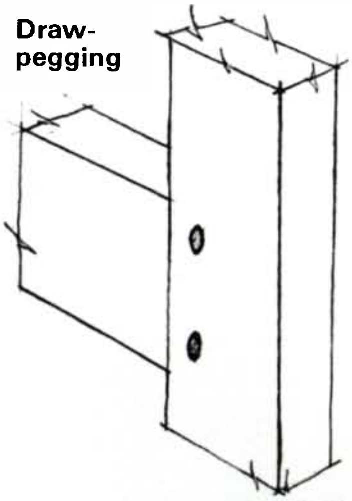
Assemble the joint with clamps on each side of it, so the wedge kerfs aren't hidden under clamping blocks. Don't overtighten the clamps or you will bend the mortise member and possibly pull the work out of true. Spread glue on both faces of the wedges as well as in the mortise itself. You can keep glue off your fingers by dipping one wedge into the glue, and wiping the excess onto the other. Drive the wedges with an iron hammer, not a mallet—you'll hear a distinct change in the sound of the blows as the wedge fills its space and becomes solid. Hit them alternately so they enter together. Once the wedges are snug, if time is pressing, you can remove the clamps and continue working. But if you are using a C-clamp across the joint to get a good cheek-to-tenon interface, best leave it alone until the glue has cured.



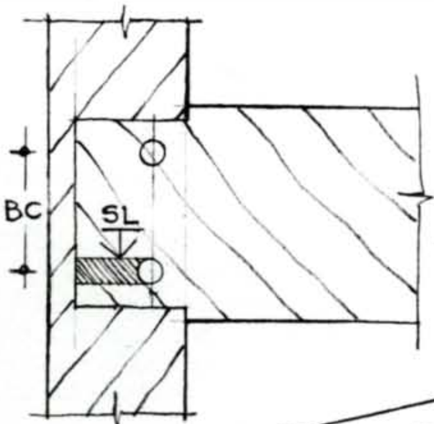
Wedges do not normally go parallel to the grain direction of the mortise pieces, else splitting is likely.

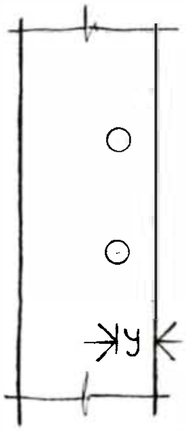
The blind version of this joint—foxtail wedges—requires strict attention to accurate measurement. Make the wedge without any excess wood on the end, and when cutting the mortise leave a good pad of wood on the blind side—at least 3/8 in. Clamp with a support block on the blind side, since the wedges press hard on the bottom of the mortise and are liable to damage the wood.

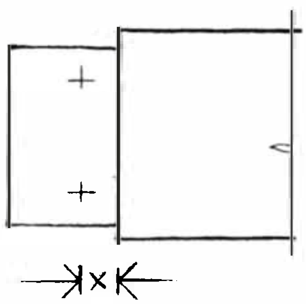
Draw-pegging



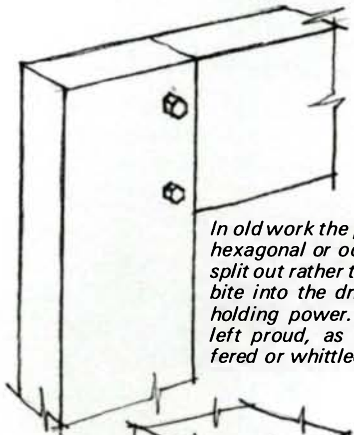
Choose a dense and somewhat pliable material for draw pegs and consider the diameter. Large pegs in buildings—treenails—are usually oak, hickory or ash. These ring-porous woods are less suitable for small work, where maple, birch or a denser exotic wood are preferred. Position is also a matter for judgment: If too close to the shoulder line, the mortise cheeks might split. If too close to the end of the tenon, the wood may fail in shear along the grain, on lines SL. If distance BC is less than 1½ in., use only one peg.



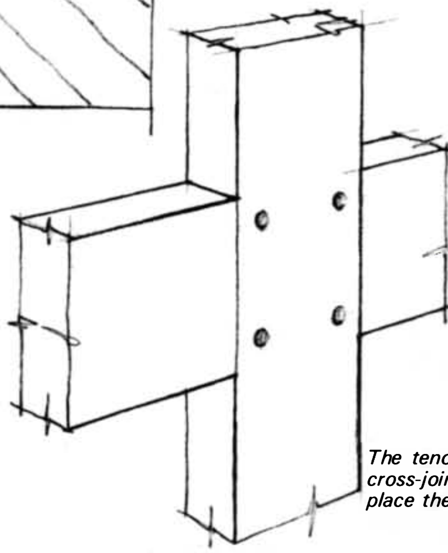




Make the mortise-and-tenon joint in the usual way. Whether one or two pegs are used depends on the size and shape of the members. Fit the joint, remove the tenon and drill through both cheeks of the mortise at Y. Replace the tenon, clamp the joint, and mark the center of the hole on the face of the tenon. This can be done by putting the drill back in the hole and giving it the lightest turn. Remove the tenon again, and drill the same sized hole about $\frac{1}{32}$ in. nearer the shoulder line from the marked center, at X. Thus the two holes are slightly off center. When the pegs are driven home the joint will be drawn tight. The procedure may be done entirely by measurement.

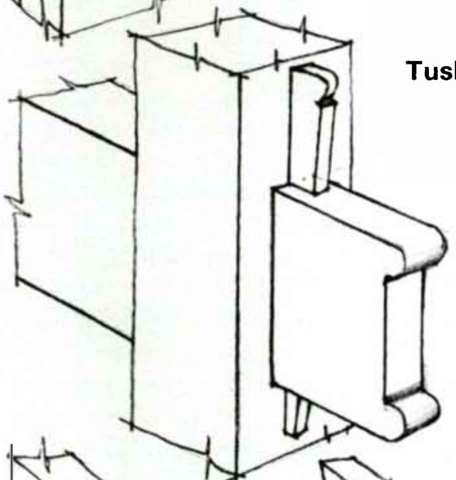


In old work the pegs were often square, hexagonal or octagonal in section, and split out rather than sawn. Their corners bite into the drilled hole, for increased holding power. Their heads are often left proud, as a design detail, chamfered or whittled.



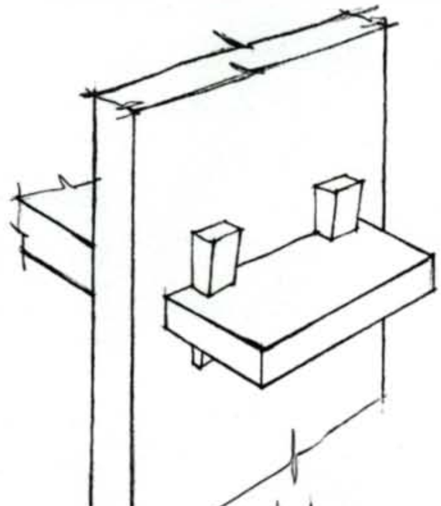
The tenons in this type of cross-joint may be short—place the pegs with care.

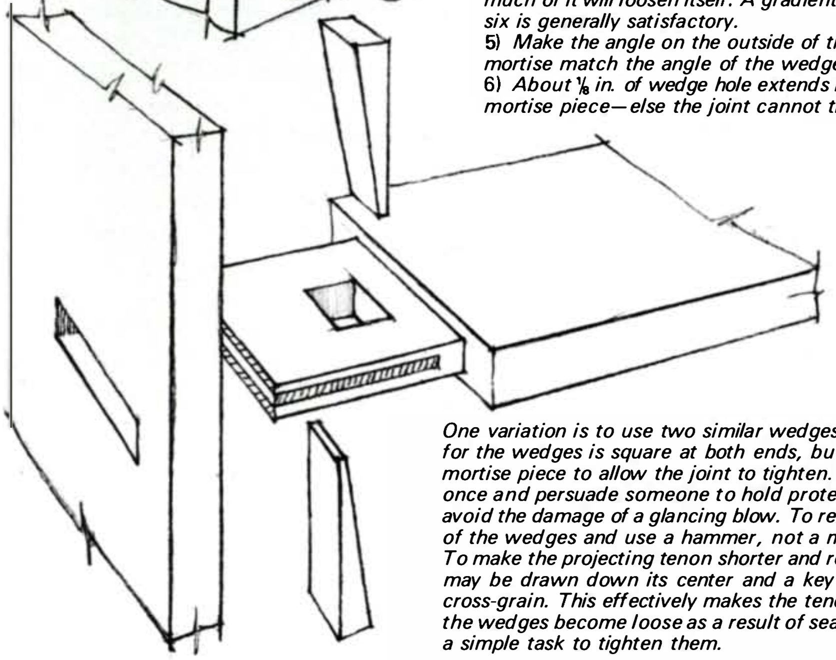
Tusk tenons

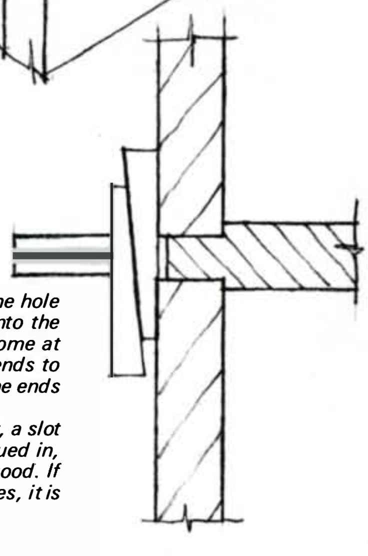


The wedged tusk tenon, left and right, is made in the same way as a through tenon. It can run vertically or horizontally—there is no formula. These drawings are only explanatory, and by no means exhaustive. Keep these points in mind:

1) Make the projecting tenon considerably longer than the thickness of the mortise piece, to guard against splitting along the grain when the wedge is driven home.
2) Make the wedges long enough for a good bearing surface on each side of the mortise. A short wedge will crush the fibers of both pieces.
3) Leave a shoulder all around the tenon piece, also for a good bearing surface.
4) Angle the wedge on one side, but not too much or it will loosen itself. A gradient of one in six is generally satisfactory.
5) Make the angle on the outside of the wedge mortise match the angle of the wedge itself.
6) About ⅛ in. of wedge hole extends inside the mortise piece—else the joint cannot tighten.







One variation is to use two similar wedges (folding wedges). The hole for the wedges is square at both ends, but it still must extend into the mortise piece to allow the joint to tighten. Drive both wedges home at once and persuade someone to hold protective blocks on their ends to avoid the damage of a glancing blow. To reduce this risk, angle the ends of the wedges and use a hammer, not a mallet.

To make the projecting tenon shorter and reduce the risk of shear, a slot may be drawn down its center and a key or spline of wood glued in, cross-grain. This effectively makes the tenon into a form of plywood. If the wedges become loose as a result of seasonal humidity changes, it is a simple task to tighten them.

Harvesting Green Wood

Patience and perseverance pay off

by Dale Nish

I have been working with green wood for several years. I have found the satisfaction of finding the wood almost as fulfilling as actually working it. In some cases, as with life, the expectations and anticipation are the most rewarding part. Once while deer hunting, I found a large, soft maple burl growing at the base of a small tree. The burl encircled the tree, rising to a height of perhaps 30 in. with a diameter of over 48 in. Over several years I envisioned the turnings which could be obtained from a burl of such beauty and size. At last I received permission to cut it off, and gathered together the necessary tools and equipment, a major undertaking, as the burl was far off the main road. After arriving at the tree and inspecting it carefully, an enthusiastic friend and I began to saw—the chain was sharp and the chips flew. Suddenly the bar fell into the burl. It was completely hollow. The only sound wood was a 2-in. to 3-in. shell. The burl was of no value at all for turning. Maybe next time.

Photos: Max Wilson

These bowls were turned from green boxelder burls found in Nish's neighbor's firewood pile. They measure 7 in. to 15 in. in diameter.

Seasoned and finished bowls turned from green silver maple, apricot, ash, black walnut, lignum vitae, macassar ebony, honeylocust and spalted maple.

The sources of wood for turning or carving are limited only by your patience and perseverance. The best wood cannot be purchased from a lumberyard or hardwood dealer, and even if the desired species is available, you will still be limited by the sizes offered. Most of us live where species growing locally far exceed species available commercially, but if you want to work local wood, you must cut your own.

Wood is everywhere. Robert L. Butler, in his book *Wood for Wood Carvers and Craftsmen* (A.S. Barnes Co., Inc., Cranbury, N.J. 08512), has a chapter aptly titled "Wood Is Where You Find It." In Utah, which is not noted for its forests, I have harvested locally grown oak, ash, maple, black locust, honeylocust, mulberry, English walnut and black walnut, American and Siberian elm, ailanthus, catalpa, cottonwood, poplar, boxelder, aspen, chestnut, sycamore, apple, pear, cherry, plum, peach, apricot and more. Wood is everywhere. I have found it in firewood stacks, trees bulldozed to clear building sites, limbs left from logging operations, windfalls after a storm and orchards being uprooted. Other good sources of turning and carving wood are tree-removal companies, city shade-tree departments, local sawmills, landfill or dump areas and friends and neighbors who know you are a wood nut and inform you when they see trees being cleared. Local sawmills frequently have short or crooked logs which have been discarded as uneconomical for processing into lumber. These logs are either inexpensive or free. Show appreciation with a gift of a turning or two and see how your supply increases.

A minimum of equipment is required for cutting your own wood. A chain saw is a necessity, and you will also need a maul, splitting wedges and a peavey (if the trees are large). A pickup or trailer is handy, but you will be surprised how much wood you can haul in the trunk of your car.

The chain saw must be sharp and in good condition. Cutting parallel to the trunk of the tree is different from cutting cross grain, as the chain cannot cut efficiently across the end surface of the log. I use a chain saw with a 16-in. bar for most of my cutting, but I have a saw with a 30-in. bar for larger pieces. Here in Utah it is uncommon for a tree to be more than 30 in. in diameter.

The chain must be sharpened according to manufacturer's specifications—teeth even in length and equally sharp, or the saw will lead toward the sharp side of the bar. If the saw has an automatic oiler, check to be sure it works. The oil reservoir must usually be filled each time you fill the saw with gas. Manual oilers must be used frequently, as improper oiling or insufficient oil will raise havoc with the bar and chain. Always use ear protection, since many saws can cause permanent ear damage after a short time of continuous use.

Cutting the wood — The first step in working a bolt (log section) is cutting off its ends to remove end checks. If you are concerned about nails or dirt in the bark or wood, remove the bark with an ax. This isn't always necessary, and I usually leave the bark on the log until I am ready to work it. The bark helps keep the log from drying out and checking, but it also encourages grubs and beetles, which may ruin the log or at least destroy the sapwood. If you remove the bark, cover the log with plastic to prevent drying and checking.

After the end checks are removed, measure the useful diameter of the log and cut the bolts in lengths equal to the useful diameter or in multiples of it. Don't cut short lengths unless you're ready to work them. Short lengths quickly check and the bolt may be ruined.

After a bolt is cut, I stand it on end on wood blocks or slabs. Be sure the bolt is in a stable position for sawing. The bolt may be laid out different ways, depending on defects, pith (small growth center of the tree) position and end use. Large checks may sometimes be the places to make the cuts. One thing is constant—the pith must be removed from the flitches (blocks of wood cut from the bolt). Several options for layout and cutting are shown in the diagram at right.

Once the cuts have been outlined on the end of the bolt, make cuts parallel to the sides of the flitches. These cuts should remove most of the bark, but don't cut too deeply into the sapwood. The exception here is fruitwoods. Their sapwood is almost impossible to season without checking and should be removed.

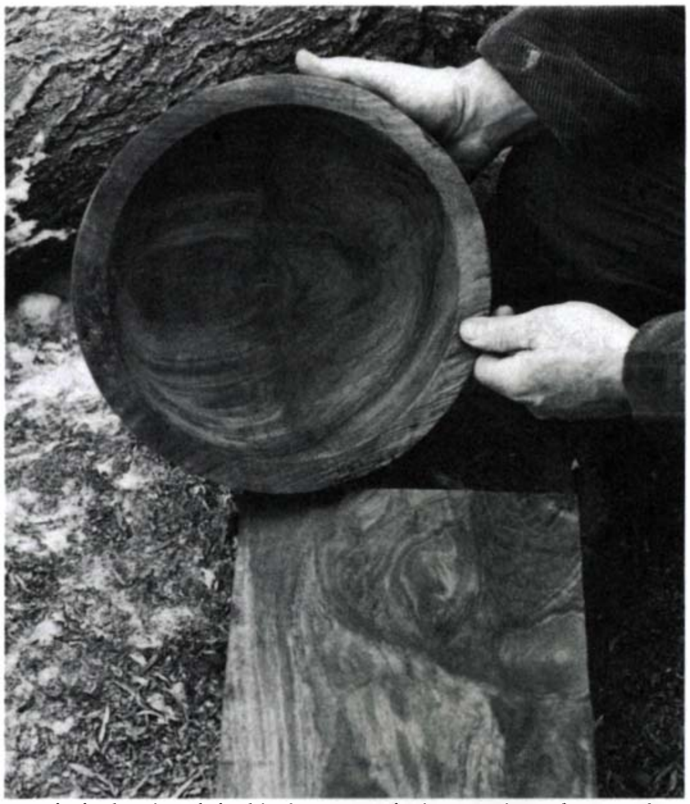
The next step is the primary cut, which will usually halve the bolt. For the remaining cuts remove the pith. Any remaining bark should be removed with the ax.

Try to cut with the sawbar making an angle of about 30° to 45° to the end of the bolt. Cutting parallel to the end of the log is inefficient because you are cutting end grain, and cutting parallel to the length of the bolt produces long shavings that can not clear the chain, causing it to bind and overheat. Short bolts can be cut standing on end. Long bolts must be laid down for sawing. In either case, the bolt must be in a secure position and raised sufficiently to allow the chain cutting room without contacting dirt or rocks.

Cutting for figure — Most of the pretty figured wood in a tree will occur in the area below the major fork (crotch figure), in the stump area (stump figure) or in the occasional burl on the trunk or around the base of the tree. Crotch figure, the most beautiful, is seldom found commercially because it is usually trimmed off at the mill, or is so thin or short as to be of little value. Some of the finest crotch figures I have found came from local cottonwood trees on their way to the dump. Cottonwood trees, at least in Utah, have little commercial value and are seldom used even for firewood. Other species with beautiful crotch wood are honeylocust, black walnut, elm, ash, catalpa, aspen, cherry and apricot.

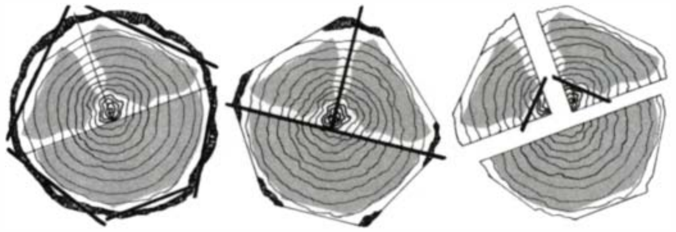
If I have a complete tree, I try to work the major fork first. The first two cuts, after the small limbs and branches have been removed, are about 24 in. above the fork of the tree, severing the two primary limbs from the main trunk of the tree. If weight is on the limbs, it's good practice to cut up from the bottom side to a point about halfway through, then cut down into the limb at a point 2 in. or 3 in. away from the first cut, toward the top side of the tree. As the downward cut progresses the cut should open up. Be careful, as the limb may break down to the first cut, and may roll or twist toward you. The next cut is made 24 in. to 36 in. below the fork of the tree. Before the cut is made, be sure to support the trunk with wooden wedges or blocks to prevent the trunk from settling and binding the saw blade.

After the fork has been cut from the tree, examine the ends for decay, splitting, insect activity or other deterioration. Use a lumber crayon, and mark the pith on the ends of the fork. If the fork is sound, transfer the crayon marks to the sides of the fork. Use a straightedge to connect the marks from top to bottom. These lines will be the cut lines when the fork is split.

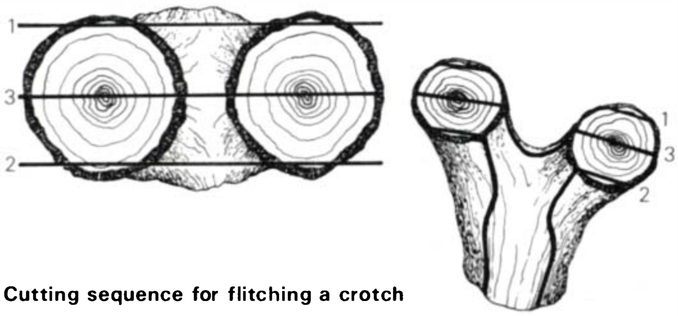


Both the bowl and the block contain the line resulting from grafting English walnut to Claro walnut root stock. The block was obtained from a tree grown in northern California.

Lay the bolt out according to how many bowls will fit, pith and any defects.



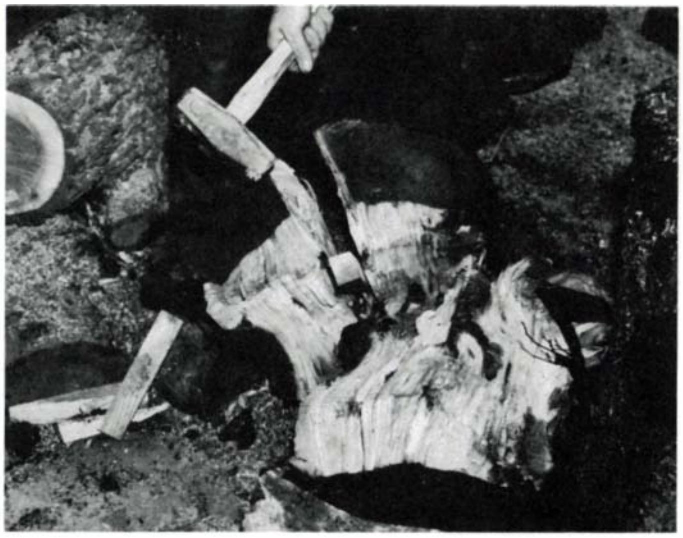
To cut a bolt, trim the sides of the flitches (left), make the primary cuts (center), then slice off the pith (right).



Cutting sequence for flitching a crotch

Using the center line as a guide, saw a slab from both sides of the fork, trying to keep the cut parallel to the center line. The slab cuts should remove part of the sapwood and bark, but should not be so deep that they remove wood that could be used during turning. Watch for nails or other metal, and pull or chop it out of the wood. Expect to hit a few nails if the trees come from yards or fence lines. Sharpening a chain is a small price to pay for a quality piece of wood, and in my experience, a nail or piece of wire does much less damage to the chain than does a small rock or pocket of sandy dirt.

After the slab cuts are complete, saw down the center line. Do not try to saw straight across, parallel to the ends of the forks. Rather, angle the cut 30° to 45° to the end-grain surface. This allows the chain to cut more efficiently. Too little an angle and the wood cut out by the chain will resemble sawdust; too much of an angle will cause the chain to produce long slivers or shavings, which will clog the chain drive. Experience will show you the best cutting angle. If the fork is large you may have to cut from both sides, at least until you reach the main trunk below the fork. Start the cuts carefully and be sure they line up and will meet at the junction of the fork. A cut running off to one side will require extra work, and could ruin a piece of wood of exceptional beauty and value. A perfect cut would be right down the pith of the tree, leaving part of the pith in each piece, resulting in minimum waste and two true, flat slabs. It is always exciting to make this cut and watch the fork separate. A feeling of wonderment comes over me, and I can hardly wait to see what is revealed. It is better than Christmas, because it happens every time a piece of wood is worked. One cannot do this and not see the Master's hand in this beauty of nature.



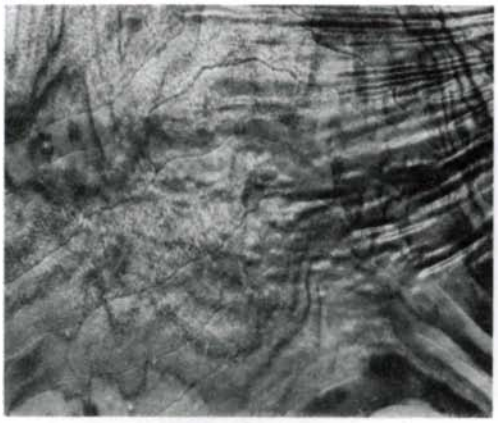
Wedges are used to split a cherry stump containing pockets of dirt and rocks. Be sure to split through the pith.

Some trees, such as black walnut, will have crotch figure anyplace a branch attaches to the trunk or larger branch. Other trees may not have true crotch figure, but you can always find beautiful figure in that area. Crotch figure of small trees is thin, often only an inch or two deep. To preserve it, shallow trays or plates must be turned, with the figure at the bottom so one can turn down to it and reveal it. Otherwise, the turner will go through the figured area into the plain wood, leaving the figure visible only at the edges.

Stumpwood — Stumpwood is that portion of the tree which starts to flare at the base of the trunk and continues into the ground. A tree is usually cut off at a point 1 ft. to 2 ft. above the ground, leaving the stump intact. One can often saw the stump off close to the ground and collect a fine piece of wood. At other times the stump may be dug out completely. The roots are cut off and the remaining stumpwood cut up. For the woodturner the stump offers many opportunities, including a lot of hard work. Color and patterns are beautifully innumerable. Stumps contain both sapwood and heartwood, just as in the trunks of trees, but they will not be so evenly separated and will flow into each other. Colors are often more dramatic, with streaks of black and dark browns coming to life, producing marble-like patterns. Because the stump is in continuous contact with the moist ground, it is subjected to mineral stains, stains from decaying surface matter and other colorants. The irregular grain found in the stump may show as quilted figure, fiddleback, ribbon or swirl—the only thing certain about a stump is uncertainty. You can expect figure equal to or better than that found in other parts of the tree, with the possible exception of the crotch figure. Because stumpwood figure goes all the way through the blocks, stumpwood usually can be cut into various sizes and turned with little regard to grain direction. This wood is excellent for deep bowls of simple design.

Burls — Burls are rare, and usually available only as veneers, but if the woodturner is alert, burls can be found. Burl wood has most interesting designs, in many colors and textures. These wart-like growths are usually found around the base of the tree, but may appear anywhere on the main trunk. The burl consists of a mass of dormant buds, sometimes called eyes. Therefore, there is no alignment of wood fibers, and the burl is gnarled and misshapen. This in turn produces figure of unpredictable color and pattern. Because burls have no grain direction, they are quite stable when turned green, and in most cases are easier to work than wood from other parts of the tree. Make sure to use sound burls, without bark pockets or decay. Cut them into their most useful sizes, disregarding grain direction. Often only small pieces can be turned, because of defects, but if the defects are small, I often turn the piece and leave the defect in the surface of the turning.

Treating green flitches — Trees are designed to carry sap, and so long as a tree is alive, its cells are full of water. When a tree is cut down, it begins to lose moisture. This process is called seasoning or drying. As the wood loses water from the cells it becomes lighter, harder and stronger, and it also shrinks in size. Seasoning will continue until a balance is reached between the water in the wood and the moisture in the air around it. This balance is called equilibrium moisture content (EMC). Because the EMC will vary with the humidity



Marble-like figure of walnut stump can be turned with little regard to grain direction.

Walnut burl. The eyes are formed by the dormant buds that compose the burl.

Shallow trays were turned from ash with crotch figure.

in the surrounding air, final seasoning should be done in areas similar to where the wood will be used. In most cases, this will be in heated rooms.

Green flitches should be end-coated immediately after cutting, as checks will quickly appear unless the ends are sealed against moisture loss. If the flitches are to be seasoned before turning or held for a month or two before turning, I prefer a commercial end-coating made by Mobil Oil Co., called Mobilcer-M. Coat the ends and about 2 in. in from each end, and also areas of high figure, knots and (with some species) sapwood. Other end-coatings such as hot paraffin wax, asphalt, thick oil-based paints, vaseline or white glue may also be used. If a flitch has been cut and left for a few days without treatment and the ends are checked, make a fresh cut to remove the checks before end-coating. For temporary storage of flitches or green turning blocks, I often use plastic bags.

Flitches that are to be seasoned for later use should be treated much differently. I cut them as long as possible, because there will be less trimming waste when they are finally used. I then weigh each piece and write its weight and the date on the flat side of the flitch. The weight will be recorded periodically, and when it stabilizes, the moisture content of the wood will be in equilibrium with that of the atmosphere.

After weighing and end-coating the flitches, I stack them in an unheated shed. Sticker the flitches if flat and of uniform thickness, or stack them if they're of random size and thickness, to allow for good air circulation. Then cover them tightly with a plastic sheet. In humid areas, you could probably leave them uncovered.

If you weigh a block of green wood on a daily basis, you will note that most of the weight loss occurs in the first few weeks. This is also the time when checking is most liable to occur. Covering the green wood with plastic gives it a chance to season slowly, without checking. If the wood has a lot of figure, or is very valuable, I sometimes leave the plastic on for several months and then open the bottom of the cover to allow the direct outside air in contact with the wood. Over a period of a month or two the cover is opened more and more until it is completely removed.

When the weight has been stable for several weeks, the EMC has been reached. In most areas, this will be between 12% and 15% moisture content. At this point, the wood should be brought into a heated storage area and allowed to season to between 6% and 8% moisture content. The time necessary for this depends on species, temperature and thickness. Periodic weighing will indicate when the moisture in the wood has reached the EMC of the heated room, or a good moisture meter can be used to check the wood.

Wood seasons at various rates, but you can expect at least a year per inch up to 8/4 stock, and three to four years for 12/4 or 16/4. Often, thick stock takes five years or more to season, and even then is not suitable for finished turnings. Green turning is the best solution for working thick wood.

If it is necessary to use wood that has been seasoned in an unheated area, rough-turn the bowl to shape, leaving a wall thickness of ½ in. to ¾ in. Remove the bowl from the lathe and allow it to sit on the bench for a week or two. It will probably warp a little, but it should not check. If you see checks appearing, put the bowl in a plastic bag for a few days to allow the moisture content to stabilize. Then, remove the bowl from the plastic bag and allow it to continue seasoning. Unless the wood has a high moisture content, one treatment in a bag is usually enough.

If during the turning process the bowl seems really damp, and you can feel the moisture in the wood, complete the rough turning and treat the bowl as green wood.

After you green-turn — Green wood should be cut to rough shape, mounted and turned in a manner similar to turning seasoned wood—except it is much more fun. After the bowl is green-turned to a uniform wall thickness of ¾ in. to 1 in. for bowls less than 8 in. in diameter, and 1 in. to 1¼ in. for larger bowls, I coat the surfaces, inside and out, to control checking during seasoning. Before coating the bowl I often weigh it and write the date on the bowl.

For bowls with no problem areas, a heavy coating of paste wax is usually sufficient. Coat the end grain carefully, forcing the wax well down into the fibers. If a bowl has high figure, knots or sapwood, coat these areas with Mobilcer-M, let the coating dry until it has a clear appearance, then coat the remainder of the bowl with paste wax. Place the coated bowls on the floor or on low shelves in an unheated area with little air movement. After about a month, move them to a moderately heated room. Bowls coated with paste wax will season and reach equilibrium moisture content in about three months. If I am in no hurry, I often dip bowls in Mobilcer-M and let them drain dry. These bowls will take six to twelve months to be ready for finish-turning. □

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Shop-Built Vacuum Press

Air pressure bends and glues veneers

by Donald C. Bjorkman

Photos: Donald Bjorkman

The author's vacuum-formed lounge chair, veneered in rosewood.

Vacuum presses are used in several disciplines, for example, the vacuum frame in printing and the thermo former for making sheet plastic into various three-dimensional shapes. The concept is also quite useful in woodworking, since air pressure can exert a force of up to 15 pounds per square inch. This is enough to bond veneers into plywood, and to bend veneers or sandwiches of veneer and other materials over curved forms. The idea is to evacuate all the air from a contained space, thus bringing the weight of the atmosphere to bear upon that space and whatever is in it. The problem is to create a container that will allow one to pull pressure over irregular forms, and if possible to let one see what is going on during the forming process.

Originally, vacuum presses used a cumbersome rubber blanket about ⅛ in. thick. One could not form items with much of a third dimension, because the blanket would have to be lapped over at the edges where it was clamped to the platform. It was hard to seal against leaks where the rubber was lapped, and one never knew what was happening—or going wrong—until the glue had cured and the blanket was removed. If there had been slippage or misalignment during assembly, it was too late. The work was ruined.

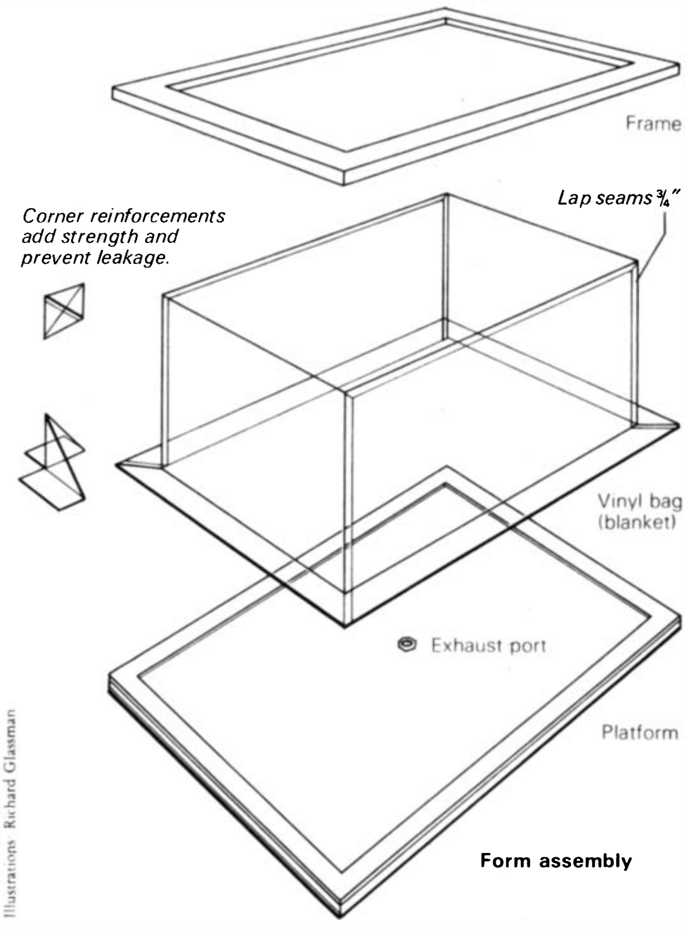
Some years ago, while doing graduate work at the School for American Craftsmen of Rochester (N.Y.) Institute of Technology, I came up with an idea that overcame both of these deficiencies. I have used this method successfully ever since. My idea was simply to substitute tough sheet vinyl for the rubber blanket, and to replace a complex plenum with a simple platform. The vinyl is easy to cement into various shapes, and it is transparent so one can see exactly what is happening as the vacuum is being drawn. My unit consists of a vinyl bag attached to a frame, which clamps to a platform. Any wood craftsman can construct this machine easily and relatively cheaply. Although many industrial pumps are sold for the purpose of drawing a vacuum, I converted my shop air compressor by a simple switching of the appropriate valves. The resulting machine permits projects that are limited only by imagination and ingenuity.

Building the press — Many woodworkers already have in their shops most of the materials necessary for this press. Everything should be available locally at lumberyards, industrial hardware stores and plastics outlets.

The press platform is a wide, flat sheet with a hole in the center for evacuating the air. I have found it unnecessary to use a perforated platform with a plenum (vacuum chamber) below, or a perforated pipe for uniform evacuation. Instead, I raise the form on skids inside the vinyl bag, which allows air to flow from all areas of the bag to the center exhaust port.

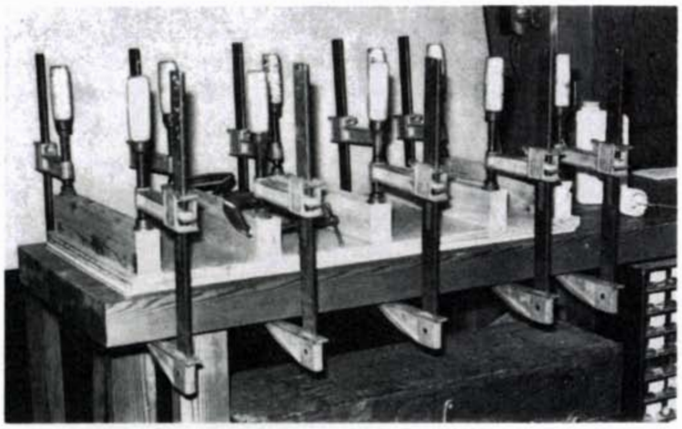
Don't make the platform from a plain sheet of plywood because it generally has internal voids that will leak air and could break out. Marine plywood is suitable, but I generally use a 3-ft. by 4-ft. piece of ¾-in. chipboard, skinned on both sides with ⅛-in. hardboard (Masonite). This sandwich not only airproofs the platform, but also strengthens it.

Gluing large, flat areas such as hardboard to composition board can be a problem if you don't already have a vacuum press or a screw-type veneer press. I suggest making up gently curved clamping members to span the platform, and compressing them with quick-set clamps. Cut scrap 2x3s to the shorter dimension of the space to be spanned, in this case 3 ft. A larger span needs more substantial stock. Allow about 6 in. between these members for the clamps. If you already have a strong, flat surface, such as a large bench, it can be

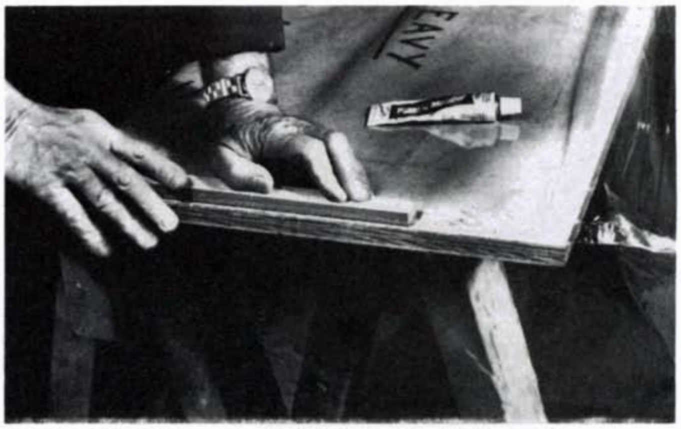


Illustrations: Richard Glassman

Form assembly



Simple veneer press for gluing up the hardboard/chipboard plat form atop a wide bench. Slightly bowed clamping members squeeze glue outward from center, eliminating glue voids.



Makeshift sawhorse table supports vinyl sheeting while seams are glued. Wooden slat maintains pressure while vinyl adhesive begins to set. Seam takes time to gain strength.

used as one clamping surface. If not, you'll need twice as many clamping members because they will have to be used on both sides of the workpiece. Put a slight curve on the side of the clamping member that will contact the work. This can be easily done by taking a series of cuts, each about 1/32 in. deep, with the jointer. Start the first cut about a fifth of the distance toward the center from the end. Take the next cut two-fifths of the way to the center, and so on. Rock the piece with pressure at the back as you pass it through the jointer. With four cuts on each side of center, the clamping member will rock 1/8 in. both ways from center. This way, as the clamps are tightened, pressure will be transmitted first to the center of the work and gradually farther toward the ends of the members, forcing the excess glue to the edges and preventing voids. Use a 3/4-in. sheet of plywood next to the hardboard to distribute the clamping pressure. Glue-up will be a two-person job if you don't have a flat surface to clamp to.

After the glue has set, drill a 27/64-in. dia. hole in the platform center to receive the fitting that goes to the vacuum pump. Finish the platform edges to your liking and then place a gasket around the edge. A good material for the gasket is 1½-in. to 2-in. wide camper tape, a self-sticking, sponge-rubber tape to be used between pick-up beds and camper tops and sold by hardware stores and recreational vehicle centers. Buy the thinnest tape available. Make sure the joints at the corners are tight. Liberally dusting the top surface with talc prevents it from sticking to the bag, but be sure to remove all loose talc before applying vacuum to the unit.

Next, make the frame that holds the vinyl bag to the platform. The frames's outside dimension should be the same as the platform's, and made of stock about 2½ in. wide and 1 in. thick. It can be made of plywood or lumber, and a simple lap joint at the corners is strong enough to resist leaking between clamps and to withstand repeated clampings.

The bag is made of 16-mil or 20-mil clear or frosted vinyl sheet. This sheeting generally comes in 52 in. widths. Check the Yellow Pages under: "Plastics—Rod, Tubes, Sheets, etc., Supply Centers." Mail-order suppliers include Cadillac Plastics, 15841 Second Avenue, Box 810, Detroit, Mich. 48232, and AIN Plastics, Inc., 160 Questen Parkway South, Mount Vernon, N.Y. 10550. Vinyl adhesive is used to cement the bag together. This can be purchased from plastics supply centers or local hardware stores.

A bag about 18 in. high should be enough for most projects. If you plan to produce a quantity of one object, you may want to tailor the bag to its shape. This somewhat simplifies the pressing process, because there is no extra bag material to contend with. In either case, it is best to have some of the material touching the platform when it is under vacuum rather than stretching directly from the form to the frame. This relieves some of the stress on the bag. An oversize bag is better than one too small. When clamping a small bag down over the form the vinyl could pull away from the frame, creating problems in the middle of a glue-up.

Cut the vinyl to shape. If the bag is to be rectangular, as shown in the sketch, I recommend that it be cut out in three pieces: two sides and a piece that forms the top and two ends. Remember to allow material for lapping at the seams, under the frame and at the miters at the bottom corners. A marker pen works well for laying out the vinyl pieces.

A sheet of plywood slightly smaller than the top dimensions of the bag and set on sawhorses makes a good table for cementing the bag. It works the way a shoemaker's shoe jack holds a shoe—by holding the bag in place without wrinkles and overlaps. Allow a 3/4-in. overlap for the seams. Using a brush or the tube and your fingers, spread a good amount of vinyl adhesive over the area to be lapped. Quickly press together. Do one straight seam between corners at a time.

A wood slat about 3/4 in. by 1/2 in. is suitable for applying even pressure on the seam while the glue sets. Hold the seam together with the slat for a few minutes until the adhesive sets a little. Then if the slat can be removed without exerting any tension on the seam, remove it. Otherwise weigh it down for another five minutes. Then remove the slat and let the seam set another five minutes before handling the bag. The seam takes time to get strong.

Corners are hard to make airtight. A corner with a radius may look nice, but a right angle has fewer points at which to leak. Notch at the corner so that it may be tailored square. Reinforcing corner patches make a stronger, more airproof bag. When the bag is assembled, cement it to the frame. Allow seams to strengthen overnight before using. Acetone will clean up hands and brushes, but the fumes can be harmful—work in a well-ventilated area or use a good respirator.

The pump — A vacuum pump for this press should be a high-volume type, minimum 1/3 hp. It should be able to pull at least 3 cubic feet of air per minute. Mine pulls 5 cfm and works well with a press of this size. The lower the cfm, the longer it will take to evacuate the bag. Any pump that can

New valve/fitting arrangement controls vacuum to press.

maintain a vacuum of 15 in. of mercury will work, whether it be reciprocal, diaphragm or whatever—you might even try the pump from a milking machine. One can rent pumps, but generally only in large cities. The pump can be hooked up directly to the press, or a unit with a tank reservoir and a vacuum switch can be used. The latter creates a vacuum quickly and lets the pump rest once it reaches the point the switch is set for. Without a vacuum switch the pump runs continuously, equilibrium being maintained by leaks in the system.

The difference between an air compressor and a vacuum pump of the same horsepower is slight. The pump generally has larger pistons, because the pump runs at lower internal pressures, the extreme being a bit under 15 psi. Compressors operate at much higher pressures, so I can see no harm in converting a compressor into a pump. I never got a straight answer from compressor salesmen or repairmen on this subject, so I finally went ahead and converted mine.

I have a Bell and Gossett ¾-hp compressor. To convert it, I switched the exhaust valves with the intake valves, keeping the exhaust valve plug and the intake filters in the same ports as they were. The check valve was also reversed so that the compressor was now pumping. The check-valve spring had to be replaced with a lighter one from a comparable pump. The pressure switch was replaced (it could also be bypassed) with a vacuum switch, and the conversion was complete. I have used this unit as both a pump and a compressor over the past five years with no bad effects.

Finding proper fittings to connect the pump to the press can be a hassle. The drawing below shows fittings obtainable from good hardware and auto parts stores. The filter may be purchased from an auto parts store or from the pump supplier. If a ¼-in. to ⅛-in. pipe reducer can't be found, a 5/16-in. O.D. tubing to ⅛-in. male pipe fitting may be used by removing the flare end area of the fitting.

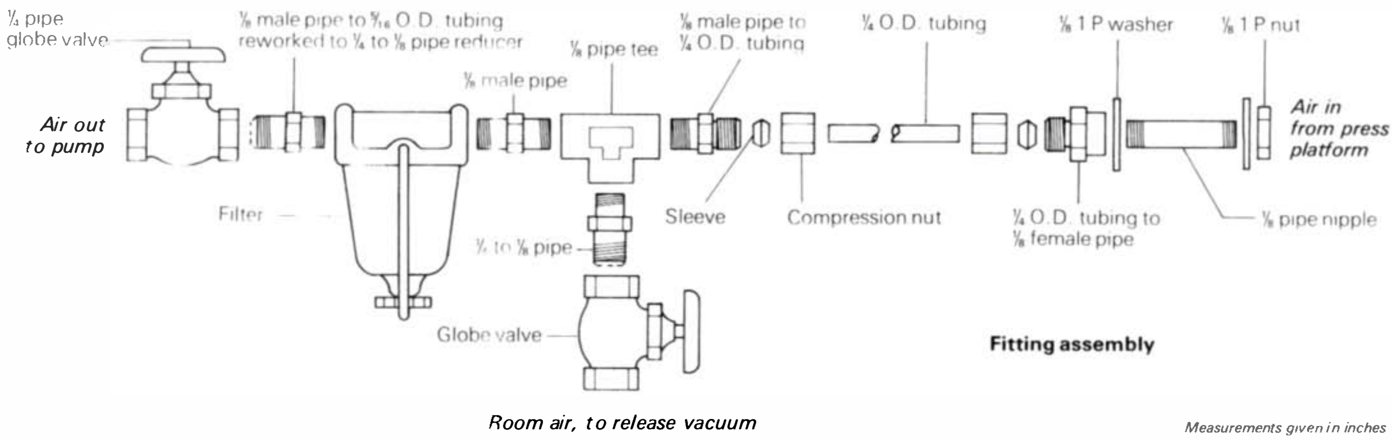
A thin ring of plumber's putty under the washers that clamp the nipple to the platform helps seal that connection. A loop bent into the tubing between the pump and the platform lessens the chances of work-hardening the tubing from vibration. The globe valves are to control the vacuum. The valve nearest the pump can be closed while the tank is brought to vacuum, or to stop air removal from the bag.

Materials to bend — One can vacuum-bend veneers, paper honeycomb, thin sheets of rigid foam, polyester resin and glass cloth, sheet aluminum, or virtually anything that bends relatively easily and can be cemented together with a time-lag adhesive. I find ⅛-in. poplar bending plywood imported from Italy easiest to use. It is three veneers thick, each veneer being about 1 mm thick, and comes in 4x8 sheets. This plywood will bend along the grain of the outer veneers to a minimum radius of about 2 in. When bent across the grain of the outer veneers, the radius has to be quite a bit larger. The plies are glued with waterproof glue, so tighter bends can be achieved by soaking the plywood.

The strength of a single sheet of this bending plywood won't set any records, but three or more sheets laminated together form a material strong enough for most applications. This is especially true if curves are incorporated into the design, and that's what this process is all about. Poplar is a white, bland wood with little character, but it veneers well and the multiple veneers of the edges are quite attractive.

A few years ago there were several suppliers of this material, but now I can find only one: North American Plywood Corp., with branches at 800 Third Ave., New York, N.Y. 10022; 3333 South Malt Ave., Los Angeles, Calif. 90040; and Box 24454, Oakland, Calif. 94623. No warehouse will sell less than a bundle of 60 sheets. To find the retailer nearest you, contact the closest branch.

The advantage of Italian plywood is the ease with which it bends. Several ⅛-in. pieces are easier to glue up and handle than three times as many 1/24-in. pieces of veneer. The disadvantages are the rather high cost and sometimes the difficulty in finding a retail source. Other types of ⅛-in. plywoods or door skins are available and will work. Door skins come in 3-ft. by 7-ft. pieces. The most common and usually the cheapest is Philippine mahogany. One-eighth-inch plywood in birch, beech, ash, oak, walnut or other hardwoods is often available at local lumberyards. Unfortunately these materials do not bend as easily as the poplar without fracturing. The tightest possible radius for mahogany ply, bending with the



grain of the outside veneers, is 4 in. or more. With birch it is much larger, and of course they all bend to larger radii against the grain. For large simple bends I've used poplar for the core material and a hardwood plywood for the faces, thus eliminating the veneering process. The reason these materials do not bend as easily as poplar is their construction. Poplar has three plies of even thickness, but the others have a core twice as thick as the face veneers. And the woods themselves have different bending characteristics.

Hardwood plywoods create very strong units when formed. A vacuum-bent piece, say of birch, is almost indestructable.

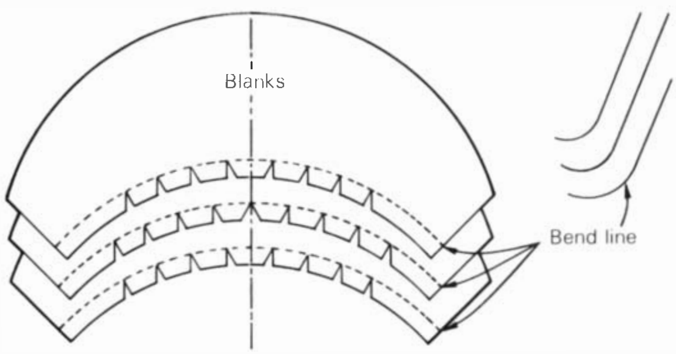
You may also want to consider veneers. I avoid using thin face veneers for core material, but core veneers about a millimeter or $\frac{1}{24}$ in. thick work well. Single veneers allow good control over forming curves because one can control the lay of the grains of the veneers as they are built up into plywood.

Design considerations — You must design to the limitations of the material you are using. If birch plywood is used, the curves must be large and simple; with $\frac{1}{24}$-in. poplar veneer, the radii can be much smaller and might possibly include compound curves.

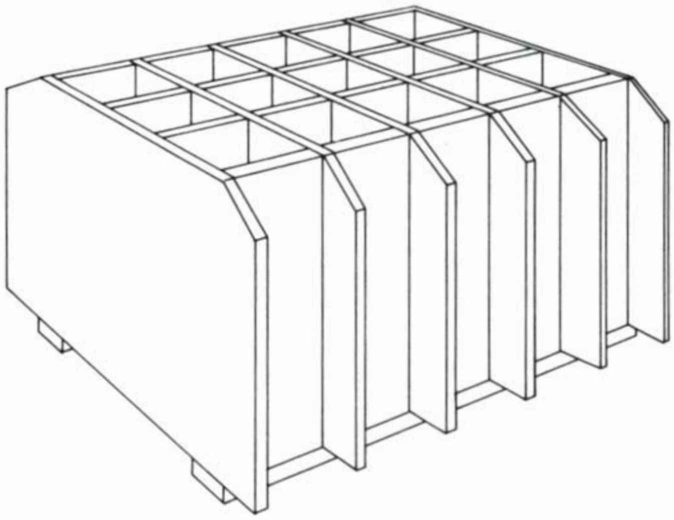
Straight, flat surfaces can be obtained from sheet plywood. Vacuum-bending permits curves that can add strength and beauty to the piece. Straight flat surfaces also have a tendency to show up irregularities and flaws, whereas curved surfaces are less likely to do so. Flat surfaces though, are sometimes necessary to a design, as in a sofa back. When confronted with such a situation I vacuum-bend the curved areas, then splice them to flat areas of standard plywood with a spline or tongue and groove joint. The joint is then made flush on both sides and the complete unit face veneered. This eliminates the need for a large form and press.

As you design, keep in mind what the form and press are forcing the material to do. Thin sheets of wood will bend to a point, then fracture. Slight compound curves can be formed without tailoring the pieces, but smaller curves require tailoring. Tailoring means notching the individual sheets that will make up the finished piece, as in tailoring clothing, so that they will bend over the form into a compound curve. The joints of the notches in one sheet must not fall in line with the joint in the sheet next to it or the piece will have no strength at these points.

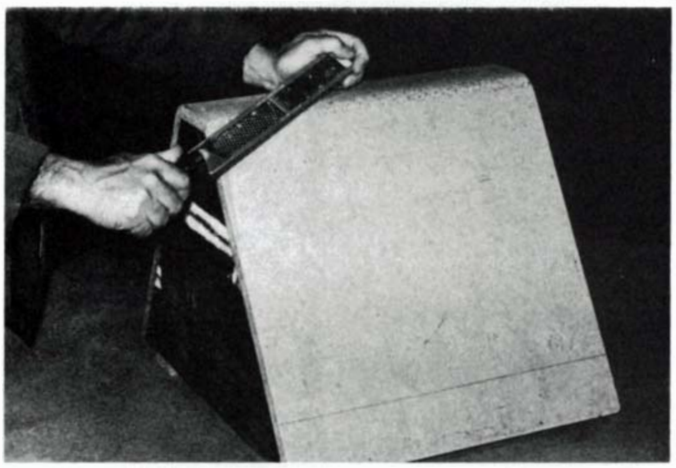
Forms — One might think that a simple pine form would suffice, but this is inviting catastrophe. The atmosphere exerts tremendous pressure when air is evacuated from a contained space. This system should be able to maintain 15 in. of mercury, which works out to 1,060 pounds of pressure per square foot, enough to crush a simple pine form, especially when you consider that the pressure is exerted in all directions, not just downward. I generally make forms of odds and ends and scraps of plywood and chipboard. I usually make an egg-crate framework and face it with hardboard or with poplar plywood. Composition boards work nicely for shapes with somewhat flat areas and are easy to shape with Surform rasps. If you use bending medium for face material, it should be glued and nailed in place one sheet at a time, with the last sheet vacuum-pressed into place. This way, no nail heads protrude and no frame ribs show through. If all the pieces were vacuum-formed onto the framework in one process, the blanks would not yet be bonded together and would have



On tight compound curves, blanks must be tailored, or notched, so they can bend around the form. If the notches are not staggered from layer to layer, the finished laminate will be weak.



An egg-crate framework made of plywood scraps supports the exterior part of the form, and must be strong enough to withstand pressure from all directions for vacuum-forming.



Surform easily shapes chipboard face of form.

only the strength of individual sheets. When pressure was applied they would give between supports and bond in that shape. This would most likely create a rippled or checkerboard effect that would be transferred to the finished piece.

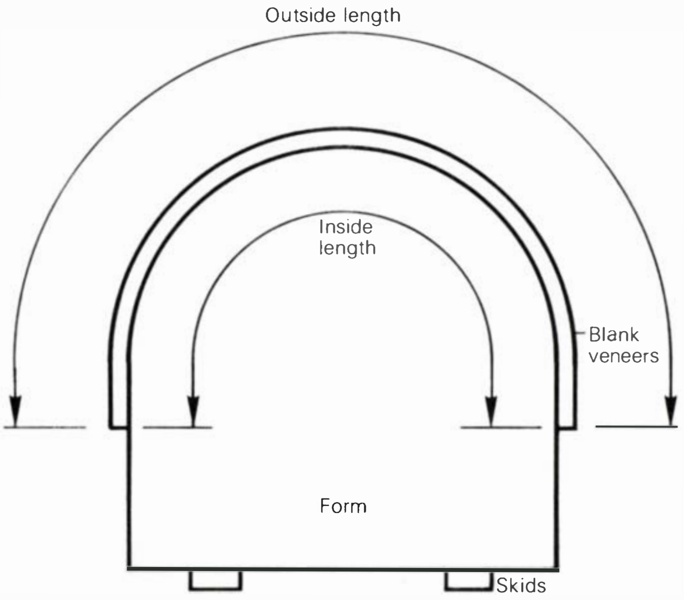
A set of skids glued and nailed to the bottom of the form allows it to set over the fittings in the platform and prevents the form from blocking the air passage out of the press.

If the piece to be formed is irregular in shape I suggest covering the form with heavy paper, such as kraft wrapping paper, and taping it in place. The outline of the piece can then be laid out directly on this. This creates a template for cutting the stock, and also tells you whether the plywood will bend into the shape you want without crinkles, overlapping or spaces between the form and the piece. If the paper won't conform to the form, the form may have to be reworked to compensate. If the shape of the form is simple, the stock can be sized directly from your drawings.

Transfer the template outline or its dimensions to the bending plywood and cut. Allow extra material at the edge for trim, and don't forget the increase in dimension needed to pass over radii as the thickness of the piece increases. To position the blanks on the form, place index points on the blanks that relate to points on the form. These should be placed in positions where the blanks will be secured to the form, generally at center lines.

Using the press — The importance of having all your equipment ready has been stated many times, but is worth repeating. Clear off a table or bench other than the press platform for rolling the glue onto the blanks, which should already be cut to size, cleaned, indexed and (if desired) veneered. A hammer, wire nails and wood washers should be ready, along with masking tape, brown paper tape and a piece of light rope. A helper would be welcome.

Now a dry run should be made. The blanks are indexed in place on the form and secured. Wire nails, with washers made of ⅛-in. ply scrap, work best when driven in at strategic points. The washers permit easy removal. Put the nails in areas that will be trimmed off. If the piece is to be veneered, put the nails wherever you want because the veneer will cover their holes. Don't put nails where they would prevent the layers from being pulled down tight against the form. Be sure no nails protrude, or they may puncture the vinyl blanket. A couple of nails along the center line are usually enough to hold the blanks in place. Masking tape can be used instead of nails (or to supplement them), but the vacuum pressure drives the adhesive into the grain of the wood and it is very difficult to remove. Another way is to countersink flathead screws with a brace and screwdriver bit.



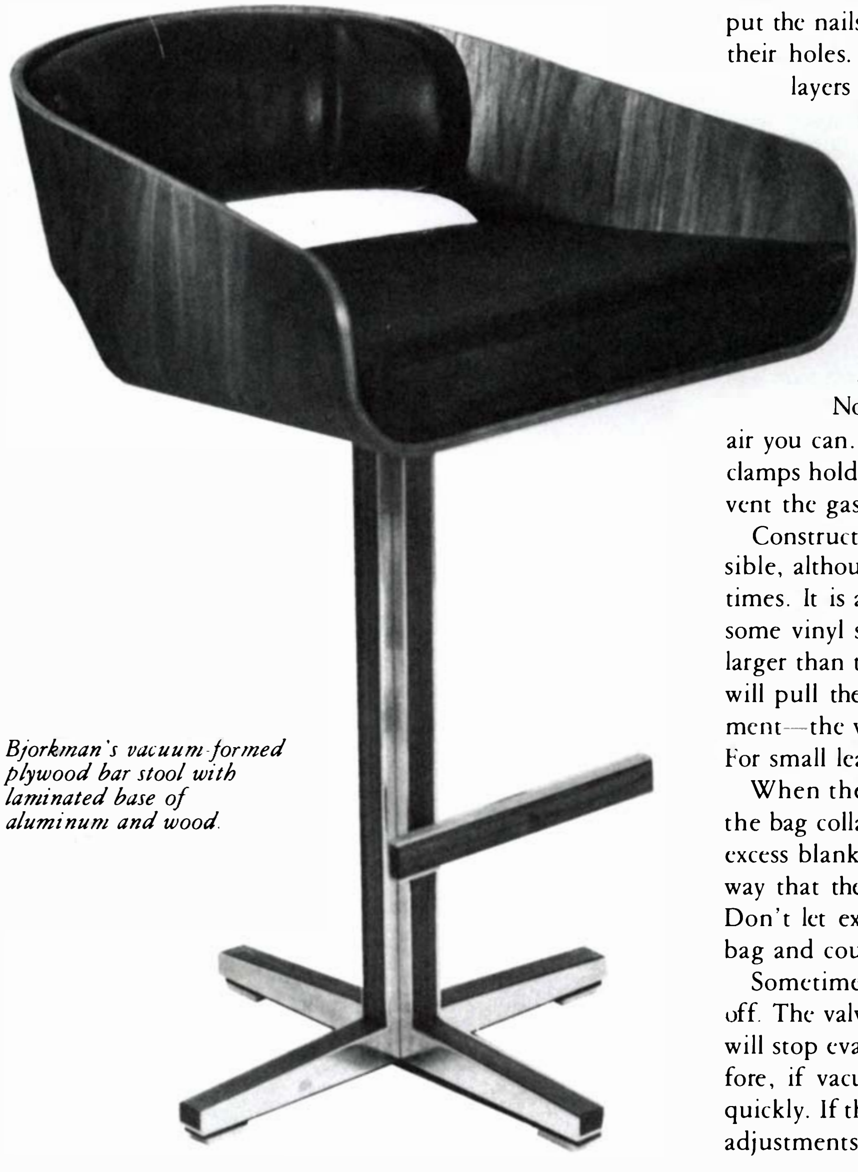
The thicker the piece, the longer the outside blanks will progressively have to be to wrap around the form.

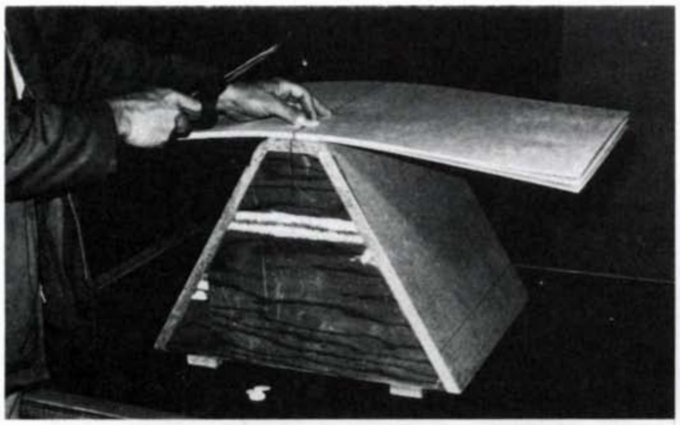
Now clamp the bag into place and work out all the air you can. Clamp about every foot along the frame. These clamps hold the bag in place until the vacuum is up and prevent the gasket from being sucked off the platform.

Constructing a completely airtight system is nearly impossible, although I have managed to get fairly close a couple of times. It is a good idea to have handy the vinyl cement and some vinyl sheet scrap from which to cut patches, in case a larger than tolerable leak occurs. The vacuum within the bag will pull the patch into the leak. Just don't overdo with cement—the vinyl can soften and the vacuum will pull it apart. For small leaks a dab of adhesive will generally do the job.

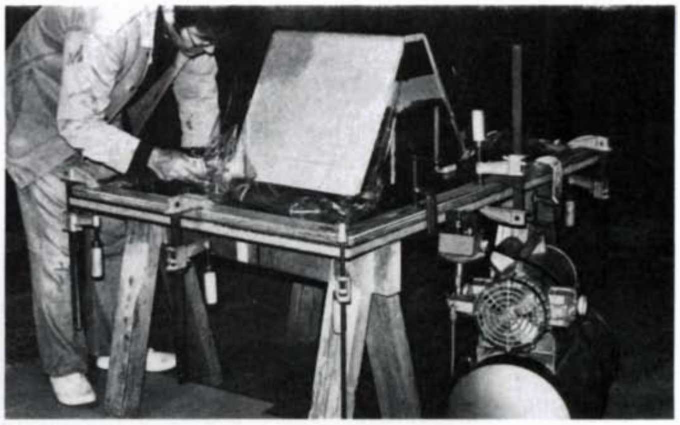
When the bag is clamped down, turn on the suction. As the bag collapses, smooth it over the workpiece and fold the excess blanket neatly around the form. Take tucks in such a way that the bag can be pulled taut as the air is evacuated. Don't let excess bag pull under the mold—it is hard on the bag and could block the air outlet at the platform center.

Sometimes the vacuum builds too fast and it must be shut off. The valve closest to the tank should then be closed. This will stop evacuation of the press, but not of the tank. Therefore, if vacuum is needed later, a reserve will be available quickly. If the vacuum is still too great inside the bag to make adjustments, open the second valve to bleed air in and relieve

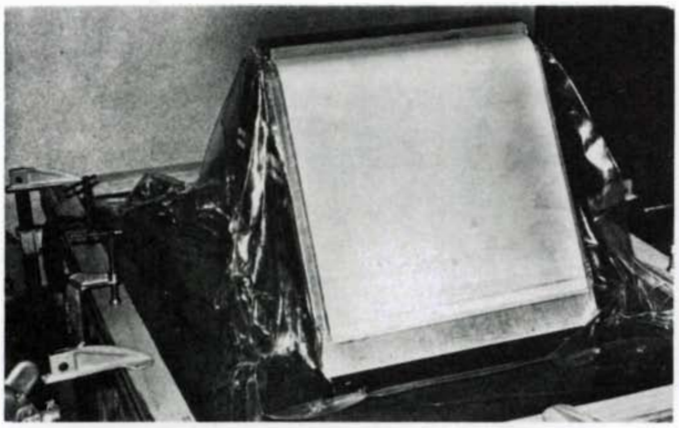

Bjorkman's vacuum-formed plywood bar stool with laminated base of aluminum and wood.



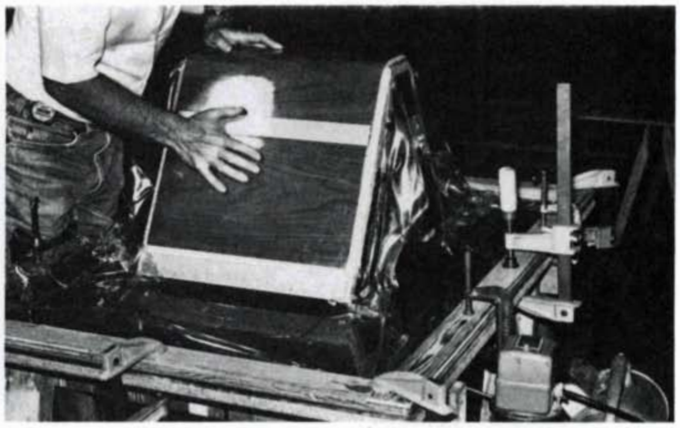
1 *Wire nails and wood washers hold correctly aligned plywood blanks in position.*



2 *Bag is smoothed over workpiece in dry run. Tucking excess blanket neatly around form prevents blockage of air outlet.*



3 *The workpiece under pressure: Extra sheeting is tucked neatly around form and away from clamps, air exhaust.*

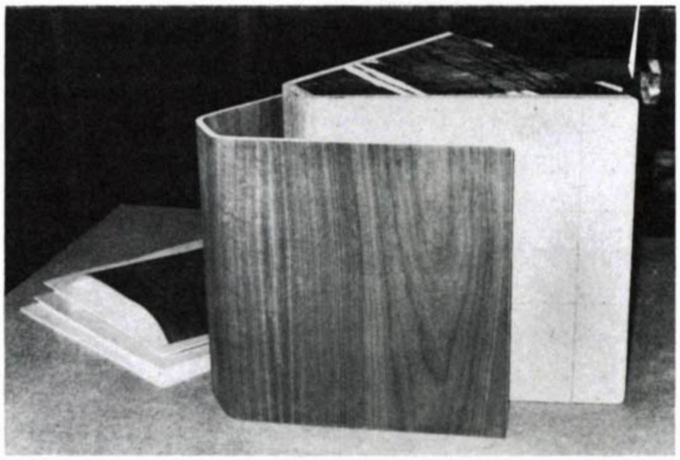


4 *Taped veneer is bent and glued to curved plywood in one vacuum operation.*

the vacuum. You'll appreciate the transparent blanket at this point, because you can see what is happening to the workpiece as the vacuum is being applied, what adjustments are necessary and what is happening during those adjustments. Most of this can be accomplished without removing the bag.

When the dry run is satisfactory, remove the workpiece and roll glue onto the contacting surfaces. Be careful not to apply glue to the surfaces that will touch the form or blanket. A medium coat of glue on each side is best, but a heavy, even coat on one side will suffice. Then proceed as with the dry run. I have found aliphatic (yellow) glues the best because of their relatively short setting time. Contact cement should never be used in vacuum-bending. The latex binder will sooner or later fatigue under stress and let go. An hour's press time usually does the trick, depending on room temperature and humidity, wood moisture content, and the amount and type of glue. Pieces with small radii or complicated curves may take longer. There will be some springback when the piece is removed from the form. The piece should be clamped to shape until thoroughly dry, because the bond can still creep from the forces exerted by the ply trying to return to its flat configuration.

If the piece is to receive a face veneer, it could be applied with hot glue and a hammer (Spring '78, pp. 52-54) But we now have a vacuum press, so let's veneer with it. Cut the face veneers to shape and index them, as with the plywood blanks. Apply glue to the contact surface of the workpiece only. Position the veneer on the piece and tape it in place with mucilage (brown paper) tape. Then vacuum-form as before. A ⅛-in. thick sheet of foam rubber or flexible foam urethane



5 *Left to right: blanks and veneer, the finished piece, the form.*

placed between the workpiece and the form will eliminate any variation between the match of the form and the workpiece and thus ensure a tight bond. One could even veneer while forming the plywood, especially if the item is rather simple, but it's better to gain experience with the press before attempting this.

If you don't like an exposed ply edge, apply a ¼-in. thick lumber edge before the veneering—it will take more abuse than a veneer edge. The existing ply edge, because of its many layers and solidity, is not visually unpleasing, however, and it will take stains that match the veneer. □

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Five More Chairs: One View

Does traditional seating meet contemporary comfort standards?

by Robert DeFuccio

EDITOR'S NOTE: In January and February, Woodcraft Supply Corp. of Boston inaugurated a new display space at its retail store with a show of five traditional chairs made by contemporary craftsmen. Three of the chairmakers—Dunbar, Moser and Alexander—have written books about their techniques. So we asked Bob DeFuccio to go there and have a sit, and to give these five chairs the same rigorous scrutiny he had applied to five contemporary designs (Jan. '79). DeFuccio, of Spinnerstown, Pa., is an industrial design consultant for two chair manufacturers—Gunlocke Co. and Thonet Industries—and has designed chairs now in production at Gunlocke and Stow/Davis Furniture. He designs and makes his own full-scale prototypes, and teaches woodworking and furniture design at Philadelphia College of Art.

In the following discussion and photo captions, all angular measurements of seat and back pitch relate to the horizontal floor and to a vertical line, respectively, not to the included angle formed by the seat and back.

Whether one's own tastes run to traditional or contemporary furniture, these chairs certainly merit attention. All five have been made with care and great technical expertise. The joinery is uniformly well done, the finishes are good. The choice of woods reflects a long tradition of craftsmanship and detailed lore. The forms are familiar to everyone: Their creators have made no effort to challenge our preconceptions. To many people, these chairs will evoke comfortable images of what chairs should be like. But they all seem to sacrifice comfort for historical accuracy. Their scale reflects people who weren't the same size as people today, and sometimes other modes of sitting. Many people will feel that these problems are overshadowed by what these chairs offer in the way of craftsmanship and esthetics. Others will feel that a chairmaker should heed the physiological needs of the sitter as well as his psychological need for the familiar.

Photos: Mike Germer, Intramedia

Continuous-arm Windsor chair, made by Michael Dunbar of Portsmouth, N.H. Overall width: at arms, 21¾ in.; at seat, 17 in. Overall height: 35½ in. Seat height: 17 in. Seat pitch: 3½°. Back pitch: 14°. Seat depth: 20⅛ in. overall, 15⅜ in. usable. Seat width: 17 in. Height of arms above seat: 9¼ in. Longest back spindle: 19¼ in. Weight: 9 lb. Price: $350.

Michael Dunbar's continuous-arm Windsor chair is a fine example of a well-proportioned, lightly scaled, lightweight chair, whose heritage dates back to early 18th-century England. Dunbar made it by hand, using 18th-century methods and tools. (The procedure is described in his book, *Windsor Chair Making*, Hastings House, 1976.)

The seat is New England white pine, the spindles and arms are red oak, and the leg turnings and stretchers are maple. The pine seat ensures a lightweight chair, and also carves easily and quickly. The maple is close and straight grained, strong and turns easily. Rived red oak is strong and when shaved to thin sections, resilient. Red oak is also right for the bow back because it can be readily steam-bent. The chair is finished with two slightly transparent coats of green milk paint, which obscures the differences of the several woods and allows one to visually read the form as a unified whole.

In studying the size and sectional dimensions of the parts, one soon realizes that these dimensions make structural sense and probably evolved by trial and error. The spindles are thin enough to flex, but strong. The bow back is square in section, measuring 13/16 in. by 13/16 in. where the spindles enter, and becomes a flat rectangle ½ in. by 1 in. where it bends into the arm. This shaping provides good engagement for the spindles, yet reduces the chance of breakage during bending. The arm post turnings are heavier than the other spindles, for strength and support. The seat is 1 11/16 in. thick at the rear, plenty of bulk for the spindle mortises, and thick enough for pronounced scooping—visually appealing and comfortable to sit upon. The unsanded turned legs are substantial and look crisp. The side stretchers swell to increase the amount of wood around the joint where the center cross-stretcher enters.

A key to the strength of this chair is assembling the bow under tension, done by compressing the spindles down into place with the bow. This construction permits the chair back to flex under the load of someone leaning against it, but not to weaken. The back is significantly strengthened by the two spindles that connect the upper part of the bow to the rear extension of the seat. From the side view, a sturdy triangle is formed. All the spindles are wedged from above as they go through the bow back, and from the bottom as they penetrate the seat. The four legs are also wedged through the seat.

The chair is logical and elegant, and its scale and proportions are very appealing. The combination of thin spindles, pronounced saddling of the seat, sharp, crisp turnings and changes in section as the back bow becomes arms, all contribute to visual interest. Both the shape of the parts and the residual tool marks on them reflect the tools of the chairmaker, and these traces of manufacture do not look out of place. A small assymetry results from the way the holes were bored in seat and back. The form of the chair accepts this irregularity and is even enhanced by it. One gets the impression of complete control of the material by the craftsman, and of a form that has evolved over time. Dunbar has burned his name ¼ in. deep into the bottom of the seat, which is not painted. His intent is to discourage anyone who would plane the name off and present the chair as an antique.

As far as meeting contemporary seating needs, this chair has problems. The major one is the narrowness of the seat. The usable distance across the seat at the rear is only about 12 in., limiting the number of people who could use it. The back is comfortable, even though its pitch is too much at 14°. Modern designers consider 9° to 11° ideal for a pull-up chair. It is admirable that Dunbar has revived the old method of making American Windsor chairs, but to me the value of chairmaking of this sort is to understand yesterday's technology and joinery in an effort to make better chairs today. To make his Windsor chairs more effective, I feel Dunbar should proceed one step farther and rescale to fit today's people.

Continuous-arm Windsor chair, made by Thomas Moser of New Gloucester, Maine. Overall width: 22⅜ in. Overall height: 41¾ in. Seat height: 17½ in. Seat pitch: 2°. Back pitch: 12° (at two center spindles). Seat depth: 15⅝ in., 14⅛ in. usable. Seat width: 22¼ in. Height of arms above seat: 10 in. Weight: 11¾ lb. Price: $295.

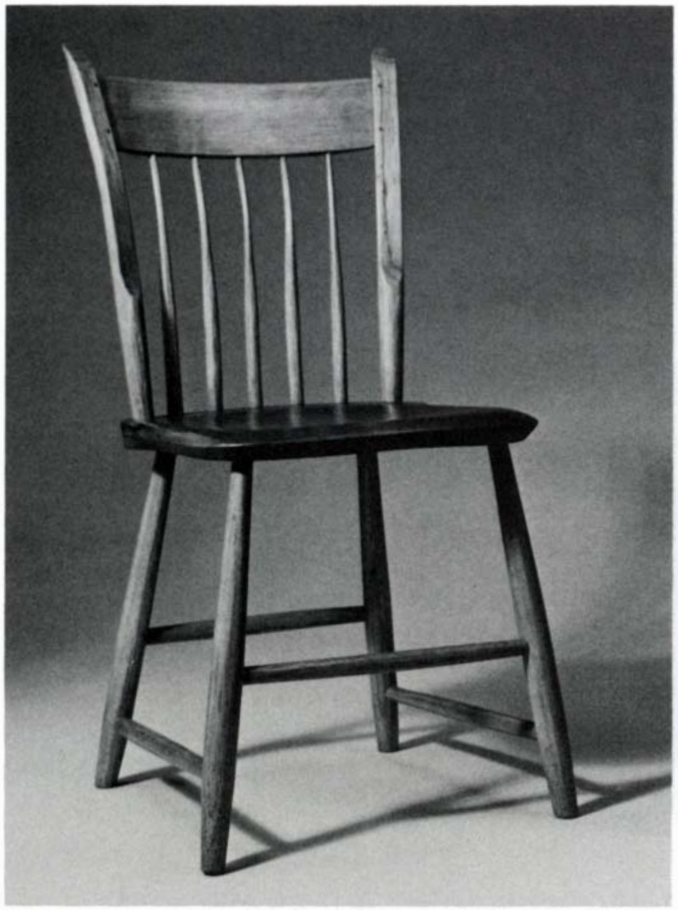
Thomas Moser's armchair is strongly influenced by traditional Windsor chair design. He has taken many of the standard elements to create his own contemporary version of an established design. (Moser's book, *How to Build Shaker Furniture,* Drake/Sterling, 1977, includes four ladder-back chairs and a bench, but omits the chair shown here.) Moser's chair is interesting because of its delicacy, but disturbing because of proportioning flaws absent from historical models. The back seems too high (41¾ in.) and the seat too short (14 in.). The chair looks compressed. The short seat provides no thigh support and is easy to slide out of because the pitch is only 2°. I put a ¾-in. spacer under the front legs, which almost eliminated the problem. The pitch was then 4½°. The seat is made from three pieces of edge-glued cherry, with the grain running side to side. It is nicely carved and scooped.

The continuous back rail and arms is bent from laminated cherry veneers. It is an eight-ply construction, with the veneers twisted during bending to permit the change of bending planes. The 14 back spindles are turned white ash. They all penetrate the back and arms, and are wedged with cherry wood. They also penetrate the seat and are wedged from the bottom. The contrasting color of the ash spindles cut flush with the cherry back and arms creates a strong graphic pattern that changes from almost perfect circles at the top of the back to long ellipses at the "elbow." This calls attention to the joinery but is also a distraction. The width of the arm is only 1⅛ in.—a wider arm would be more comfortable.

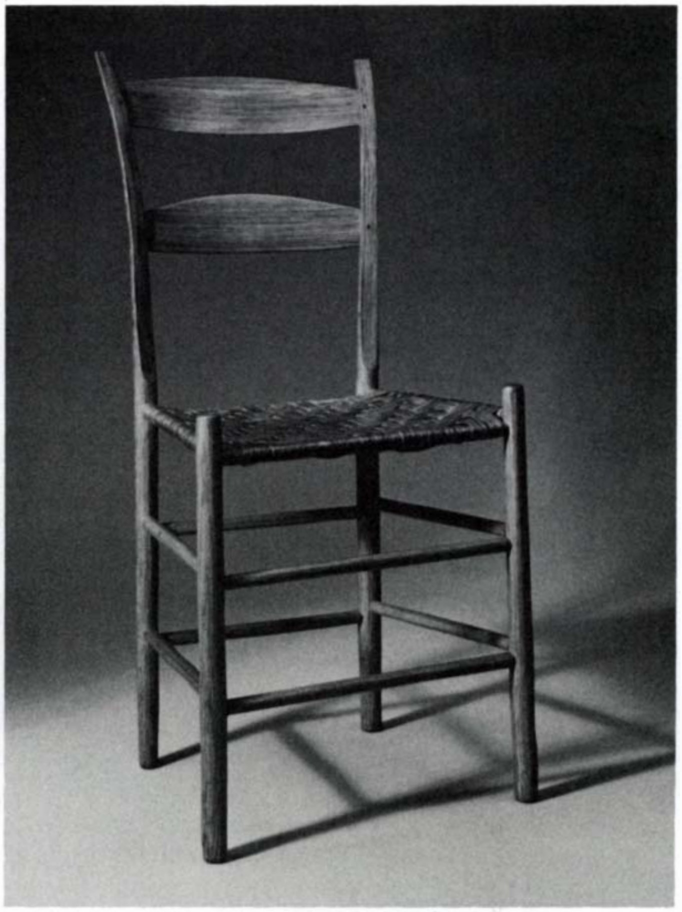
The entire back assembly flexes and adds to the general comfort of the chair. However, I doubt its strength, since the longest spindle is 24 in., 3¾ in. longer than the longest one on the Dunbar chair, and without that chair's triangulating back braces. The arm-supporting spindles are the same diameter as the other 12 spindles. A heavier arm support has to be stronger, and would be preferable.

The turned maple legs are joined to the seat with the standard wedged dowel joint. Moser has eliminated the conventional leg stretcher system and replaced it with two curved laminated braces. The braces are mortised into the back legs and doweled into the seat. This approach provides ample support for the rear legs, although I think it is visually unrelated to the rest of the chair. The front legs remain unsupported and rely solely upon their round tenons into the seat.

Moser has made an admirable effort to adapt design and structural elements from the past to create his own version of the Windsor. It is delicate and well-made, well worth the effort it would require to refine it and overcome its problems.



Thumb-back Windsor sidechair made by David Sawyer of East Calais, Vt. Overall width: 15½ in. Overall height: 32¼ in., 30½ in. to top of back rail. Seat height: 16¾ in. Seat pitch 2½°. Back pitch 19½°. Seat depth: 15¼ in. overall, 14 in. usable. Seat width: 15½ in. Weight: 7½ lb. Price: $110.



Bent-back sidechair by John D. Alexander Jr. of Baltimore, Md. Overall width: 17 in. Overall height: 35¼ in. Seat height: 18 in. Seat pitch: 3°. Back pitch: 15½° (at lower back rail). Seat depth: 13 in. Seat width: 17 in. Width of back: 15 in at top, 13¾ in. at seat. Weight 5½ lb. Not for sale.

David Sawyer's sidechair is called a thumb-back Windsor because of the shape of its back posts. It has a scooped cherry seat, with hickory legs, spindles, stretchers and back rail. It is well proportioned and crafted—visually, very fine. Sawyer is a serious student of traditional methods, who works mainly by splitting and shaving green wood.

Joinery details include legs that penetrate the seat and are wedged, back posts that neck down to dowel ends, penetrate the seat and are wedged from the bottom, stretchers that dowel into the legs and back spindles that dowel into the seat and back rail. The steam-bent back rail is tenoned into the back posts and held in place with four small pins.

The splay of the legs from both the front and side views makes the chair sturdy and stable. The height of the front stretcher in comparison to the side stretcher prevents kicking it while sitting. The angle of the back, 19½°, first seemed comfortable, but it is much too much deviation from the standard 9° to 11°. It offers little or no support when used as a dining or work chair. The back rail is only ½ in. thick at its heaviest, and the back spindles reduce to a scant 5/16 in. diameter to join its lower edge.

All the corners and edges of the chair are eased and pleasant to touch, with the exception of the tops of the back posts. They discourage leaning one's arms against them, and could well be blunter and softer.

The chair is well engineered, though I see a potential problem with the strength of the back. The back posts are not a continuation of the back legs, and depend wholly for strength upon their dowel joints into the seat. The back spindles do add some strength, but after a year in a centrally heated house, the back posts might shrink. The dowel joints would loosen and the back could be vulnerable. The back currently flexes—comfortable, but not reassuring.

The seat is too small—the usable depth is only 14 in., minimal, as is the width, 15½ in. More shaping of the seat in the form of saddling or scooping would also make the chair more comfortable. The seat height, 16¾ in., is a little low and this would be evident if the chair was used at a dining table—normally 29 in. high or more.

John D. Alexander Jr.'s chair is a post-and-rung construction, with a woven seat and bent back posts and slats. The chair's posts are riven white oak, with rungs and back slats of riven hickory. The seat is hickory splint webbing. It is a marvelous chair, like Sawyer's and Dunbar's made entirely by hand in the old way. An appealing feature is its light weight. a mere 5½ lb. Easily lifted with one finger, the chair could probably support a 300-lb. person. (Alexander, like Dunbar, has devoted an entire book to his chairmaking methods. It is *Make a Chair from a Tree*, The Taunton Press, 1978.)

The chair is resilient and reasonably comfortable, although the severely bent rear posts provide more back pitch than is necessary—15½°. It is relatively stable, even though the rear legs tilt in 3° from the side view. There is an obvious limit to how far back one can lean without upsetting results.

The hickory-splint seat is made from strips of inner bark 1/16 in. thick and 3/4 in. wide. When woven this material is strong, yet flexible enough to yield slightly when one sits.

All 12 rungs dowel into the legs in a staggered configuration. Their mortises don't interfere with one another except for an intended small tangential overlap, which mechanically locks half of the rungs in place. The bent back slats are only 7/32 in. thick and lead directly into the back post mortises, where they are pinned in place. The joinery derives its strength from the green front legs and rear posts shrinking around the drier rungs.

The woven seat has a center depression to it, a result of the side rails being higher than the front and rear rails. This dished effect provides a more comfortable seat than a flat one. The seat, at only 13 in. deep, is severely short and its 17 in. width is also minimal. The front legs protrude above the seat rails, interfering with the sitter.

A fine individual effort by Alexander, this chair is an excellent example of using early craft. But like the other chairs, it is not an answer to properly seating someone of average size in today's society.

Armand La Montagne's Brewster chair is a duplicate of one he made about 10 years ago that found its way into the permanent collection of the Henry Ford Museum in Dearborn, Mich. The earlier chair was an almost perfect replica of a chair made in the 1600s by John Alden for William Brewster, elder of the Pilgrim Church, who came to America aboard the Mayflower.

There are two known authentic Brewster chairs. One, believed to be Brewster's own, is in Pilgrim Hall in Plymouth, Mass. The second, made after Brewster's death in 1664, is in the Metropolitan Museum of Art in New York City.

La Montagne's first bogus Brewster was purchased by the Henry Ford Museum in the early 1970s for $9,000. La Montagne made this reproduction to document the first hoax. His objective was to construct a historically accurate chair, with enough consistent variations to be accepted by experts as authentic. In 1977 he achieved nationwide recognition when the Brewster chair in the Ford collection was discovered to have been made by him.

La Montagne made no money from the hoax and says he never tried to obscure what he was doing. His choice of chair was influenced by Wallace Nutting's statement in his *Furniture Treasury* that one or two more Brewster chairs might exist, other than the two already documented. In adapting the original design, La Montagne varied the number of spindles and changed the wood from white ash to white oak.

Most of La Montagne's work went into aging the completed chair. This included scratching and gouging the wood, burning the parts with an acetylene torch and removing all traces of carbon by scraping and bleaching. The chair was stained black, painted red, smoked for several days, coated with an emulsion of household dust and dilute vinyl glue, and waxed. It had aged 300 years in a matter of months.

The chair was then placed where it could be seen, and sold by a friend of La Montagne to a local antique dealer. A series of buyers bought and resold it until the chair was "discovered" by the Ford Museum. With its authenticity accepted, La Montagne next set out to prove the chair actually was a fake. He began to circulate rumors about its recent heritage, which the museum at first ignored. But in the summer of 1977, the museum re-examined the chair and for the first time X-rayed it. La Montagne had said X-rays would reveal that the holes in the leg posts had been drilled with a modern bit. So it was. The museum admitted it had made a costly and embarassing mistake.

Brewster chair made by Armand La Montagne of North Scituate, R.I. Overall width: 24¾ in., at back: 18¾ in. Overall height: 47½ in. Seat height: 18½ in. Seat pitch: 0°. Back pitch: 0°. Seat depth 15¼ in. Seat width: 23½ in. Height of arms above the seat: 9½ in. Overall height of front legs: 30⅛ in. Diameter of legs: 2⅜ in. Width of back between arms: 15½ in. Weight: 31 lb. Not for sale.

All parts of the chair are turned, except for the flat slab seat. A series of inscribed lines on the leg turnings help locate the hole positions for the ends of the round rungs. All the cross-rails are doweled and pinned into the legs. From above, the seat is a trapezoid tapering quickly from front to back.

Two of the vertical spindles are missing from the lower front of the chair. La Montagne made them, then removed them, as a logical alteration by some imaginary owner who wanted a space for his feet to rest.

The Brewster is not comfortable to sit in. The legs are perpendicular to the floor, the back has no pitch, the seat is parallel to the floor. The seat height, 18½ in., indicates that the chair was used with a low footstool which kept one's feet off cold, drafty floors. □

Hollow Turnings

Bent tools and total concentration

by John David Ellsworth

Bocote (cordia) bottle is 8½ in. by 5½ in. and sells for $250.

Bowl turning is one of the oldest crafts. It is also among the least developed as a contemporary art form, compared to the advances in related media such as ceramics, baskets and glass. Mass-produced "Taiwan teak" salad sets at functional prices have flooded the public market, and the shop-class candy bowl still pleases Mother at Christmas time. Wooden bowls that don't hold oranges and apples are still a contradiction at many levels of modern society.

Conventional turning gouges and scrapers, however sophisticated, create obstacles for the bowl turner if his concerns are with the development of pure form, rather than with the juxtaposition of form and function. The key word is "development," pushing one's process and materials to a previously unattained limit, sometimes beyond. The bent tools and techniques I am presenting here may be unique to turning, but the resulting forms are quite familiar to artisans in other media, such as potters and basket makers. My bowls range in size from 4 in. to 16 in. across, and from about 1 in. to 12 in. high. Their walls are usually ⅛ in. thick, and sometimes I can go as thin as 1/32 in.—translucence. Success and failure are determined by the forms developed.

What do I mean by "form?" Every sculptor has his own relationship to the human body, and his own way of perceiving this relationship. The spontaneity of wood grain relates to the motion, tone, texture of skin; the cracks and decay to the imperfections of the human condition. I repeat forms many times, as different woods and their grains demand. With enclosed forms, my intention is to enhance the mystery of the interior. This allows the piece a sense of privacy within itself—a personal sensuality. The "function" of the piece becomes the simple interaction between observer and object.

Turning the outside — I work primarily with imported hardwoods and special cuts of domestic hardwoods—usually crotches, butts and burls. When I buy wood, I frequently select the garbage cuts as well as the select cuts. I can work green wood or dry wood, with long grain, cross grain, knots, sapwood, pith wood, whatever. My bent tools allow me latitude that I would not have with standard tools and methods.

I have a General 12-in. variable-speed (300 to 3,000 rpm) lathe, model 260-1. It is made in Canada and sold through C.A.E. Inc., P.O. Box 12261, N. Hwy. 73, Omaha, Nebr. 68112. It is comparable in price to Powermatic, but far superior in quality, built for business and with no racing stripes.

To mount the work on the lathe, I usually glue directly to a piece of ¾-in. plywood, then screw the ply to the faceplate with 1-in. No. 10 Phillips self-tapping screws. Heavier blocks are mounted directly on the faceplate with longer screws of the same type. When the piece is completed I go in with a parting tool and cut half plywood and half bowl stock, then break or split the bowl off with a chisel. This leaves a small spot on the bottom, which I remove with a 1-in. by 42-in. belt sander, an orbital sander and hand work. This leaves a surface with the same quality as the rest of the piece.

When roughing out a bowl, I turn at speeds from 300 to 600 rpm, but once the form is established, I jump to 1,800 to 2,000 rpm. All the designing is done on the lathe following the roughing-out stage. High speeds with a tiny-tipped, long-and-heavy roundnose tool allow me to draw on the surface of the bowl while removing great amounts of stock. It's spontaneous and leaves a clean, smooth surface that is ready to sand. Because I work with cracked and partly rotted wood, it is important to sand the exterior completely before beginning the interior cutting. I use silicon-carbide (wet-dry) paper because it breaks down evenly. Garnet paper would last longer, but it leaves minute scratches that seem impossible to remove. A grit sequence from 100 to 600 gives a beautiful surface in a very short time.

Cutting the interior — The beginning stages of internal turning are a simple process of clearing stock in an effort to get to the final surface. The principle is to enter with a standard angled skew and roundnose tools, open or clear the area with bent tools, and, once there is room to work, to finish the surface to the desired thickness.

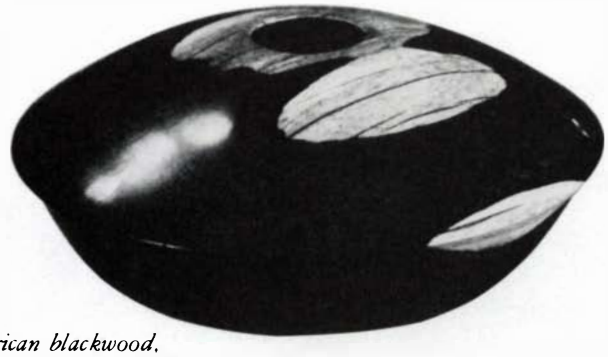
My bent tools are made from square-section, oil-hardened ground stock tool steel, also called drill-core steel. I buy blanks 3 ft. long in four sizes (¼ in., 5/16 in., ⅜ in. and ½ in.)

Photos on this page are about one-third of life-size.

David Ellsworth

*Rotted figured walnut,
1½ in. by 10 in., $250.*

*Putumuju, 3 in.
by 5 in., $150.*



*African blackwood,
4 in. by 8½ in., $450.*

*Gabon ebony, 5 in.
by 9 in., $450.*

*African
blackwood,
1½ in. by 6 in., $150.*

*Cocobolo rosewood
with Brazilian rosewood lid,
3 in. by 12 in., $350.*

*Quilted maple,
3 in. by 9 in., $250.*

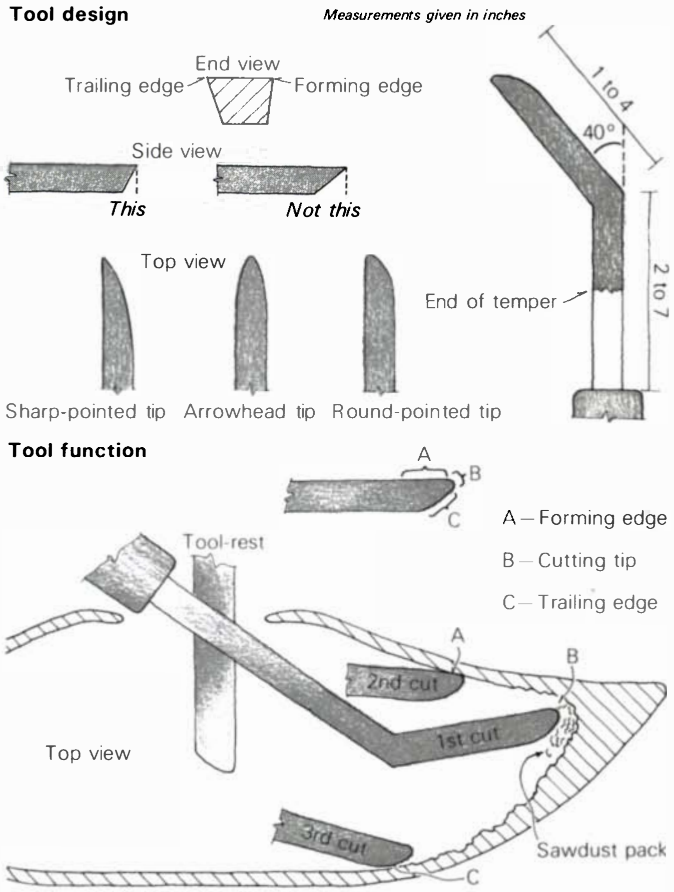
*Rare African pink
ivory wood, 3 in. by 4 in.*

*Bocote (cordia), 3 in. by
5½ in., 1/32 in. thick, $150.*

*Tulipwood,
3 in. by 5 in., $190.*

*Macassar ebony,
2½ in. by 5½ in., $90.*

from Teledyne Pittsburgh Tool Steel Co., 1535 Beaver Ave., Monaca, Pa. 15061; the brand name is Warpless Flat Stock. A nearby machinist forms the tools for me. We are presently experimenting with high-speed steel, which is harder but may turn out to be too brittle. The angle of the bend is about 40°, depending on the tool's function. I use three basic tip shapes in each of the four sizes, and each tip has three cutting areas, as shown in the drawings: the forming edge, cutting tip and trailing edge. This gives me about 36 distinct cuts with 12 basic tools. I use the 1-in. by 42-in. belt sander to sharpen—a burr edge for rough cuts and a smooth edge for finish cuts. The steep angle of the bevel provides more mass directly below the cutting edge, minimizing chatter when working great distances from the support of the tool rest.

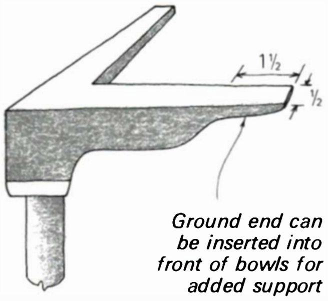


When I start work on the inside, I keep the lathe speed around 1,800 or 2,000 rpm. Slower speeds drag the tool and increase the chance of ripping the wood. On rotten or cracked wood, the high speed prevents the tool from dipping into open areas before it re-encounters solid wall surface.

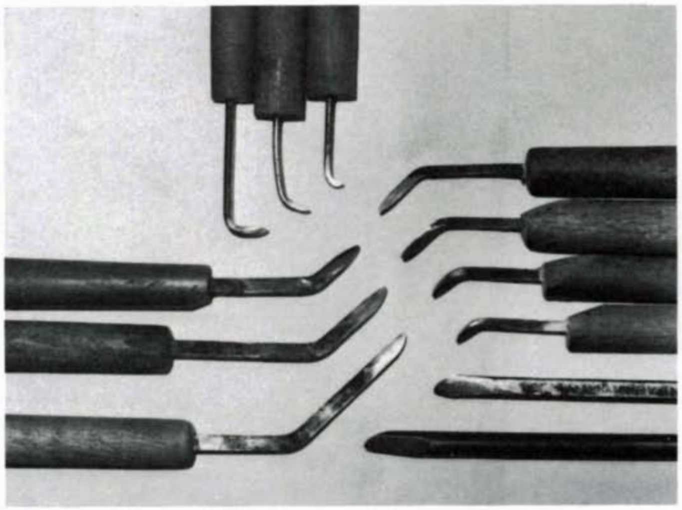
An efficient cut is a three-stage process, making use of each tool's three cutting areas. First, I use the tip of the tool to open up the area for working, which creates a rough surface. Second, I draw the forming edge of the tool toward the hole. It grazes the surface and removes the ridges left by the tip on the first cut, but it will not remove large amounts of stock. Third, I take a cut with the trailing edge from the thin wall toward the thicker area at the bottom of the bowl. Following this three-stage cut, I stop the lathe, remove the shavings and inspect the damage.

The straight-shank, pointed roundnose tool is very useful for reaching the bottom of deep bowls and for making final cuts across the bottom and up the sides. Because I am sometimes working as much as 12 in. from the tool rest, the tool must have length, weight and balance. The shaft is about 3 ft. long, made from ⅝-in. round steel shaft material, and ground as shown. All my tool handles are as simple and ugly as I can make them. The rough-turned, unsanded surface of red oak gives lots of traction for my hands. I simply split an oak 2x2, saw or rout out the halves to receive the tool shaft, reglue and turn down to desired diameter. Then I glue in the shaft with white glue, leaving 4 in. to 6 in. at the butt of the handle for weights to balance the tool, if necessary.

In tall pieces, the finish cuts are always completed before going deeper into the wood. This is important for two reasons: to eliminate mass at the point farthest from the support of the faceplate, and to use the mass in the lower portion to absorb the shock of tool contact against the upper portion. As I go deeper into the vase, I use heavier tools for increased support and control. I stop to



Ground end can be inserted into front of bowls for added support



An assortment of bent tools. Ellsworth uses four sizes of tools and three basic tip shapes. The angle of the bend is about 40°.

Dr. J. Thomas Stocker

To shape the outside of a bowl, Ellsworth uses a 3 ft. long, ⅝ in. roundnose tool.

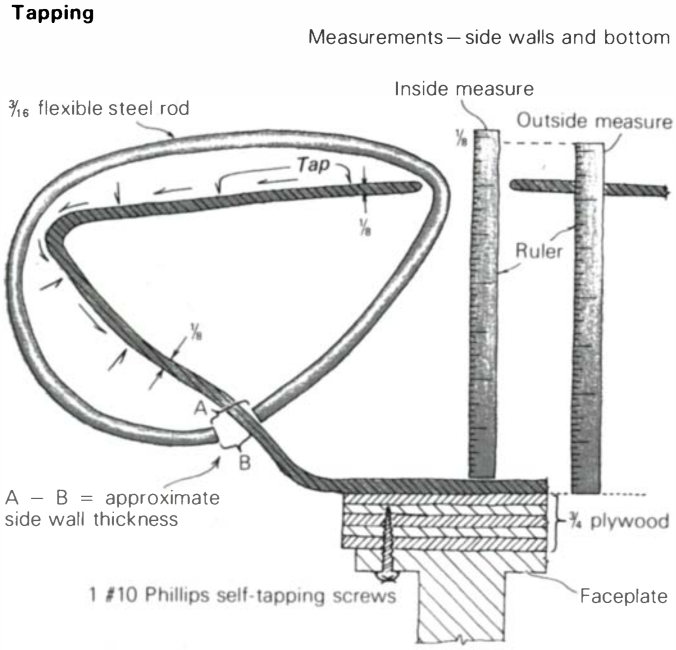
remove the shavings after each successful cut, to avoid tool drag. On open bowls, I loosen the sawdust with my fingers and vacuum or dump it out. On bowls with small openings, however, the sawdust pack must be loosened with a flexible wire, then shaken out. Whenever possible during hollowing, I insert the ground tool rest shown in the drawing on the previous page into the opening, for more support.

Determining wall thickness — My bowls can be turned so thin because an enclosed form is much stronger than an open form. It is like the strength of an eggshell. When turning at high speed with tiny-tipped tools, any single cut removes only a small amount of stock. A larger tool at a slower speed would only tear through the thin walls. I monitor the wall thickness as I work with a flexible wire caliper, and then by tapping the wood with my fingernail. The method is efficient and not difficult to learn. Even when I make a mistake and blow up a piece of wood, I no longer have to blow up *at* the piece, because I have fully known this period of its creation. Total control when working in the blind is neither possible nor desirable. Without the element of chance and the risk of error, the piece would lose some of its life—it would not have known this struggle for survival.

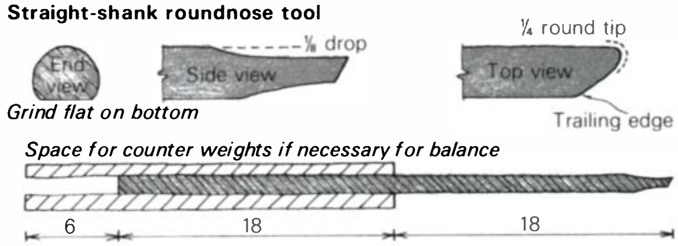
I start tapping at the edge of the hole, where the actual thickness can be measured with calipers, progress toward the rim and then down the sides to the bottom. A sharp tap with the fingernail raises a tone. When this tone is evenly balanced, I know the wall will be uniformly thin. I can then remove minute ridges on the inner surface by sweeping cuts with the trailing edge of the bent tools. The 3⁄16-in. steel rod I use for a flexible caliper is also useful for locating the actual area to be worked. In determining thickness it is only accurate to about 1⁄8 in., at which point tapping takes over.

The key to tool control is total concentration. This is why I rarely allow visitors into the studio when I'm taking a piece down to final wall thickness. I work each piece from start to finish by a series of controlled movements. These movements are gross in the roughing-out stage, but very fine in the thinning stage. It begins when I climb onto the machine, feeling its vibration and establishing a relationship of comfort and

Tapping

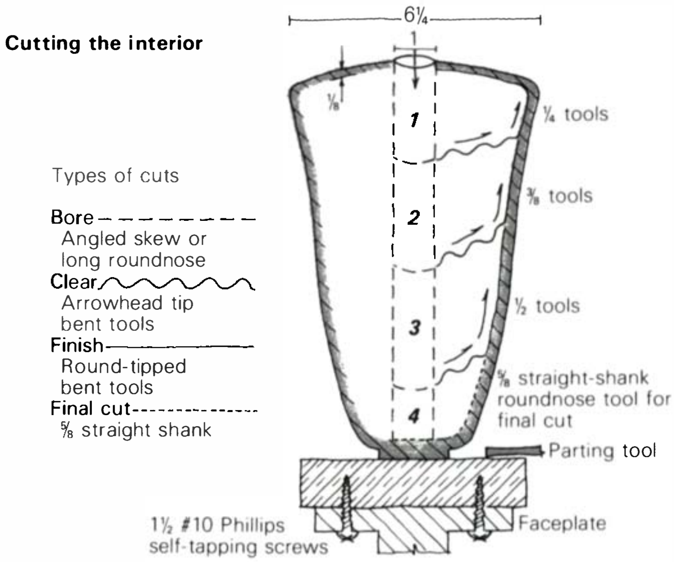


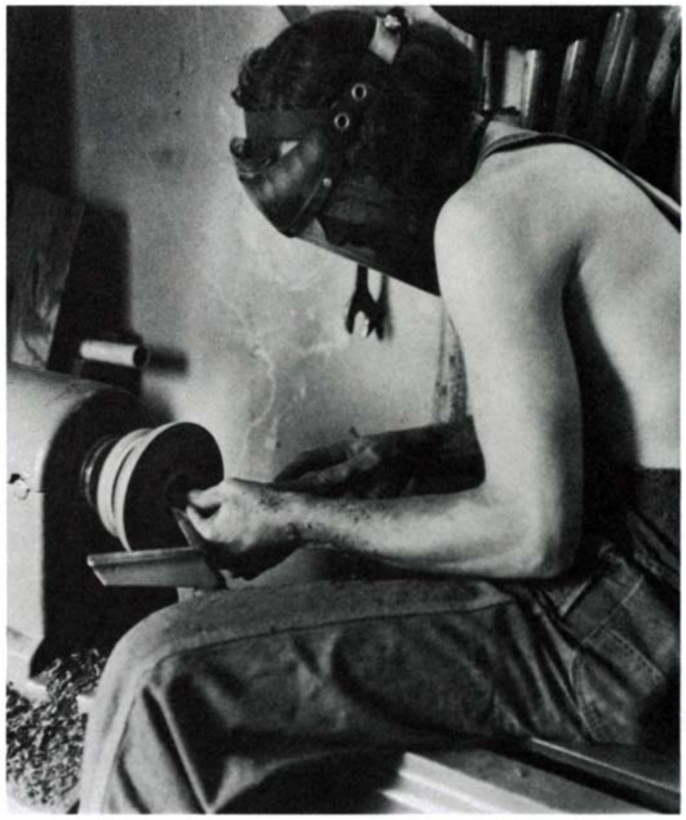
Straight-shank roundnose tool



Tool handles for round and straight-shank tools

Cutting the interior



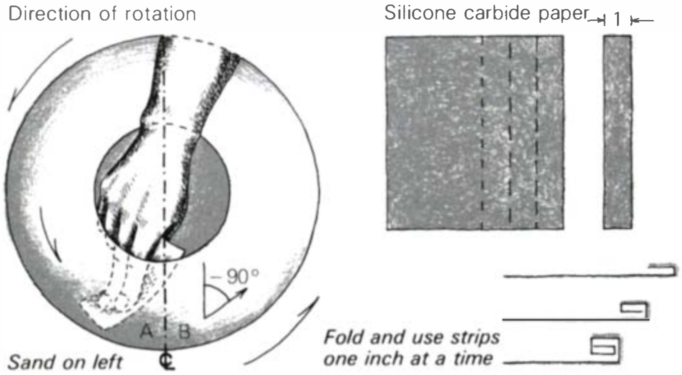


Total concentration is necessary for tool control. When Ellsworth straddles the lathe, each movement of the tool is a result of a movement in his entire body.

Internal turning begins with a ⅜-in. arrowhead-shaped tool.

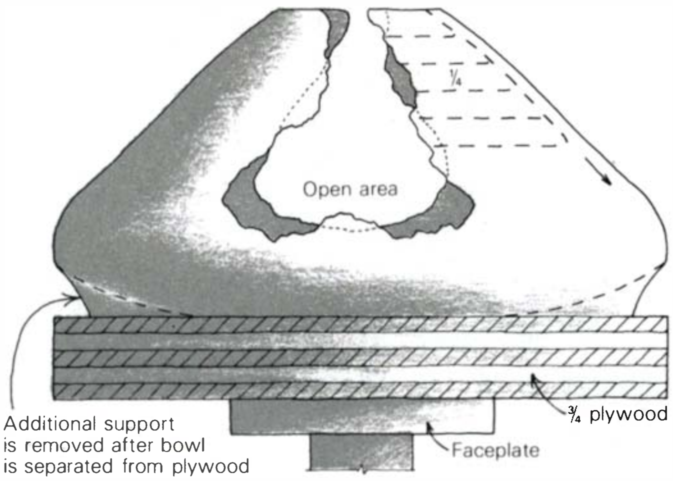
The tool is supported on an angled tool rest.

Sanding



Cutting the interior of rotted or cracked wood

Each cut should be no deeper than ¼



support as the turning progresses. Each movement of the tool tip results from a total movement in my body, not simply in the fingers, wrist or arm. I like to think of a cat stalking a bird: The concentration involves all senses equally, and the center of focus is transferred to the tip of the tool.

In the final stage of thinning the walls, tool contact with the whirling wood creates humming tones, and these become my clue to the consistency of wall thickness. The nature of the tone depends on the type of wood and on the mass remaining within the wall. With most woods, this tone becomes dull as the thickness approaches 1⁄32 in. Now the walls are very fragile at any single point, just like an eggshell. Any loss of concentration, including breathing at the wrong stage of the cut, can mean disaster. Thus sound, not accurate measuring devices, is the determining factor between success and failure. The only way I can describe it is that I talk to my pieces and they talk to me.

Rotten wood — The process of turning a rotted piece of wood is much the same as when working a solid block. More attention must be given to supporting the delicate walls, but I use the same tools and turning speeds. I always begin by gluing the blank to ¾-in. plywood. In the final stages of turning, this block gives extra support to the walls, especially if the rot extends into the bottom of the wood. I complete and sand the exterior before starting on the interior. I begin thinning the walls as soon as the entry hole is opened, leaving the bulk of the interior intact. I progress to the bottom of the piece, thinning the walls as I go, but never taking more than ¼ in. at a cut. If the tool seems to be ripping the wood or catching in the rot, the lathe speed is too slow. On the other hand, if I go too fast, centrifugal force could blow the piece apart. Experience is the only true guide.

Ironically, rotted wood offers several advantages. You can see the tool contacting the interior surface through the gaps in the whirling walls. The shavings fly out through the openings as the cuts are made, and wall thickness is easy to measure through the same openings.

Sanding the interior — I have a simple rule for interior sanding: If you can reach it, sand it. If not, learn how to leave very smooth tool marks. Sanding the interior is the only physically dangerous part of this process. I have broken two fingers learning to do it correctly. I fold strips of sandpaper as shown, folding 1-in. sections back against the strip as use demands. Support the strip between thumb and palm, allowing the area to be used to rest against the first two fingers. Insert the hand from the top, to make contact at the center of the bowl, and work the paper down and toward you, to the left of a vertical center line. This way the spin of the bowl is going away from contact with the sandpaper. If the hand drifts to the right, the angle of contact with the direction of spin falls below 90°. The surface is now coming toward you, and your fingers are supporting the sandpaper. One learns quickly.

I stop the machine between each grit and blow out the sawdust. Then I sand with the grain to remove circular scratches before moving to the next finer grit. The result is a beautiful interior surface, free of circular scratches.

Finishing — Once the final cuts are done on the inside, the piece is ready to finish. The following works well for kiln-dried woods, and it is essential for air-dried woods. I remove the bowl from the lathe, pour Penofin oil into the interior, work it around and pour it out. Penofin oil is made by the Penofin Oil Co., 819 J St., Sacramento, Calif. 95814. Don't use it on food containers. Then I remount the bowl on the lathe and with cotton sheet material coat the exterior with a liberal amount of oil. Crank the lathe up as fast as you dare, almost to where the piece blows up from centrifugal force. By working the rag all over the surface of the bowl I create a great amount of heat from surface friction. The hot oil begins to boil on the rag. Any moisture in the pores of the wood escapes in the form of steam. The boiling oil is then absorbed into the wood fibers previously occupied by moisture. As the rag finally dries, so does the wood and the oil within it. □

David Ellsworth, 34, of Allenspark, Colo., taught sculpture until 1975, when he became a full-time bowl turner. He developed the methods described here after hours, when each day's production quota of traditional bowls was done.

The History and Practice of Marquetry

Ancient art updated by new techniques

by William C. Bader

The inlaying of colored woods, both natural and dyed, has always been a specialty with fine cabinetmakers. There are two types of inlay work, woodmosaic and intarsia or marquetry. Woodmosaic is a geometric design, usually in straight lines. It is at home in the Orient—China, India and Persia—from where it found its way West. Today this type of mosaic is made up in blocks of several pieces of wood glued together, then sliced off with the band saw or circular saw.

Intarsia is not as old as woodmosaic, because it requires more developed tools. There is hardly any intarsia from pre-Christian times left today. Japan still has some intarsia from the 8th century and Italy has some from the 15th and 16th centuries, mostly in churches. These inlays are copies of fine intarsia in stone and glass, made many years before. The tools were very primitive, especially the saws. The ancient Egyptians cut veneers about $\frac{1}{4}$ in. or $\frac{1}{2}$ in. thick with a pitsaw, which was still used in the 19th century. Furniture made during that time shows these thick veneers. The inlay design was laid on the wood block and the outline traced, then cut with carver's chisels. This space was then cut out and the inlays of different woods glued into it. This type of work was done mostly by woodcarvers and monks, and continued until the end of the 16th century.

The jigsaw blade, invented by a southern German clockmaker around 1590, changed the technique of intarsia completely. By the beginning of the 17th century, most intarsia work was done with the jigsaw. With this invention, the carving of intarsia in Italy began to decline. From then on, Austria, Germany, France and Holland carried on where Italy left off. The jigsaw blade made new methods possible, and the Renaissance, with its rich ornamentation, especially furthered their development. It was possible then to nail a light and dark-colored veneer together, trace a design on the package and cut it with the jigsaw to produce two veneer panels, one with a dark ground and light inlay, the other in reverse. Both panels were often used on one chest or cabinet. Four or six veneers could be cut in such a manner. This method is still in use today where simple designs are required.

For about 100 years, the jigsaw blade was used clamped in a hand frame, but human ingenuity invented something better. The 17th century, with its wars, brought a decline in intarsia in central Europe, and Paris became the capital of fine woodworking. It remained so until the latter part of the last century. Intarsia workers from the Rhine country went to France, among them J.F. Oeben, David Roentgen, Jean-Henri Riesener and Hans Kraus. There they invented the mechanical hand-operated jigsaw called the "donkey," which is still being used today in France and England. The machine age also brought some improvements for the marquetry cutter: Foot-powered jigsaws allowed faster and more accurate work because both hands were free to guide the work. Then foot-powered machines were motorized. It is absolutely wrong to think that the artistic value of such work suffers because of using machines—machines are only instruments that help produce the work faster, better and cheaper. The operation of the saw contributes the least towards the artistic value of marquetry. The design itself and the composition and selection of woods are most important.

The basis of all marquetry work is, of course, a good design. The design has to be multiplied, a number of copies made. This is done by perforating one master pattern with a fine needle and making a copy by laying this pattern on a sheet of white paper. It is held in place by several weights and asphaltum powder is rubbed over it, thereby making a copy. The copy must be heated over a gas flame or electric burner so that the asphaltum powder melts onto the paper. Any number of copies can be made as needed. From these copies are cut the various pieces until all sections of the design have been cut out. They are then glued on blocks consisting of the particular veneers required. These veneer blocks are fastened together with thin nails. Holes for nails must be drilled first. One $\frac{1}{8}$-in. thick plywood piece goes on the bottom of the block to prevent the good veneers from breaking during sawing. With all pieces so prepared, the cutting can begin.

Marquetry in clock by author; cabinet work by Glen Hofecker, Bonner Elk, N.C.

Barber's Studio

Cutting is difficult and needs many hours of practice, good eyes and a steady hand (*Fine Woodworking*, Winter '75). Cutting must be exact so that the pieces will fit when they are finally assembled. Usually, the larger pieces are cut first. Complicated designs are better assembled on a design copy with a few dots of fish glue or gum arabic. When all assembled, the whole panel is glued over with a piece of thin wrapping paper and put between two boards with newspaper on

William Bader, of Asheville, N.C., has been working with marquetry since 1919. He apprenticed with Heinrich Maybach, Karlsruhe, Germany.

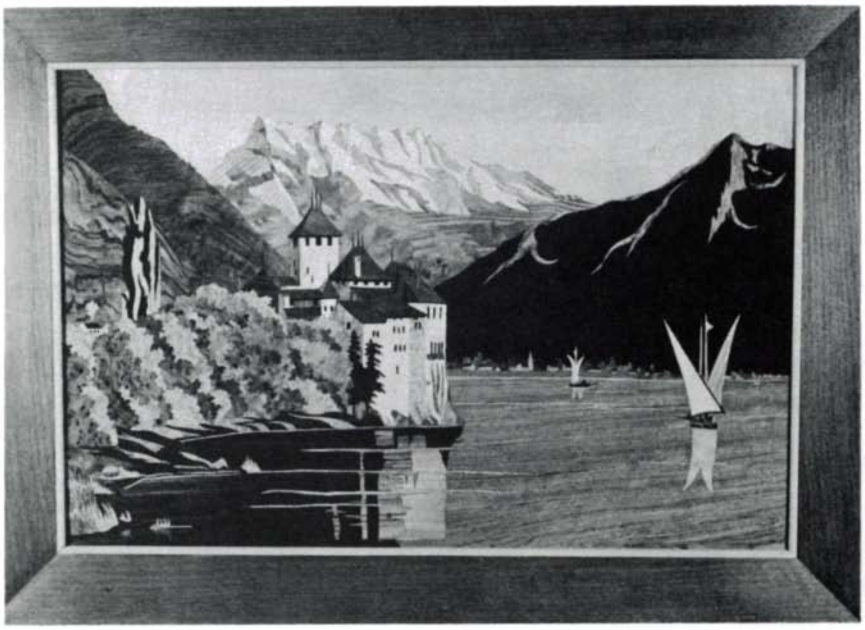


Photo King Stober

'Castle Chillon,' by author.

Lester Morgan

'Winter Solitude,' by author.

both sides of the veneer to prevent sticking. It is then clamped. After a few hours it is unclamped, and the design copy on which it was assembled is soaked off using warm water. The panel is then put back between boards again until dry, with weights on top. After it has dried for some time it needs to be filled. A dough of finely sifted wood flour, sawdust or sanding dust will do, using a thin glue for mixing. This is then rubbed into the joints and sawcuts as a filler. Again, it is put between boards with weights on top to dry. When it is dry it can be sanded lightly to remove any excess filler. This is best done by hand.

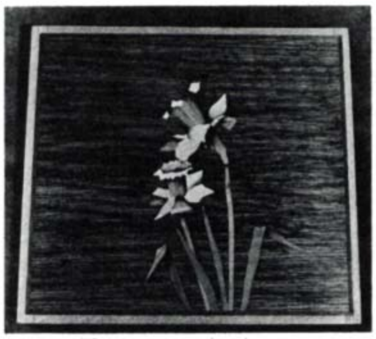
Now the panel is ready to be glued up on plywood or chipboard, but a piece of cheap veneer has to be put on the back to counteract the pulling action of the inlaid veneer on the front. It should be left under pressure overnight. After this, the panel should have enough time to dry thoroughly before it is sanded and polished—about 5 to 6 days drying should do it, but more time is even better. To remove the paper, the panel can be sanded lightly. Any paper remaining can be removed with a little hot water, but the panel must dry again before it can be sanded smooth and polished.

To enhance the beauty of marquetry work, the technique

Silas Kopf's Marquetry

Photos: Dan Cherry

SILAS KOPF of Northampton, Mass., writes that the design of this screen was controlled by the 24-in. throat opening on his scroll saw. He ran the background veneer horizontally, both for visual effect and because this enabled him to divide the total screen into nine sections of two bookmatched pieces of walnut, each about 24 in. square. He worked these sections independently, then taped the three parts of each panel together for pressing. Kopf uses an old five-section 32-in. by 96-in. hand-screw veneer press. The screen panels are retained by grooves in the solid walnut frame. The background veneer is walnut, leaves are poplar and cherry, branches are ebony, wenge and canaletta, grass is maple, ash and cherry, chipmunks are mahogany, ebony and holly and ground is elm burl. The screen measures 78 in. high and 74 in. wide.



Veneers for this daffodil boxtop, like the rest of Kopf's work, are sawn with a double bevel to ensure tight joints and a minimum of glue line. He usually uses powdered plastic resin glue because of its long assembly time, and sometimes white glue for smaller panels. The finish is penetrating oil, which deepens the tone of the marquetry, usually evenly. The boxtop has satinwood, holly and capoma petals, cherry and mahogany leaves, a poplar stem, a walnut inlay border and an English brown oak background. The white oak box measures 12 in. by 12 in. and is 3½ in. deep. —J.K.

of shading or burning is used. This is a later invention; the old Italian masters of the 15th century did not know about it, although they used engraving. Originally, this shading was done on an open flame or with hot irons, using molten lead. Today, heated sand is a good medium for shading. You need a cast-iron fry pan about 9 in. in diameter, filled with sand which has been rinsed in water several times to remove any dust. You also need a tweezer about 10 in. long. With this

Country Folk and Family Photographer

'Roman Girl at a Fountain,' by author.

tweezer, one or two pieces of cut veneer are dipped into the sand. The sand takes about an hour to get hot enough on an electric burner. The burner should be surrounded by heat-resistant material to confine the heat and to prevent burning your hands. It takes a few seconds or minutes to shade a small piece of veneer, but it should not be burned like charcoal. If that happens, discard the piece and cut a new one.

The inlaying of one material into another to produce a decorative effect is of great antiquity. Much of the furniture found in the tombs of ancient Egypt is decorated in this way, and primitive craftsmen used inlays to decorate their weapons and implements. The inlaying of wood into wood is closely related to the inlaying of metal into metal, known as Damascene work, made in the East and Spain. The exact date when French marquetry cutters began to use tortoise shell, brass and copper in the manufacture of what is generally called "Boulle work" (after Andre Charles Boulle, who used brass and copper to a large extent) is not known.

There was another development of marquetry, perhaps not quite legitimate, but which should nevertheless be mentioned—"relief intarsia." In producing this, the marquetry cutter and carver cooperate, and the shaded effect is not obtained by scorching the wood or by the use of a graver, but by actual carving in low relief. In this case woods of various thicknesses are used instead of veneers. The jigsawn pieces are assembled on a sanded piece of plywood with a good glue and left to dry. The carving requires great care so as not to dig into the plywood background. Polishing is usually done with pure beeswax and a stiff stippling brush. □

Before the Finish

Whiskering, patching and staining

by Don Newell

Taking a wood surface to its final state, ready to receive the finish, appears to be straightforward. The professional and the long-experienced amateur woodworker may well have put all their cut-and-try mistakes behind them, during the early years of learning what worked best for them. But for the amateur whose only woodworking time is a few weekend hours, many mistakes are yet to be learned from.

The phrase "what worked best for them" expresses a truth about the art of finishing wood that every serious devotee must come to recognize. In most cases, one's specific materials or tools are probably less important to fine results than one's technique in using them. The successful artisan works *with* his materials, rather than trying to force them to act as he thinks they should. Nevertheless, in learning what to expect from your materials, and what they demand from you, the crucial word is "work." If the finish is to do justice to the cabinetwork and the wood, you need to get the feel of the finishing materials before you apply them. And the essential tools for learning the feel are scraps or ends or extra boards of the same wood from which you've built the piece.

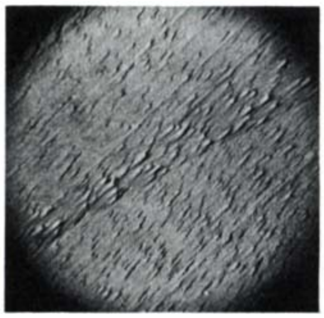
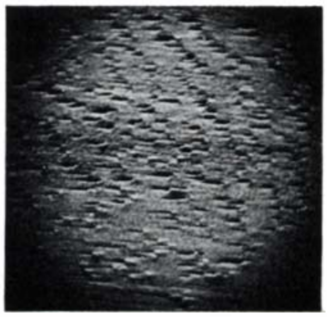
Try out the finishing system you've selected, so as to know beforehand what will happen. Does the stain hide the figuring, rather than enhance it? Experiment by thinning the stain. What does the finish material do to the stain? Does it go muddy, or does it clarify? If you plan on rubbing out lacquer or varnish to a desired sheen, how well does it rub out? How much rubbing does it take to cut through the finish coat to the wood itself? Does the finish really dry, if it's a varnish/drying oil concoction you've thrown together on your own? Or does it merely surface-dry, with the base remaining soft and susceptible to easy fingerprinting and marring? Trial-run your entire finishing system on sacrificial scrap before you entrust your cabinetwork to it: What you're going to get in the end is what you see now.

Sanding — The beginning of a fine finish is the physical condition of the top few thousandths of an inch of wood, which is all the viewer sees, and which is going to have to withstand the continuing presence of dirt, dust, moisture, glass-rings and human handling. The finish must protect the wood but the condition of the wood, in turn, must help the finish achieve maximum effectiveness.

The two commandments of sanding are Thou Shalt Not Use Flint Sandpaper, and Thou Shalt Not Sand Across The Grain. Flint paper is cheaper per sheet than production-type aluminum oxide or silicon carbide paper, but flint costs much more to use in the end. It can lose its grit particles, which will roll under the sanding pressure and gouge the surface.

As to grit size for finish sanding, 240 grit is coarse enough to eliminate the last cross-grain scratches. Follow it with 360 grit for final sanding, as the sanding marks are fine enough to be made invisible by whatever finish you use. Purists will be

Photos: Don Newell

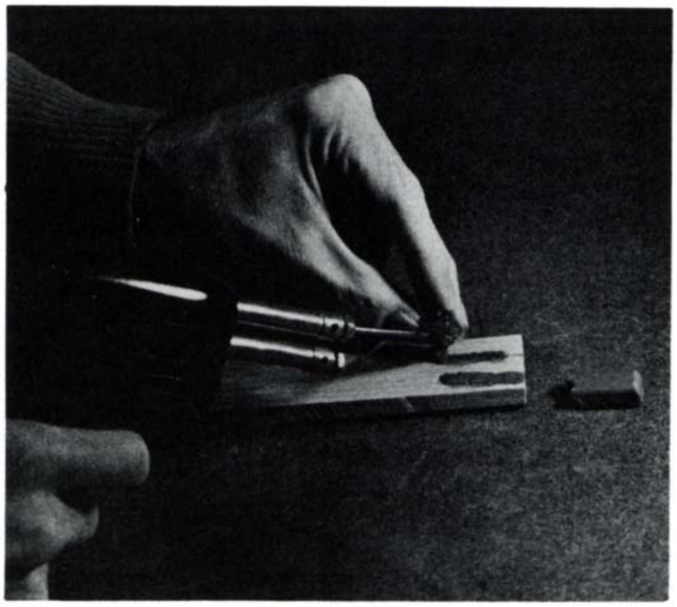



Left, walnut board is lit from the side to emphasize the raised grain, which is the ends of wood fibers meeting the surface at an angle. Photo was taken through a low-powered microscope. The board was wetted with water, then dried with the flame of a propane torch. The faint band through the center of the microscope field is a pencil line, right. Above the line, the wood was whiskered with a ball of steel wool; below, it was whiskered with sandpaper. Then the wood was wetted and dried again. The section that was steel-wooled remains smooth, while in the sandpapered section a number of fiber ends have popped up.

permitted one more run with 400 paper.

There is one essential step after final sanding: Play the light from a reflector floodlight, spotlight or even a flashlight across the surface of the wood at a very low angle. Scratches, indentations and other imperfections that were invisible under normal overhead worklights will instantly pop into view. It's much simpler to correct them at this stage than to attempt it after the finish is complete.

Grain raising is a common, vexing problem. The one-time solution is an established practice among professional gunstock makers, though I've seldom seen the technique mentioned in books dealing with furniture. Grain raising is simply the expansion of wood fiber ends above the surface, due to moisture absorption. It probably occurs continuously during the building process, but because the wood is being sawed, chiseled, planed, carved, filed or sanded, the minute roughness is never noticed. Only at the end, when you've finally filed and sanded and scraped the surface to baby-cheek smoothness, then left your little beauty in the humid basement or garage workshop overnight, does the grain obviously raise. If you're lucky. When you're not lucky, you proceed to finish the workpiece, spending long hours brushing or hand-rubbing or whatever, only to have those whiskers come right through the finish some muggy August day.



Stick shellac, melted into place with a soldering gun, is a quick, permanent and hard repair for nicks, gouges and cracks. Shellac can be applied in minutes and filed smooth, ready to finish, in seconds.

The usual solution is to sand the surface lightly, at a slight angle to the grain, to cut off the raised tips of the fibers. Some finishers apply a dilute glue or shellac size coating, to freeze the whiskers in place for sanding, but I prefer not to.

The gunstocker's answer to grain raising is steel wool, used to pull the fiber ends up and out of the wood. Once you've removed the fiber ends, none are left to raise through the finish, regardless of moisture changes. Whiskering, as the process is called, is simple. First, deliberately raise the grain by wetting the surface well with a wet, not dripping, sponge or rag. Let the water sink in, then come back over the wetted area with the flame from a propane torch. Play the flame over the wood, keeping it moving so as not to char or darken any spot, until the surface is completely dry. Be careful at edges and corners since the flame will char the wood if allowed to stop there even momentarily. In this water/flame technique, water is taken into any susceptible fiber ends, which expand almost immediately. The subsequent heat evaporates the water, some of it turning into steam which further contributes to the wood's expansion.

Now you have a veritable forest of whiskery fiber ends standing up, ready for removal. Form some medium-grade steel wool into a loose ball and firmly whisk it against the protruding ends of the fibers, always in line with the grain, never across the grain. The loose ends and loops of steel wool hook under the raised fibers and pull them out of the wood. Keep in mind that you're trying to rip the whiskers off the surface.

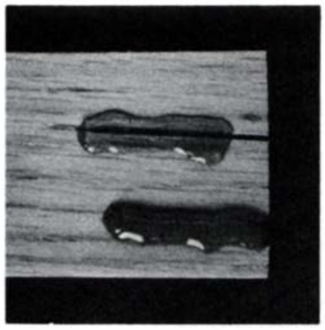
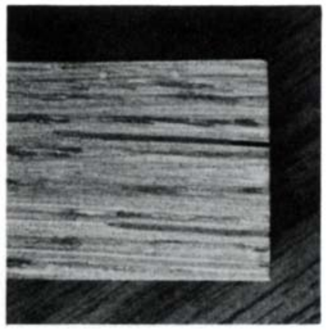
Two or three whisks of the loosely balled steel wool will eliminate the raised grain for good. One treatment of the water/heat/whisk process is usually sufficient, though two won't hurt. Of course, grain raising occurs only where the wood fibers run out of the surface. If your wood has the fiber structure running truly parallel to the surface, you'll not get grain raising.

The quick stick repair —Even the most experienced woodworkers occasionally gouge or nick the surface. Or small checks may open when wood is taken down to its final dimension. Repair recommendations often range from filling the imperfections or damage with a sawdust/glue mixture, to using a rub-in putty-type stick or crayon, to the ultimate repair of inlaying a matching-grain wood patch.

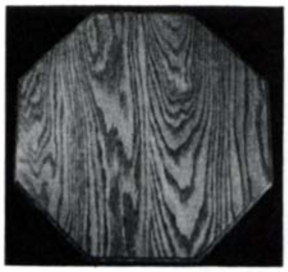
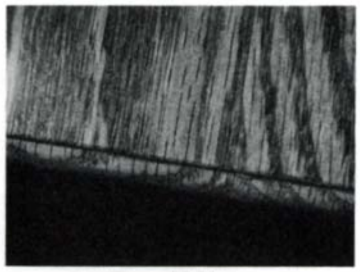
The method that works well for me is far quicker and easier. It's stick shellac, which is simply everyday shellac molded into stick form and available in a goodly range of colors and shades, including transparent. To use it, clean the gouge of all dust and debris. Where possible, especially with shallow depressions, rough up the surface. Then melt the stick shellac, as much or as little as needed, into the hole and let it cool. In less than a minute the shellac hardens all the way through, ready to file or sand level. And your repair is ready for the stain/finish coating.

A soldering gun is best for melting stick shellac. Its small tip makes it easy to melt just enough shellac, which can be flowed onto the wood where needed. Hold the shellac stick directly over the damage and trigger the soldering gun until the shellac begins to flow down into the hole. Trigger the gun off and on so the shellac stays hot enough to flow easily, but not so hot that it begins to blacken and burn. Let the flowing shellac build up a little above the surface, since it shrinks slightly upon cooling. If the hole is a deep crack or seam, keep the hot tip of the gun in the pool of molten shellac for a few moments to help the shellac penetrate as deeply as possible. A little practice will give you the feel of the gun and the amount of heat needed to let the shellac flow well.

Color matching to the final stain/finish should be done with a piece of scrap wood. Because the shellac will not accept color from a subsequent stain, the problem is to stain the scrap the way you plan to stain the workpiece, then select the shade of shellac that most closely matches the color of the stained scrap upon drying. If you select a shade of shellac to match the color of the wood when it is finished, you can generally create a repair indistinguishable from the adjacent surface. It will also take almost any finish you wish to put over it without danger of losing adhesion, since the area of such a repair is generally very small.

Left, test beads of shellac, transparent (top) and tan-colored (bottom), were melted into saw cuts in oak to determine the proper shade for filling a crack in an oak table. Both beads were filed to a level surface, then the scrap was stained and varnished to match the table itself. Although the saw cuts are apparent since they are straight and quite long, both patches blend well, right. But the tan-colored shellac on the bottom is the better match.

Oak tabletop was cut from the best part of an old, larger table and mounted on a new pedestal. An open butt joint where the old glue had given way was mended almost invisibly with shellac (close-up). Before applying the shellac, the two boards were clamped tight and dowel pins were glued into holes drilled at an angle from below to cross the crack line.

Stains — When should you consider using a stain or dye, and when should you leave well enough alone? The only reason to use a stain is when you want to enhance the beauty of the wood. Plain or weakly figured wood benefits greatly from the judicious application of a colorant. By brushing or ragging a stain selectively into a barely discernible figure, you bring out the wood's character. Strengthening the figure without changing the color of the adjacent areas is sometimes the only way to achieve the beauty your joinery deserves—particularly with the plain-figured wood many amateurs obtain via mail order.

Staining (dyeing) doesn't have to be an overall color bath. But when the entire piece cries out for a little more color or a little deeper darkening, the stain material *must* be chosen in relationship to the finish coating you plan to use. The critical factor is *compatibility within your finishing system*. Anytime you use more than one kind of material on the wood, you create a system made up of two materials that either will work together or will not work together. If they are compatible with each other, a bond is formed where one interfaces with the other. If the two materials are compatible, the bond will be strong and the two will effectively harden into a single structure. If they are not compatible, you have two hardened layers without much to hold them together. The result too often is that the top layer flakes or peels off under the slightest stress. The simple expansion or contraction of wood under changing humidity is often enough to loosen the top coat. When this happens, the only recourse is to sand to bare wood and begin again.

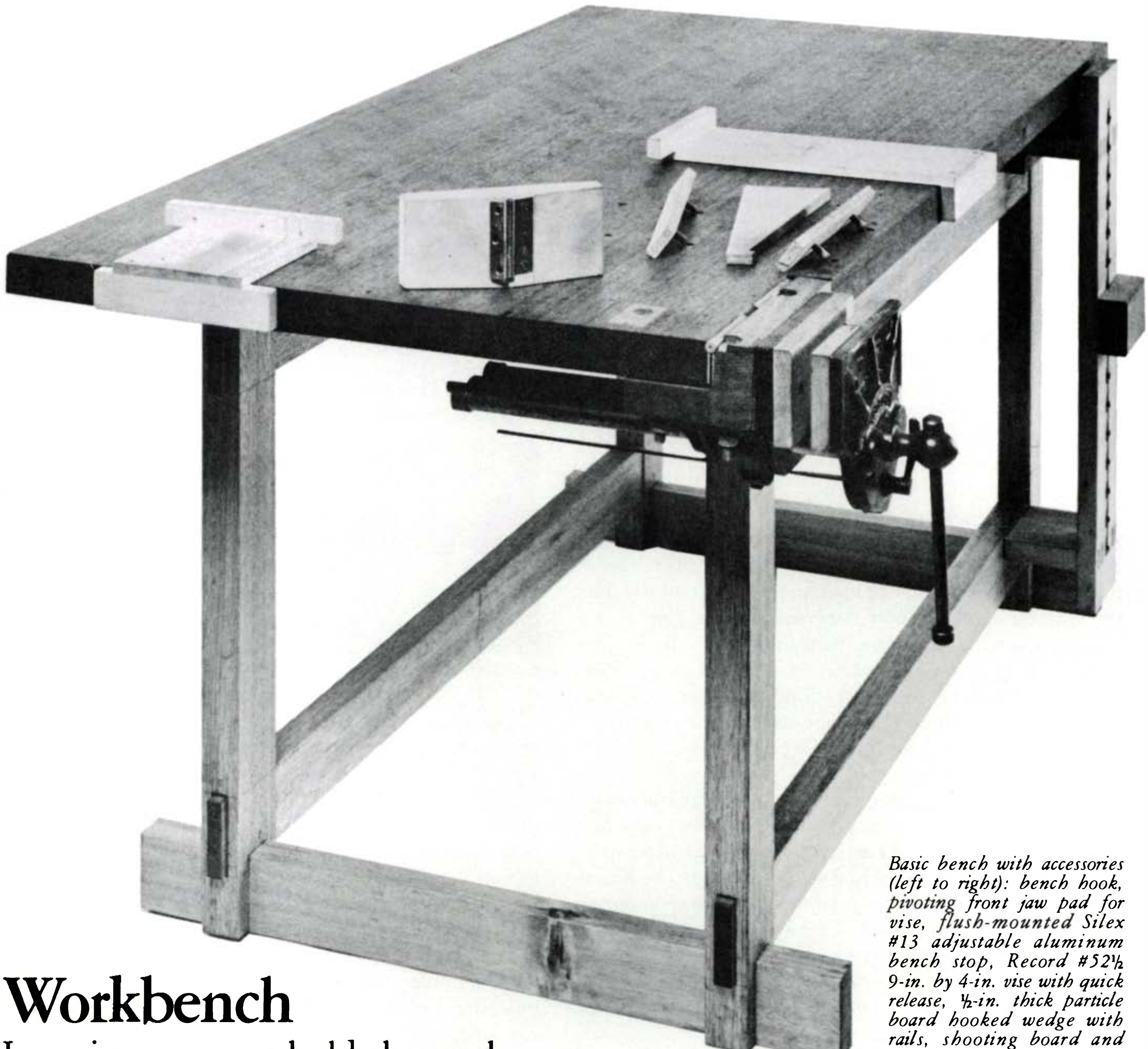
But back to the stain. Water-based, alcohol-based and oil or solvent-based stains (see Stains, Dyes and Pigments, *Fine Woodworking*, Sept. '78) generally are compatible with almost any varnish, assuming that the stain coat is thoroughly dried all the way through. Occasionally, oil/solvent stains, commonly called pigment stains, have linseed oil as their main ingredient. Never use a linseed oil-based stain under any finish coat containing lacquer. Read the labels. If the finishing material label lists such things as nitrocellulose and aromatic hydrocarbons, that's lacquer. You are building in trouble if you put it over linseed oil, no matter how thoroughly you may think it has dried.

You are also asking for trouble by putting shellac over a linseed oil base. The reason is the same, incompatibility. If the two materials (stain and finishing coat) can be dissolved by a common solvent or thinner, you have a compatible system. If they cannot be dissolved by a common thinner, they should not be used together. As an example, most oil/solvent (pigment) stains have as a main ingredient an aliphatic solvent, usually mineral spirits or something very much like it. Most varnishes also use aliphatic solvents to make them brushable and flowable on the wood. Thus, pigment stains and varnishes are almost universally compatible and they will bond well to each other upon drying.

As an example of a potentially incompatible system, take the same oil/solvent (pigment) stain and lay a coat of brushing lacquer (or even spraying lacquer) over it. Chances are, the powerful solvents and thinners in the lacquer will attack the oil base of the stain, no matter how well it has dried. The lacquer will generally cause the surface of the stain material to swell, wrinkle and attempt to lift off the surface. Even if it doesn't, the adhesion of the dry coat of lacquer to the oil in the surface of the wood will, at best, be minimal.

The potential incompatibility of a finishing system can be anticipated by reading the labels. If there is no major, single ingredient common to both formulations, the finisher should expect trouble. The chemical-reaction type of water-based stains are compatible with any finishing material. So are alcohol-based stains. Only the oil-based pigment types occasionally cause compatibility problems, and then only under shellac or lacquer. □

Don Newell, of Farmington, Mich., is a gunstock maker, paint and varnish chemist, amateur furniture maker and author of an industrial finishing textbook.



Basic bench with accessories (left to right): bench hook, pivoting front jaw pad for vise, flush-mounted Silex #13 adjustable aluminum bench stop, Record #52½ 9-in. by 4-in. vise with quick release, ½-in. thick particle board hooked wedge with rails, shooting board and bench jack.

Workbench

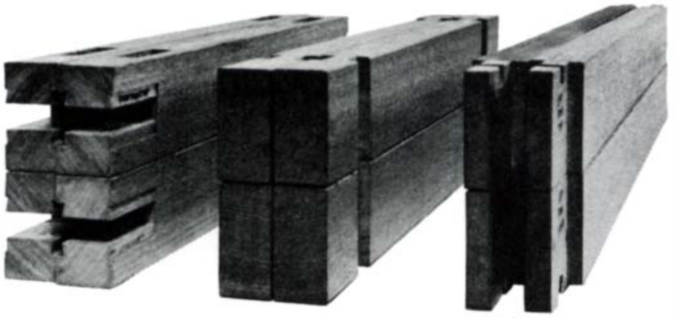
Ingenious ways to hold the work

by Donald Lloyd McKinley

EDITOR'S NOTE: Donald Lloyd McKinley, who teaches woodworking and furniture design at Sheridan College near Toronto, spent the year starting August 1976 in Tasmania. He came home with a remarkable workbench, incorporating several ingenious work-holding systems, which he describes in the following text and photo captions. The bench was made of "Tasmanian oak," the local trade name for several species of eucalyptus. Its overall dimensions are 72 in. long by 36 in. wide by 36 in. high.

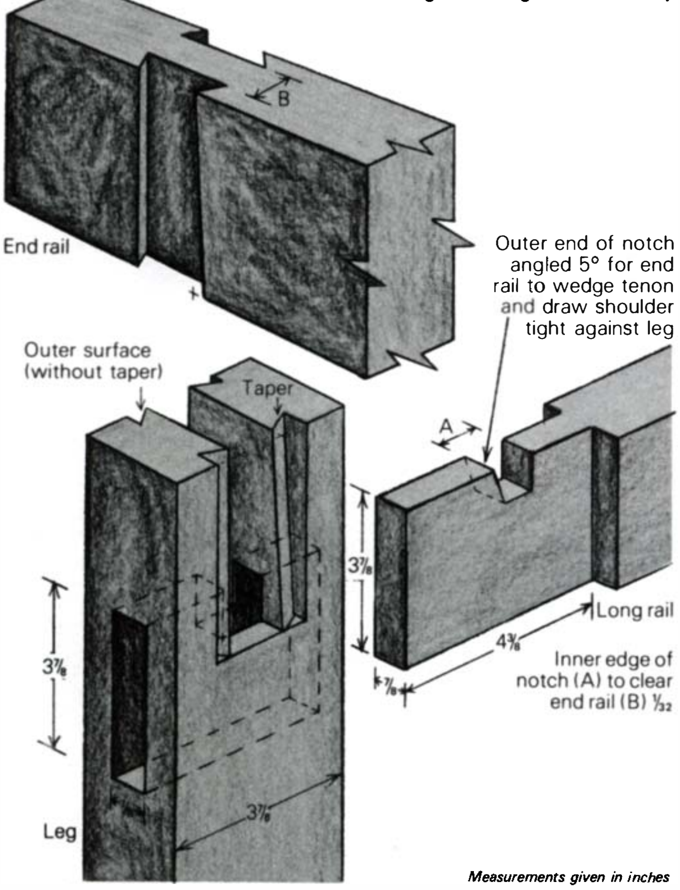
Base: *Eucalyptus regnans*, total weight 90 lb.
Legs: 2 @ 2⅛" × 3⅞" × 34" (rear)
2 @ 2⅛" × 3⅞" × 34⅜" (front)
End rails: 4 @ 1⅞" × 3⅞" × 36"
Long rails: 4 @ 1⅞" × 3⅞" × 52¼"
Top: *Eucalyptus obliqua*, weight with vise 190 lb.
1⅞" thick × 36" wide × 72" long
Accessories: Huon pine *(Dacrydium franklinii)*

As a furniture maker/woodworker your workbench is the most important piece of furniture you'll ever make or own. At its simplest a workbench is a table—an elevated surface that supports and accommodates an activity at a comfortable height. In principle, a chopping block, if you want to split kindling or billets, is a workbench because it elevates and supports the workpiece for the task at hand. Fitted with vises and securing devices, the usefulness of the workbench is wonderfully increased. It is as basic as the tool. If you can't hold the workpiece, you can't do the work.

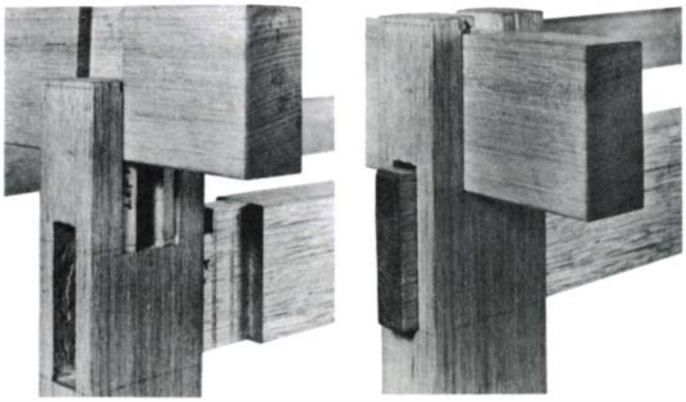


Ends of the basic frame parts, arranged in groups of four, in the relationship they will have when assembled. The annual rings form a diamond toward the center of the bench. This may not be important to many people, but it is a perception and an arrangement that is possible and pleasant to be in charge of. The front legs are ⅜ in. longer than the rear legs, to fit locating sockets in the bench top (shown in the photo at right). Joints were roughed out on a radial-arm saw. Bevels were cut using sharp chisels and gauge blocks.

End rail, leg and long rail assembly

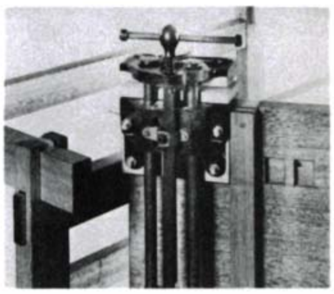


Measurements given in inches



From top to bottom, left, the end rail, leg and long rail at the top-front-left corner of the bench, partially assembled. The notch in the top edge of the long rail tenon (partly visible) will coincide with the bridle in the leg. Thus the interlocking lower edge of the end rail will draw the long rail shoulders snug against the leg. The joint assembled, right. The gap at the top of the leg mortise is due to the shrinkage in width of the long rail, when the bench was transported from humid Tasmania to the dry Canadian winter.

Photos: Donald Lloyd McKinley



Top, the tilting vise, at an angle appropriate for coopering. The vise mounting block is assembled from scraps of eucalyptus and held to the bench with two standard door hinges, their barrels let into grooves safely below the surface. The arm (1½ in. by 2 in.) that extends from the vise mount is simply clamped to the 2x4 huon pine diagonal brace for intermediate angles. For frequently used angles, a hole may be drilled through both arm and brace and a dowel inserted to lock that position. Above, the bottom side of the bench top is mortised only at the front to accept the front leg extension. This keeps the front edge of the top in alignment with the front of the understructure, but allows the top to expand freely and contract rearward as it exchanges moisture with the atmosphere. The arm of the tilting vise mount is also shown.

I made this bench in Hobart, Tasmania, Australia, at the start of my year as state resident designer-craftsman in wood. The wood had been adequately dried for use in humid Hobart, but has predictably shrunk in Canadian winter dryness. The tapered-dovetail bridle joints at the ends of the legs have been lengthened by 3/16 in. to restore self-locking rigidity in their contact with the end rails.

The dimensions given are "as-finished" rather than "as-is" and were reasonable finished dimensions from the rough stock dimensions available in Tasmania. The proportions have proved structurally satisfactory. I believe the finished dimensions could be safely reduced to 1¾ in., as typically yielded from 8/4 rough stock. Equivalent domestic North American woods would be red oak for the base and white oak for the top. Eucalyptus is almost invariably quartersawn and for the stability required of this floating top, quartersawn stock is essential.

I had a number of basic objectives (and personal preferences) when I designed the bench:

—rigidity and solidarity in use (increased load tightens joints in the base);

—compactness for easier storage or shipping (assembly and disassembly with minimum tools);

—slab top (no tool trough to fill with shavings or reduce usable surface area);

—top overhang or clearance from base for ease of clamping workpieces flat on the bench top (i.e., for mortising);

—vise end of top overhanging the base structure (to permit the mounting of a standard Record #52½ vise);

—layout for right-handed user.

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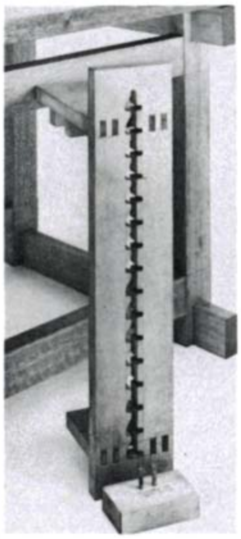
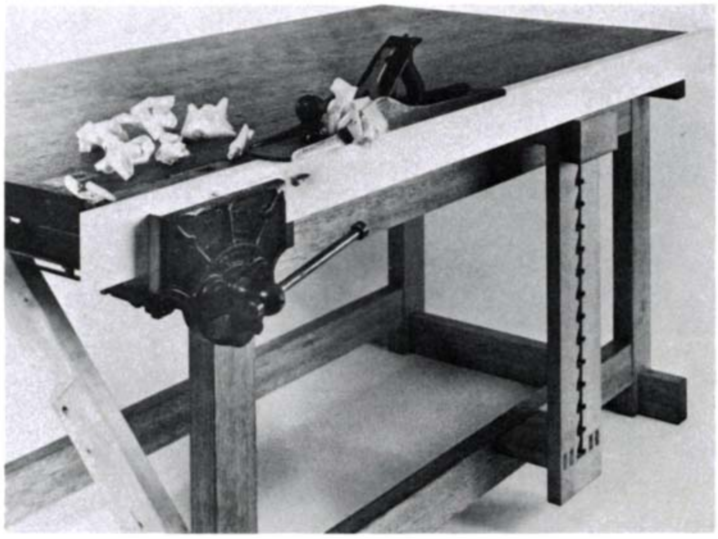
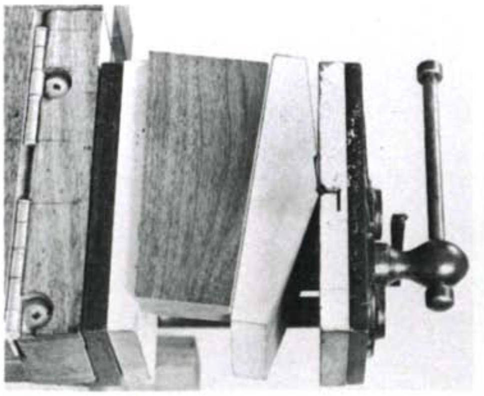
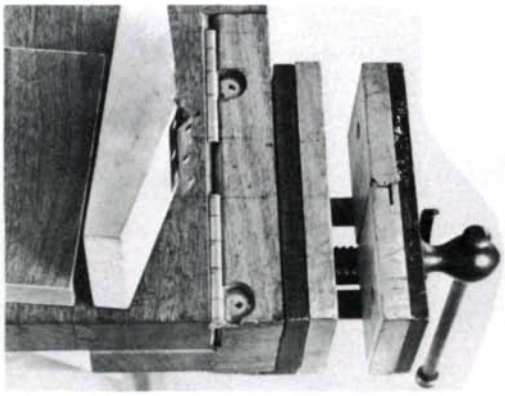
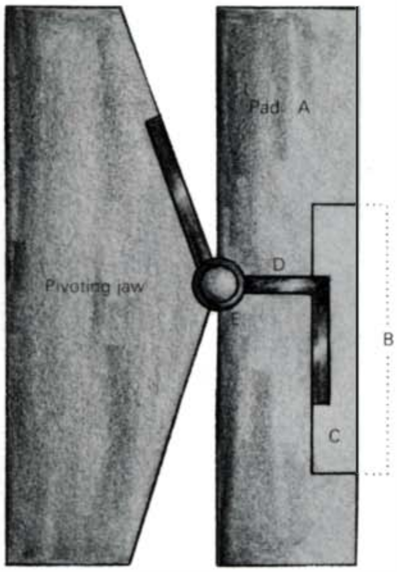




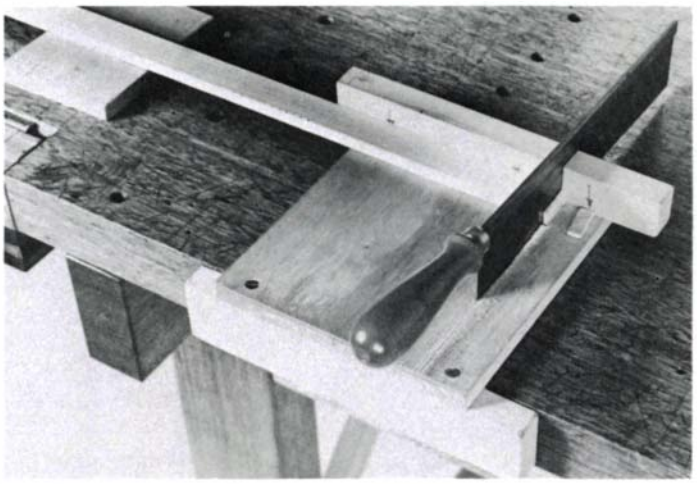
An adjustable bench jack made of huon pine supports the right end of a long board. This reduces deflection and the need for overtightening the vise to stop an unsupported board from twisting down. The bench jack simply hooks over the long front rail. Two cleats straddle the rail, and the jack may be slid anywhere along the bench. The cleats and foot support are placed so that the face of the jack is the same distance out from the bench top as the fixed jaw of the vise. The support block adjusts vertically in the notched slot: A quarter-turn clockwise from horizontal allows it to be slid up and down or removed. The two lag screws in the block are set off-center by one-half the amount of the quadrant-notch interval, to double the number of height positions simply by removing and inverting the block.





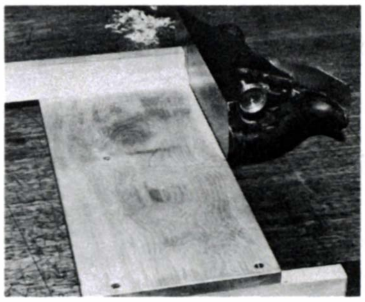


A pivoting block fitted to the front jaw pad of the vise allows it to hold tapered work without stress and without crushing the wide end of the work, left. The pivoting block removed from the vise, right. A butt hinge fastened to the back of the pivoting block has one leaf bent at 90°, which slides into a corresponding slot in the front pad of the vise.
Here's one way to make the front jaw pad: A) Start with complete pad, B) dado out the area marked against the vise jaw itself, C) glue back in a piece the shape of the unshaded area, D) saw a slot in the face of the pad, and E) shape a half-round to accept the hinge knuckle.



Once you have a bench, a bench hook is one of the most useful accessories for cutting small parts that you can have. The work is held against the back cleat with your left hand. This pushes the bench hook and its front cleat against the edge of the bench top, immobilizing the whole setup. Long pieces may have additional support by keeping a bit of stock the same thickness as the hook base to slide under the overhang.

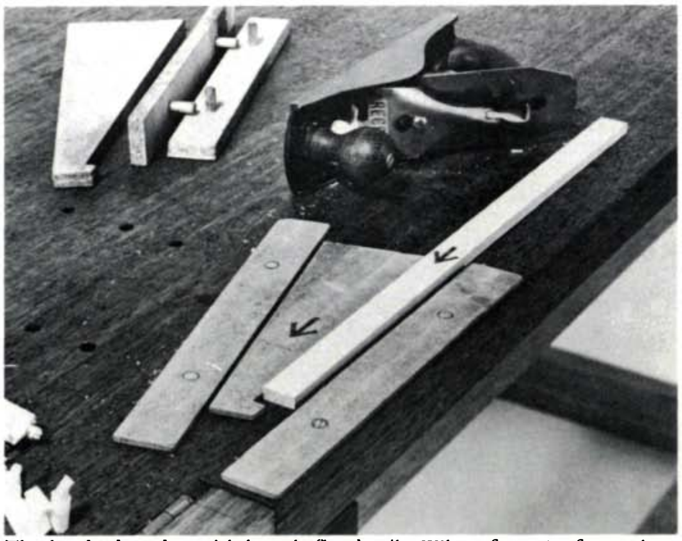
The bench hook prevents tear-out as the saw teeth pass through the back and bottom of the workpiece, because the fibers at the back and bottom are supported. As sawcuts widen in the bench hook and give less support, a new cutting position along the back cleat and base should be established. The arrows on the back cleat locate screws, and serve as a reminder not to cut there. As with a miter box, other angles may be sawn. In addition, extra length on the right side of the back cleat may be used to clamp on stops for repetitive cuts.

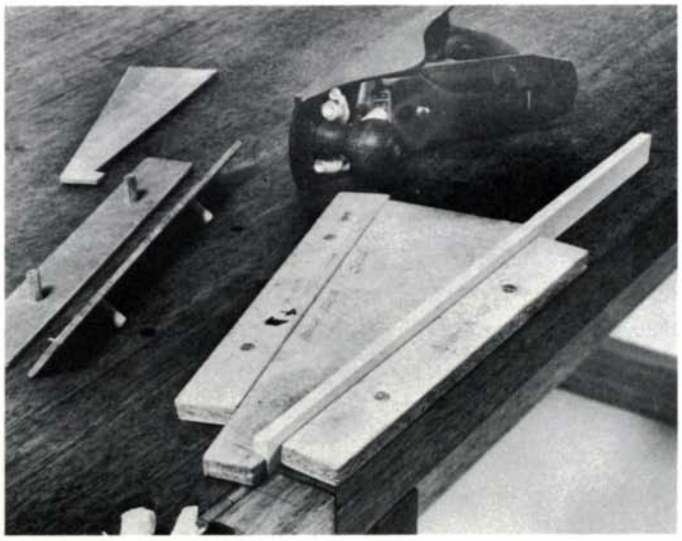


A shooting board is primarily used to true end grain on the work. The type shown at right is very similar to the bench hook. The workpiece is held against the back cleat in the same way, but instead of sawing on the board, plane along its right edge, using a regular smoothing plane that has been laid along its right side. Take care that the cutting edge of the blade is at 90° to the right side of the plane. This will ensure that the end of the workpiece will be planed square vertically.

Squareness, looking down on the work, depends on the front face of the back cleat being perpendicular to the edge of the shooting-board base. A rabbet plane could destroy squareness in this direction since the whole edge of the board would be planed away. A regular bench plane will not cut closer than about 3⁄16 in. to its side. This means that the lower edge of the board remains true and will continue to guide the plane.

It's wise to break in the shooting board by planing along the whole length of its edge, front-to-back. Otherwise, a small taper might result at the front edge of a wider-than-usual workpiece. Of greater importance is using essentially the same amount of blade projection each time. If the board edge and back cleat have been deeply rabbeted by previous heavy cuts and you then use a shallow setting, the workpiece must project beyond the back cleat for the blade to engage it. This invites tear-out when the plane blade leaves the unsupported back edge of the work.





The hooked wedge with bench-fixed rails. When force (as from planing) is applied to the workpiece in the direction of the arrow, the work contacts the hook of the wedge. The work and the wedge then move together in the direction of the arrows, and are forced against and confined by the converging rails. Right, the same workpiece on edge, wedged in place by a half-inch thick set of parts. The work is easily disengaged by tapping back on the hook end of the wedge.

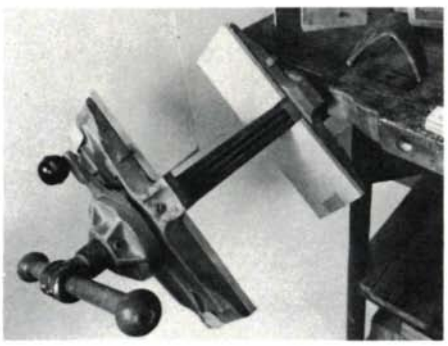
This version of the hooked wedge is my answer to the inadequacies of a commercial product. About 20 years ago I bought a Stanley bench wedge designed around a flanged tapered plate of bent steel. Its various problems included an inside radius where the flanges were bent—unfortunately, the workpiece needed a matching radius and was abused to this condition whether you wanted it or not. Its fixings to the bench necessitated a recessed area into which the work would teeter under pressure of the plane, it would only accept pieces narrower than 3 in., and a plane could be devastated by unwarily working a thickness down to the height of the metal flange. It was still a good system, so I worked it through several generations over the years, and finally abandoned the use of metal altogether to arrive at the parts shown here. It is a versatile, inexpensive, easily made and installed device that does some of the work-holding better than anything else I've used.

The rails are made by gluing and wedging dowels into $\frac{3}{16}$-in. hardboard or $\frac{1}{2}$-in. particle board. The dowels plug into pairs of holes on the bench top. The width of work that can be held is limited only by the width of the bench itself. The hooked wedges are made of the same materials—thus you can safely plane into the wedge and rails. A suitable taper is about 1 in. in 4 in., or 15°. I sometimes find it useful, with a few strokes of the plane, to readjust the edges of the wedge or rails to a bevel, thereby shifting the pressure higher or lower on the part held (especially if the part also has a bevel).

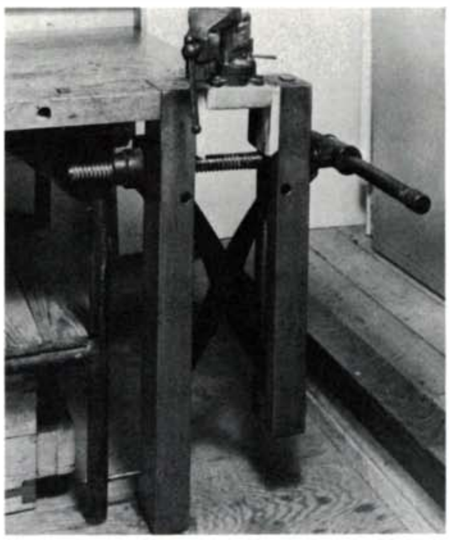
The most versatile narrow setting seems to come from a combined width of hook and wedge (narrow end) that will just pass through the gap between the converging ends of the rails. A really narrow hook (much less than $\frac{1}{2}$ in.) can cause concentrated pressure and some marking where it contacts the end of a softwood workpiece.

The last batch of rails I made, in thicknesses from $\frac{1}{8}$ in. to 1 in., has the dowels located off the centerline to provide three increments of space for each set of bench holes. This is accomplished by turning one or both rails end-for-end in the holes.

I am well aware of the carpenter's pinch block, that is, two converging strips or two converging cuts in a single block nailed to floor, bench or sawhorse. It is quick to make and use, and usually no more shoddy than the work it holds. However the pinch it exerts on the end of a soft workpiece may be unacceptable, justifying the trouble of making a hooked wedge to match the converging strips, thus distributing the pressure over a larger area. Obviously the nature of the gripping edges can be altered by applying felt, rubber or sandpaper to match the task at hand. □



McKinley's primary bench since 1958, top left, has been this pipe-frame construction salvaged from a ceramics factory. Its amenities include tool storage above and below, and two unusual vises: the Emmert Roto-Vise, left, and a scissors-section leg vise of unknown manufacture, right. You can't buy either vise because neither is being made any more, but both have features worth study and imitation in shop-built versions. The Emmert vise, bottom left, made in Waynesboro, Pa., until about 1965, houses its single screw in a cast beam, which rotates through 360° as shown here. The whole vise tilts up and down through 90°, which inspired the tilt modification shown on the Tasmanian bench. Its front jaw also swivels about 5° to hold tapered work—another feature transferred to the standard vise on the Tasmanian bench. Right, leg vise with 3-in. by 5-in. maple jaws has cast-steel scissors that ensure parallelism at any opening. Eyes at the top end of the scissors rotate freely on $\frac{5}{16}$-in. bolts, while the lower ends rise as the scissors spread riding in a groove plowed in the jaws. The bottom of the groove is faced with a strip of $\frac{1}{8}$-in. by 1-in. strap iron to prevent wear. The replaceable basswood jaw pads can be inverted, whereupon they project above the uprights and their angled ends give more access to fine work. In this photo, the leg vise holds a square fir block carrying a small metalworker's vise. —J.K.



Circular Stairway

Laminate stringers around forming cylinders

by Laszlo Gigacz

I will tell you how I built a circular staircase, but before I begin I should tell you that I'm not a special stair builder by any means. I am Hungarian and have lived in the United States since 1957. I have made my living as a woodworker in Boston, New Haven, and for the past 16 years, in Jordan, N.Y., where I have had my own shop for 12 years now.

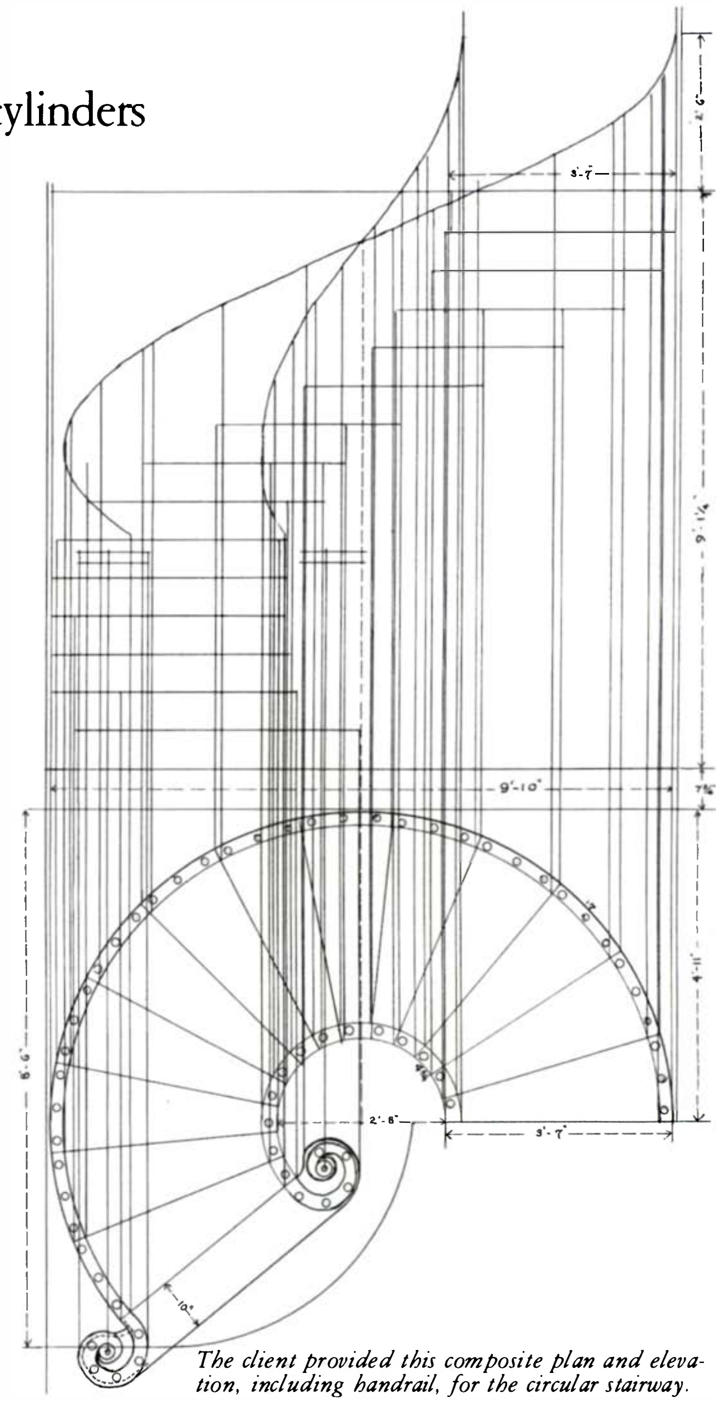
One afternoon a man and woman came into my shop and wanted me to turn two columns for a fireplace mantel and to carve an Ionic capital with a neck. I said, "Why not, that's what I'm here for." They seemed surprised, but when I delivered the job they were delighted and before too long they commissioned me for the staircase they wanted. The client was Porter Bachman, who lives in a fine house on Skaneateles Lake. Bachman himself did the design for the staircase.

Bachman furnished a dimensioned set of plans like the drawing alongside. Nothing about construction, so I worked on that. First I went to the library, a waste of time as there was nothing on circle stairs, or even straight stairs. My alternative was to think. I would like to remind you that this stairway was to be suspended in air, fastened to the upper and lower floors only, not a spiral staircase hung on a central column.

The first thing I did was to take down the loft in my shop to gain head room—16 ft.—and clear away a 15 ft. by 15 ft. area. The stairwell measured 10 ft. by 10 ft., and 108¾ in. from finished floor to finished floor. The stair was to be 9 ft. 10 in. at its widest, and the central space was to be 2 ft. 8 in. across. I put down ¾-in. plywood on the shop floor, and on it drew the floor plan of the stairway in actual size.

Next you work out the height of the risers, and it is basically the same as straight stairs. One rule of thumb is to divide the total height in inches by seven and forget about the remainder, to get the number of risers. Then divide the total height by this number of risers to get the exact height of each. There is always one less tread than there are risers. So in this case there are 14 treads and 15 risers, each 7¼ in. high, which equals the total height, 108¾ in. This of course includes the thickness of the tread. So when you decide the tread size, the riser height is minus that thickness. In the circle of stairs the width of the tread is governed by the radius of the stairwell, or by what part of the radius the stair is using. In this case, the stair winds less than three-quarters of the radius, as you can see on the floor plan. The bigger the radius the wider the tread, and the smaller the radius the narrower the tread. It is as simple as that, this is how I see the mathematics of it.

To make the stringer strong enough, it was merely speculation. I came up with 2½ in. thickness and 8 in. depth in white



The client provided this composite plan and elevation, including handrail, for the circular stairway.

Illustration: P.W. Bachman

oak, which worked out swell. I made the stringers out of ¼-in. and ½-in. thick laminates of oak and here is how. First of all, you have to make up two cylinders, one as big as the outside diameter of the stairs less the thickness of the stringer, and one the size of the inside diameter. First you make the inside cylinder and after you have laminated the stringer onto it, you build the outside cylinder around it. Be sure you do it this way, otherwise you won't have room to swing your boards in between the two cylinders. To make the cylinders, I simply used 2x6 framing lumber, first putting the location of each upright piece on my floor plan, and also the size and shape of the horizontal bracing segments between the uprights. I nailed one segment on the floor, then nailed one 2x6 next to it, then nailed stiffening segments at about 24 in. height,

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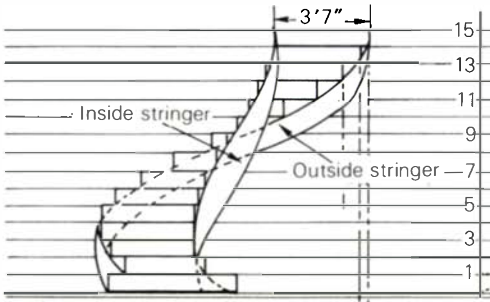
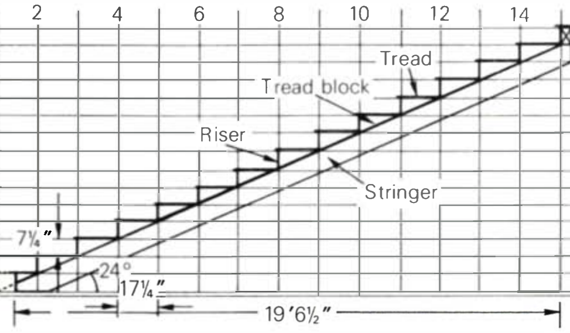
EDITOR'S NOTE: The only book we've found on stairway design is *Stair Layout* by Stanley Badzinski, Jr., published by the American Technical Society (5608 Stony Island Ave., Chicago, Ill. 60637, $4.25). A discussion of circle and geometric stairs appears in *Building Construction Carpentry* by A.B. Emary, which Sterling (2 Park Ave., New York 10016) plans to reprint in the fall.

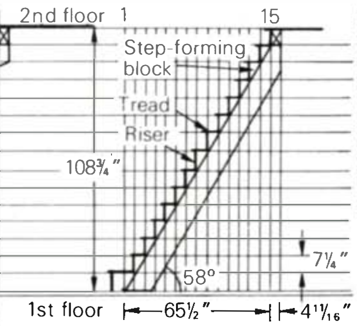
Laszlo Gigacz, 43, lives in Jordan, N.Y. He is currently tooling up to produce spinning wheels.



Stairway front elevations

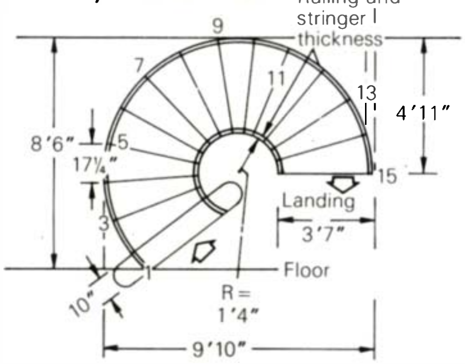


Development of outside stringer



Development of inside stringer

Illustrations: Richard Glassman

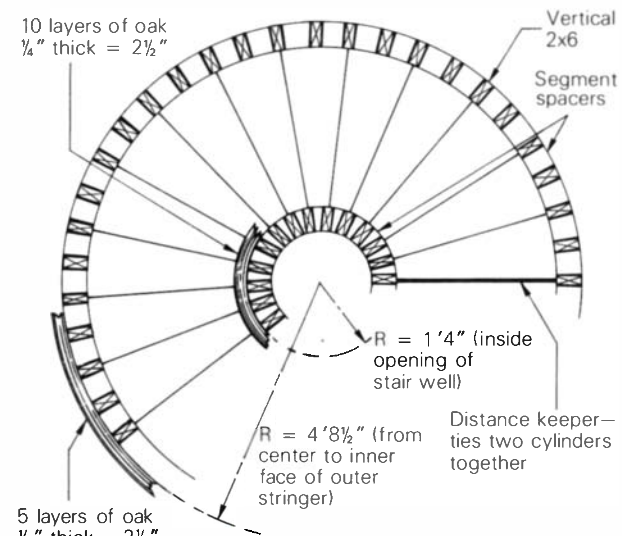


To develop drawings of a circular staircase, start with the plan (left) and the known distance between the floors. Calculate the rise of each tread, and directly above the plan view construct a horizontal grid of lines representing the top surface of each tread. Then project verticals from the plan to the horizontal grid, to locate each tread and riser as it would be seen in front elevation. The balusters and handrail are left off this drawing for clarity, but they can be projected in the same way. Then extend the horizontal grid to the right of the front elevation, and calculate the running length of the outside and inside stringers, from the known radius of the stairway. Since the number of treads is also known, the inside and outside width of each can be calculated, and the risers can be located by a grid of vertical lines. The stringers may now be drawn as if they were stretched out flat, along with the tread-supporting blocks, risers and treads. The slope of the stringers and the length of the stock needed to make them may be measured directly from these two developmental views.

again at 48 in., and so on. As you progress building up the cylinder you have to figure out where the segments should go, otherwise you might end up putting one where you would want to clamp. In other words, arrange the height of the horizontal stiffeners so that when you laminate they won't be in the way. The photos (next page) should help you understand.

After you have the inside cylinder done, you nail a piece of ⅛-in. thick fiberboard that is 16 in. wide on the side of the cylinder, roughly where the stringer should be, and lay out the steps and risers to locate stringer position on the cylinder. I nailed small nails where the top edge of the stringer crossed each 2x6, taking the heads off the nails so I could remove the ⅛-in. board. The small nails remained in the 2x6s as the actual markers for the stringer. At this point I made 2 in. by 2 in. by 6 in. pieces of wood, cut at the angle the stringer was going, and nailed them to the 2x6 where I had the small nails. This block is preventing the stringer from climbing. It aids you in keeping the laminates in proper line.

I was able to bend ¼-in. thick boards of oak without any problem of breaking fibers. So I clamped the first board and on its backside I put little glue blocks to hold it to each 2x6 upright. After the glue set up I could take off the clamp and proceed with the next board. It took 10 laminations, each 12 ft. long, to make up the 2½ in. thickness. I clamped at each 2x6 upright and clamped in between, spreading glue as I went along. You have to have a good, even pressure distribution throughout your gluing. With the inside stringer done I built the outside cylinder and went ahead the same way. But it was nearly 20 ft. long, so I had to join the boards and stag-

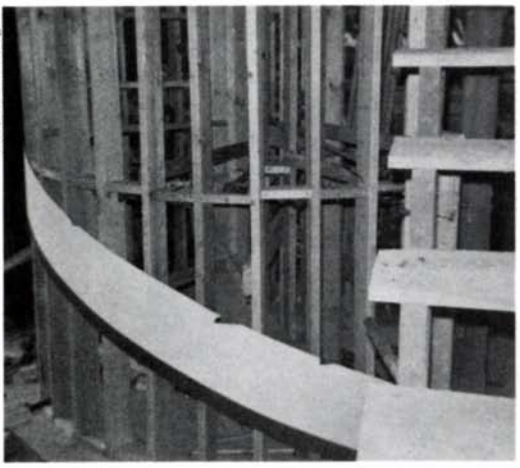


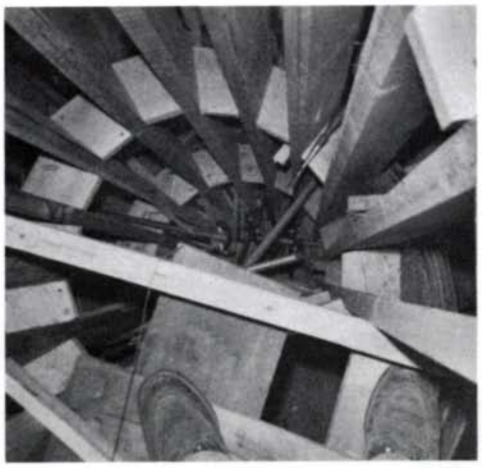
Floor plan of forming cylinders

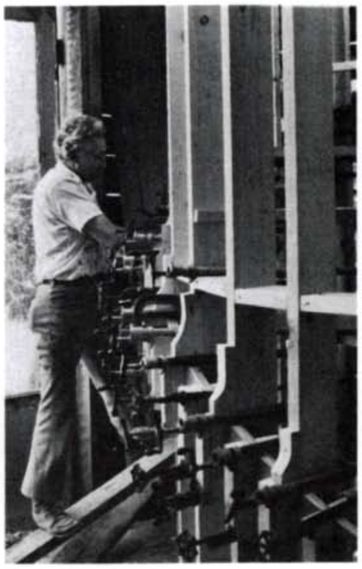
Photos: Edward Krause

Author finishes trim on circular staircase, which is supported only at the floor and landing. The sweeping railing was laminated on the same forms as the stringers, then carved to shape by hand.

Photos: Laszlo Gigacz







Gigacz built the outer forming cylinder after completing the inside stringer. Left, paper pattern for the outer stringer is pieced together on a layer of fiberboard. Center, the inner forming cylinder, seen from the top, is a forest of studs, spacers and clamps. Right, author twists clamps, dozens of clamps, as the outer stringer takes form. Curved blocks nailed to uprights keep the laminates from climbing upward.

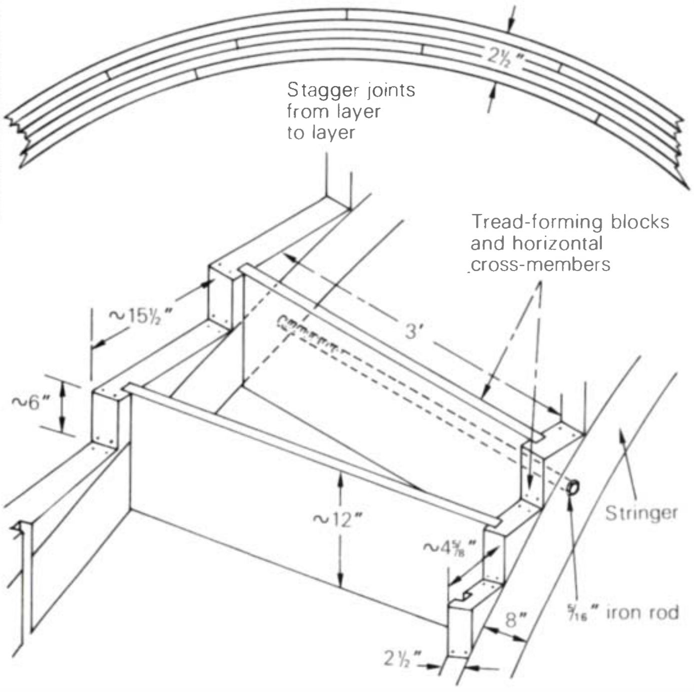
ger the joints. I used a *V*-joint. The curve was easier so I could use ½-in. thick boards, five laminations.

While I still had the form up, I did a layout for the railing in the same fashion as for the stringer and laminated five strips of mahogany, each ½ in. by 2¼ in. After it was done I shaped the railing by hand, using gouges and rasps. I made a separate form to laminate the balcony railing. It was a simple bend. The volute and goose neck I carved out of solid. I bought the newel post and baluster.

Now that I'm done with laminating, I will talk about the so-called carriage. The carriage is a frame consisting of the two stringers, the step-forming members, and horizontal wooden members to tie the stringers together. I used ⁵⁄₁₆-in. iron rod threaded for nuts and washers to span the width behind the horizontal members. As you see on the drawing, the horizontal member has nothing to do with the risers. I should say, as I was putting the horizontal members in place and tightening the rods, I was able to remove the 2x6 cylinder forming members. The stair was on its own. I cut the step-forming pieces out of 3-in. thick stock and placed them on top of the stringers by way of glue and wood screws, and shaped them to the same curve as the stringer. I used 1⅛-in. thick white oak for the treads, rounding the face and ends. The risers are ¾-in. thick pine. Keep in mind, the steps and risers are nothing more than an aid for walking on. The load bearing is in the carriage. The steps and risers I glued and screwed together in pairs, and later at the job site I glued and screwed the top of each riser to the bottom of the next step. I put the screws in from the face of the riser, which was covered later with a molding going all around under the steps. Fancy applique—you could call it fretwork—also went on the face of the inside stringer, for covering up the nuts and for looks.

Next is to take down the stairs, which are marked where each piece will go. Then a short ride on a flat-bed truck, the ride for home. I must say I was a little nervous but soon, as I started to put the pieces of the puzzle together, my nervousness went away. I worked about a month in the house. Bachman painted the risers and balusters, and varnished the treads and railing. A plasterer covered over the metal lath on the bottom side of the stair. Everything worked out fine. □

Illustrations: Richard Glassman



Laszlo Gigacz

Done with laminating, Gigacz adds horizontal tie-members reinforced by iron rod, and step-forming blocks, and removes the forming cylinders. The stairway is on its own.

Three Stairways

Collaboration with architects is mutually profitable

by Andrew J. Willner

Photos: Andrew Willner

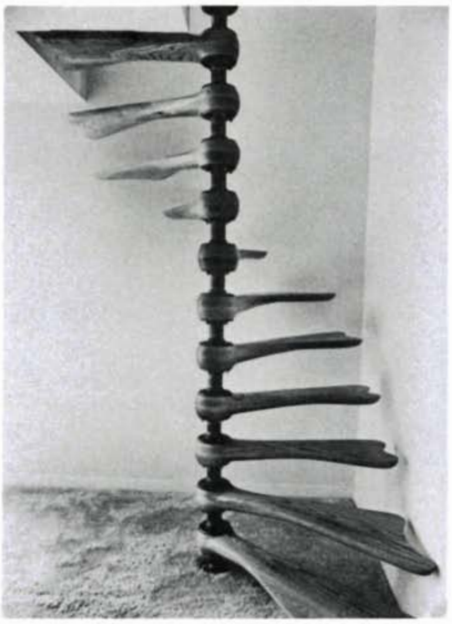
Platform-railing-sculpture of closet stairway.

A contemporary woodworker can make a living by creating large pieces on speculation or commission, making multiples of small (under $100) items, or a combination of both. My personal choice has been to devote my time to large, sculptural—though functional—work. I have been selling my work through galleries, shows, direct commissions and recently by working with architects. My tactic has been to convince them that when they have an unusual design problem, a woodworker might be able to solve it, and at a cost close to available commercial solutions.

The stairways shown were designed and built in accordance with architects' specifications and restrictions. One is a simple solution to a traditional problem, a circular stairway for a small space in a new home. The second is more unusual, a stairway for a silo being converted into a two-story living room. The third was built in a townhouse, in a small space created by cutting through a closet ceiling in a basement bedroom. In the first and third cases, the architect did have a commercial solution available (prefabricated circular stairs can be purchased for $800 or more), but in the second instance there was none. All three had to solve an architectural problem as well as an esthetic one. The stairs had to function, support weight, have the correct rise and run and feel safe. The stairways for the new home and the townhouse also had to be justifiable esthetically, since they were chosen over the competitively priced alternative.

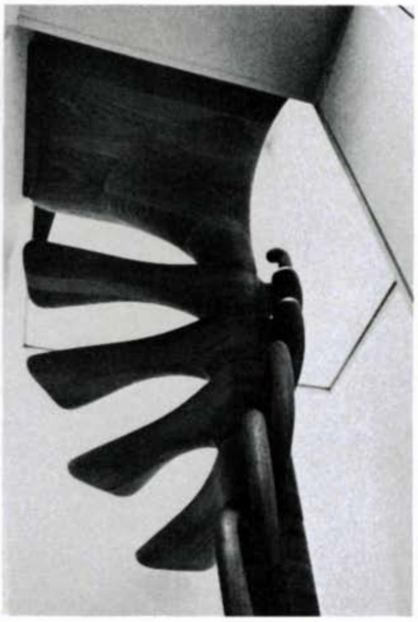
The circular stairway for the new home (left) is 8 ft. tall, 4 ft. in diameter, of red oak and steel. It is relatively simple in construction because the client specified a low price and the stairway had to be moved from the shop where it was built to the site. There are only two anchoring points: It is bolted to a reinforced portion of the floor, and through a steel plate to the floor joist above. The central post is not solid, but is made of plumbing fixtures, floor flanges and pipe nipples. It is through-bolted and spot-welded once in place and adjusted. The treads were joined and laminated, cut on the band saw, carved and finished in the shop, numbered, taken to the site and assembled. The pieces are modular, and shaped to fit the square space. There is no railing (and no need for one) except for the carved handhold on top.

The stairway for the silo (center) was more of a technical problem. The client requested a railing and no visible means of support. The silo itself was no longer round—it was shaped more like a Coke bottle than a cylinder. The treads are carved red oak about 22 in. long, supported on the wall by two threaded rods connected to drilled and tapped pieces of steel buried in the center board of the treads. The rods are connected, through the reinforced wall and a steel plate, to washers and bolts on the exterior. The treads were carved in the shop, brought to the site, and individually placed and



Circular red oak stairway was designed to compete with a prefabricated product. It is supported by bolted pipe flanges and nipples, spot-welded after installation.

Willner buried two threaded rods inside the deep keel of each carved tread on this staircase The rods are bolted through steel plates on the outside of the silo wall.



Treads of this closet stairway fit over a steel pipe bolted to the concrete basement floor. Individual handholds eliminate railing. Material is red oak.

leveled relative to the floor and to each other. The railing supports are ¾-in. square steel, bent on a form and screwed to the treads in a routed groove. A line was struck along the top of the railing supports with a flexible piece of wood to compensate for the differences in height and angle caused by the wall's irregularity. The steel was then taken down and cut at the proper angle. Tabs were welded to the top of each piece, wooden blocks screwed to them and thin wood strips glued to the blocks. A red oak railing surface was fabricated to create a cap. I chose this method, rather than a continuous bent lamination, to compensate for the irregularity of the circular wall. Once the railing was fastened in place, it didn't flex at all.

The stairway for the townhouse is also carved red oak. The treads are fitted over a steel pipe, which is bolted to the concrete floor and pulled tight by a flange on the pipe. The pipe is covered by a platform-railing-sculpture assembly, which is bolted to the floor joists. Individual handholds, which are part of the tread structure, take the place of a railing.

The techniques and designs used for these stairways reflect my solutions—there are many other ways to deal with the same or similar situations. The constraints presented by irregularities and limited space seemed to give me more latitude in design rather than inhibit me. One discovery I made is that early on in design, especially with experimental structures, it is essential to check your work with someone who has technical knowledge of the strength of materials—an engineer or the architect himself. The relationship between architect and craftsman is mutually beneficial. The architect can allow the woodworker to design and build on a larger scale than usual. The woodworker can provide the client with an object of beauty and integrity that transcends the usual commercial solutions. □

Andrew Willner, of Thompson, Pa., is chairman of the committee organizing "Wood Conference '79: The State of the Art," planned for Oct. 5-7, at the State University of New York, Purchase. For more information, write Ken Strickland, Visual Arts Department, SUNY, Purchase, N.Y. 10577.

Spiral Staircase

by Simon Watts

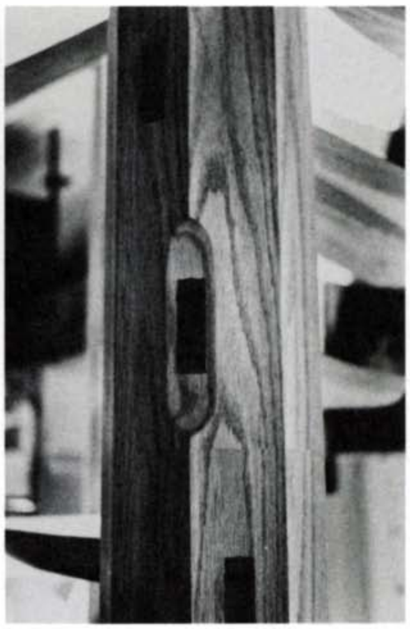
This spiral staircase was made for a converted barn in Chelsea, Vt. It was made entirely of oak—I fabricated all the pieces in my Putney, Vt., shop, assembled the stair, knocked it down and reassembled on the site. Distance between floors was about 12 ft., so I decided to make one complete turn of 16 treads, giving a rise of 9 in. between steps. The staircase is 5 ft. in diameter.

The treads were laminated from three pieces—two thinner side pieces were glued and dowelled to a thick center rib. Each rib was mortised right through the stem and glued and wedged on the far side (detail, right). The treads are cantilevered from the stem but get some support from being, in effect, hung from the handrail. It often happens that one designs not only for strength but for rigidity, or, as engineers have it, "minimum deflection."

Although stock 18 ft. long had been ordered for the stem (and paid for), the actual boards were not straight enough to work with. We therefore cut each length into three pieces, jointed and planed them separately, and then end-glued them back together with Titebond. To my surprise, the reconstituted stock was strong enough to be handled, replaned and then laminated to make the stem. When laminating, we took the precaution of staggering the end-glued joints at least two feet apart.

The handrail was steam-bent in sections in the shop, using the assembled staircase as a form. Since the steambox was only 10 ft. long, the rail had to be joined up at the site. This gave us trouble and I would do it differently next time. I still like the shape of the treads. They give the whole structure an elegance and sweep that is pleasing. □

Photos: Simon Watts



BRUCE HOADLEY

Black light makes some woods glow

A rather unfamiliar property of wood—fluorescence under ultraviolet radiation (black light)—is a fascinating visual phenomenon well worth investigating. Certain woods viewed under black light appear to emit a mysterious glow or fluorescence, which is almost sure to inspire ideas in woodcraft.

Fluorescence is the absorption of invisible light energy by a material capable of transforming it and emitting it at wavelengths visible to the eye. The human eye can see light over the spectrum of wavelengths varying from about 8000 (red) down to about 3800 (violet). (Wavelengths are measured in Angstrom units, which equal about 4 billionths of an inch.) Above 8000 is invisible infrared light; below 3800 is invisible ultraviolet light. The black light commonly used for visual effects is in the 3800 to 3200 range and is referred to as long wave or near ultraviolet light. It won't harm the eyes. Light in the 3200 to 2900 range includes sun-tanning and burning rays. Below 2900 is shortwave or far ultraviolet, which is used to kill bacteria and is very dangerous to the eyes. Sterilization units or other sources of shortwave ultraviolet should never be used to view fluorescent materials.

Commercial long-wave or black-light lamps emit light averaging about 3700, although the light may range from as low as 3200 to about 4500, well into the visible range. We therefore often see a purple glow, although most of the light emitted is invisible. Chemicals in a fluorescent material absorb this invisible light and transform the energy so that the light emitted from the material is visible in a particular color.

Many domestic species of wood exhibit fluorescence. The table at right lists the principal species, although there are doubtless others. The colors listed are typical, but both hue and brilliance will vary among individual samples. Countless other species from around the world also show fluorescence, but our native species are as attractive as those found anywhere in the world.

Yellow is the predominant color, and also the most brilliant, as in black locust, honeylocust, Kentucky coffeetree and acacia. Barberry, a lemon-yellow wood under normal light, is also among the most brilliant yellows, but since it is a shrub it is difficult to locate pieces large enough for anything but jewelry, inlay or other small items.

Perhaps the most interesting is staghorn sumac. Its sapwood has a pale lavender-blue fluorescence. In the heartwood, each growth ring repeats a yellow, yellow-green, lavender-blue sequence. Yucca and holly have a soft bluish to grey fluorescence. Purpleheart emits a dim coppery glow. Badi exhibits a mellow pumpkin orange. In addition to normal sapwood and heartwood fluorescence, certain anatomical features such as resin canals, oil cells, vessel contents, bark, fungal stains and pigment streaks show selective fluorescence. In aspen, for example, a brilliant yellow fluorescence usually occurs at the margins of areas stained by fungi.

Fluorescence is of obvious value for identification purposes, but it also suggests interesting applications for the woodworker, expecially in carving or marquetry. Inspiring sculpture and religious statuary can have moving effects when viewed in darkness or subdued light with hidden ultraviolet lamps. With the increased use of black light for entertainment areas, such as game rooms and cocktail lounges, fluorescent figures, decorative carvings and items such as light-switch covers are quite popular. Fluorescence can add extra excitement to already popular wooden jewelry and personal accessories. An African mask or Polynesian tiki carved in a fluorescent species makes an unusual pendant or pin.

Fluorescent woods can be used in combination by laminating or inlaying. Menacing fluorescing teeth can be set in the mouth of a carved dragon. Spooky yellow eyes that "light up" can be inlaid into a carved owl. Laminated woods can be carved or turned into unusual lamp bases—especially for black lights. And don't throw away carving chips or planer shavings, as children delight in gluing these to cardboard to create fluorescing designs or pictures.

Wood fluorescence is subject to surface chemical degradation, apparently associated with the familiar darkening or aging effect. Fluorescent wood is most rapidly faded by exposure to daylight, especially direct sunlight. A carving will retain its brilliance for years if kept in a dark place. In normal indoor light, a year's exposure will fade a piece to about half its original brilliance. A light recarving or sanding of the surface to expose unaged wood will renew the original fluorescence. Most finishes reduce the fluorescent brilliance, but in the long run may maintain brilliance by minimizing aging. Clear paste wax seems to be the least dulling. □

Scientific Name	Common Name	Color of Fluorescence
Acacia greggii	catclaw acacia	deep yellow
Annona glabra	pond-apple	dull yellow
Asimina triloba	pawpaw	faint yellow-green
Berberis thunbergi	Japanese barberry	bright yellow
Cercidium floridum	blue paloverde	yellow green
Cercis canadensis	eastern redbud	bright yellow
Cladrastis lutea	yellowwood	pale yellow-light blue
Cotinus obovatus	American smoketree	deep yellow
Gleditsia aquatica	waterlocust	pale yellow
Gleditsia triacanthos	honeylocust	bright yellow
Gymnocladus dioicus	Kentucky coffeetree	deep yellow, bright light blue
Ilex verticillata	common winterberry	light blue
Magnolia virginiana	sweetbay	pale yellow
Mangifera indica	mango	pale orange
Piscidia piscipula	Florida fishpoison-tree	dull yellow
Rhus copallina	shining sumac	bright yellow
Rhus glabra	smooth sumac	bright yellow
Rhus typhina	staghorn sumac	bright to greenish yellow to pale blue
Robinia pseudoacacia	black locust	bright yellow
Robinia viscosa	clammy locust	bright yellow
Torreya taxifolia	Florida torreya	dull yellow
Yucca brevifolia	Joshua-tree	yellowish gray
Zanthoxylum clava-herculis	Hercules-club	sapwood pale yellow to light blue, heartwood bright orange

Editor's Notebook

Magazine business

by John Kelsey

A magazine, like any living thing, changes as it ages. This issue, I'll take time out from technical notes to bring you up to date on some of our changes and some of our plans.

First, some new names are on our masthead (page 3): Cabinetmaker Simon Watts of Putney, Vt., joins us as a contributing editor; machine designer Lelon Traylor of Carterville, Ill., is our newest Questions/Answers consulting editor (page 20), and woodworker Jim Richey of Houston, Tex., becomes editor of the Methods of Work column (page 14).

Watts, 49, has been making furniture since boyhood in England. He turned to it for his living about 20 years ago, upon realizing that civil engineering offered no opportunity to design beautiful things, and opened his Putney shop in 1965. He's become widely known in New England for elegantly clean and exactly proportioned work—an example, his spiral staircase, appears on page 80. Watts now plans to start yet another career, as boatbuilder, researcher and writer, and he's agreed to supply *Fine Woodworking* with design and construction notes, photographs and measured drawings of his best furniture. Many readers have asked us to include good plans for household furniture. We think Watts' designs are just what's needed. He's always had apprentices and pupils working in his shop, and so knows well the problems of the beginner and the amateur. We'll be printing three or four of his articles a year, starting with a library ladder in July, followed by drop-leaf and gate-leg dining tables in the fall.

Richey, 34, is a skilled amateur woodworker who caught the bug in junior-high shop class. He learned the craft by buying basket-case antiques and taking them completely apart to rebuild them. Then he turned to period reproductions to develop confidence in his own sense of design. He's worked as a carpenter and builder and has a knack for jigs, gadgets and novel techniques. Because our Methods of Work column has lacked the coherence a strong editor would bring, we're happy to hand the task over to Richey. He'll select reader's shop tips for publication, clarify the text and draw the sketches. Readers wishing to contribute to the column should still send their Methods to our Newtown offices.

Traylor, 55, builds precise reproductions of early American museum pieces, and has done so for the past 35 years. His work is superb—you'll see some examples in a forthcoming issue. Like many of us, he never could afford to buy the machines he wanted, so he made them. Over the years he's designed and built 32 heavy-duty woodworking machines, including three 30-in. thickness planers. One of them half-fills the garage beside his home. It has edging and molding heads, power to all four feed rolls, and is driven by an old, six-cylinder car engine. Today Traylor is associate professor of tool and manufacturing technology at the School for Technical Careers, Southern Illinois University. He brings a rare savvy about woodworking machinery to our Q&A column.

For those who have just tuned in, the other answer men are consulting editors A.W. Marlow and George Frank, and Contributing Editors Watts, Tage Frid and R. Bruce Hoadley. Marlow is an old-time craftsman in the best American tradition, who at age 75 still designs, builds and sells period furniture from the modest shop behind his home in York, Pa. He's written four of the best books we know of about how to make period pieces. You can see photos of his work on page 70 of our November '78 issue. Frank, also 75, learned the finishing trade in Europe and owned a busy shop in Paris during the 1930s. The war swept him to New York, where he built up a thriving trade as cabinetmaker and finisher until retiring a few years ago. Now he refinishes furniture for family and friends at his home in Florida, and frequently contributes to this magazine instructive tales drawn from his vast experience. Frid, 62, is a master craftsman in the Scandinavian tradition and the dean of woodworking teachers in America. He apprenticed and worked in Denmark and Iceland before coming here around 1950 to teach woodworking and furniture design at the School for American Craftsmen, now part of Rochester (N.Y.) Institute of Technology. For many years that was the only place to do college and graduate work in our field. Today you can scratch the faculty at any college-level program and chances are you'll find a student of Frid, or else a student of one of his students. He's now professor at Rhode Island School of Design in Providence. Hoadley, 45, brings the wood scientist's eye to the craft, as well as the hand of a talented carver. He teaches wood science and technology at the University of Massachusetts, and is one of the few scientists anywhere whose research is concentrated on the problems of the individual woodworker, not on industrial needs.

Both Frid and Hoadley are writing books for The Taunton Press. Frid is completing volume one (joinery) of a three-volume text to be called *Tage Frid Teaches Woodworking*. Hoadley has almost finished work on *Understanding Wood: A Craftsman's Introduction to Wood Science.* Both books will be for sale this autumn. Our third fall book will be the *Fine Woodworking Design Book 2*, a collection of 1,000 photographs of things made by our readers during the past two years. The judging has been exceedingly difficult: The work and the photography are equally excellent. Readers awaiting word on the fate of their photographs will have heard from us by the end of May.

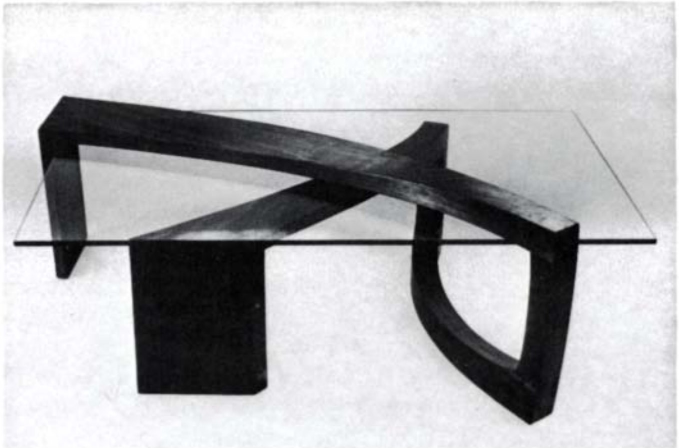
* * *

Readers often ask where they can find working drawings for some particular piece of furniture. In Summer '76, we published a comprehensive list of the contents of all the books of plans then in print. But we couldn't cross-reference that survey. You had to read the whole thing to find your Chippendale tilt-top table—if it was there at all. We're going to do the survey over again, now that our circulation department has a fancy computer. It can sort the list by furniture function and period, and cross-reference it. We'll do the work this summer, but before starting we want to be sure we've located all the available sources of furniture plans and measured drawings—not only in books, but also sold by mail-order. If you have a favorite source, drop us a card or a note.

Later this year, we plan the same computer treatment for our lists of hardwood lumber dealers. Let us know where you buy fine hardwoods. We'll send your dealer a questionnaire.

* * *

The Visual Arts Program of the National Endowment for the Arts (Washington, D.C. 20506) has money to give away to working craftsmen, in slices ranging from $1,000 to $10,000. In addition to the established grant programs for individual craftsmen, crafts projects and apprenticeships, a new "building arts" category this year "is designed to promote the integration of the arts in the construction of permanent buildings and their components." It is a natural for a woodworker who needs financial support to tackle a handmade house, an architectural commission or a decorative structure, and the rules encourage use of historical tools and traditional techniques. Application involves filing numerous forms with slides of finished work. To find out more, write the office named above and ask for the 1980 application guidelines.



Ben Mack, Mt. Tremper, N.Y., showed this walnut and glass coffee table at the Baltimore Winter Market during late February. Woodworkers made a good showing and generally sold well, especially those offering small production work such as boxes and turned ware to the wholesale trade. The next juried fair sponsored by American Craft Enterprises, an arm of the American Crafts Council, is the St. Louis Spring Market of American Crafts, at the city's convention center May 3-6, followed by the Northeast Craft Fair, June 22-24, at the Dutchess County Fairgrounds in Rhinebeck, and the Pacific States Craft Fair, Aug. 2-5, at the Fort Mason Center in San Francisco.

California symposium

Alan Marks, our man in California, journeyed to Berkeley on Feb. 27 for a one-day symposium called "Wood: A Contemporary View of a Traditional Material." His notes follow:

When more than 300 professional and amateur woodworkers pool their experiences, you get more than sawdust. You walk away with a collection of new and ingenious things to try:

—A promising new technique for molding wood, dubbed WEST (Wood Epoxy Saturation Technique), has been devised by the Gougeon Brothers, 706G Martin St., Bay City, Mich. 48706. The Gougeons build boats, but the trick can be used by anyone needing compound-curved shapes. Veneers ⅛ in. thick and 6 in. to 8 in. wide are stapled side-by-side lengthwise on a form, then epoxy is brushed on. Another layer of veneer is stapled at right angles to the first, then the process is repeated to reach the desired thickness. The last layer is stapled but not glued, so it can be stripped off to expose enough staple for gripping with pliers. Thus the outer shell shows no metal. Gougeon, at the address above, will send a detailed brochure for $2.

—Bowl turner Bob Stocksdale *(Fine Woodworking*, Fall '76) contributed tips and quips garnered during 30 years on the end of a gouge. He uses epoxy to fill cracks in exotic woods, but not the quick-drying varieties, which he's found inferior to the slow stuff. He saves sanding dust of various colors and mixes them into the epoxy, making a color-matched putty. Often he uses dust from a lighter wood than that of the piece needing repair, since the epoxy darkens color. He's also solved the problem of eating dust by installing a 12-in. exhaust fan behind his main lathe, with a hood reaching toward the headstock. Says Stocksdale, "It doesn't do anything with the shavings, but it does blow the dust out—onto the neighbors."

—Jack Dohany of San Jose told how he makes large numbers of toys and dolls in his small shop. The principle is to do maximum work to many pieces at a time. Hence, complete repeated operations on long stock before cutting it up, or stack parts for machining with double-stick tape between layers. Dohany's fun seems to derive from inventing wild machines to speed production, such as a tandem router with eight spindles for simultaneous slotting via a moving table, a dowel-taper grinder, a sanding lathe with two pivoting belt sanders that attack the work from either side at adjustable angles, and a drill press with 11 in. of spindle travel and 24 in. of freedom between spindle and column. Each of his many machines has its own dust collector, a rebuilt Electrolux vacuum cleaner salvaged at small cost.

—Symposium organizer Willie Evans discoursed on cutting thin veneers with the band saw. He regularly slices laminated stock, and has found that the glue lines made normal blades quickly lose their set, clog, overheat and wander in the kerf. The answer is a carbide-tipped band-saw blade of the sort usually used in foundry work. Evans has settled on a ¾-in. three-tooth-per-inch blade, also available in ⅝ in. width, which costs four or five times what you'd pay for a standard blade. Even so, he comes out ahead.

The main problem in band-saw blades is flexion. The larger the wheel, the less flexion and the longer the blade lasts before metal fatigue breaks it. Evans also found that he can minimize wobbling and binding in the kerf by angling his fence a few degrees with respect to the blade, such that the blade toes in slightly.

Evans plans to expand the symposium to two days next year. He doesn't see it as a concentrated workshop, but more as a "potboiler," a chance to contact a lot of stimulating ideas and techniques in a short time. Most university extension departments are able and eager to organize symposia like this one, as part of their commitment to community needs. It takes a dedicated craftsman like Evans to get the ball rolling, and legwork to enlist local craftsmen who can contribute catalytic topics. □

Photos: D.A. Cheetham

The Machinist

Harry Hitchner, 35, of Hollandale, Wis., doesn't aim to create awe-inspiring carvings. Instead he concentrates on creating an aura of plausibility through subtle detail—position of the hands, condition of the clothing, texture of the hair. This lifesize carving of The Machinist, like others in Hitchner's repertoire of representative figures from American history, depicts an ordinary man reacting to the events of an ordinary day. Rarely does Hitchner portray the rich or famous. Easy recognition, he feels, discourages careful examination and the viewer's active interpretation.

The carving was gouged out of laminated 4-in. planks of cherry. The gears and flywheel were built up from turned hubs centered within a spoke-supported rim of laminated boards. The rims were cut to true round by rotating them into a band saw, while the hubs were held by a stationary jig. Some of the gear surfaces were worked smooth, while others left with the texture of the gouge, to depict the contrast between rough-cast and machined iron.

Hitchner, who has been a professional woodcarver for the past ten years, completed The Machinist in six weeks. It captured best of show honors and the Marples purchase award at the 1978 International Woodcarvers' Congress held in Davenport, Iowa, and is now on permanent display in the lobby of the Marples tool factory at Sheffield, England.