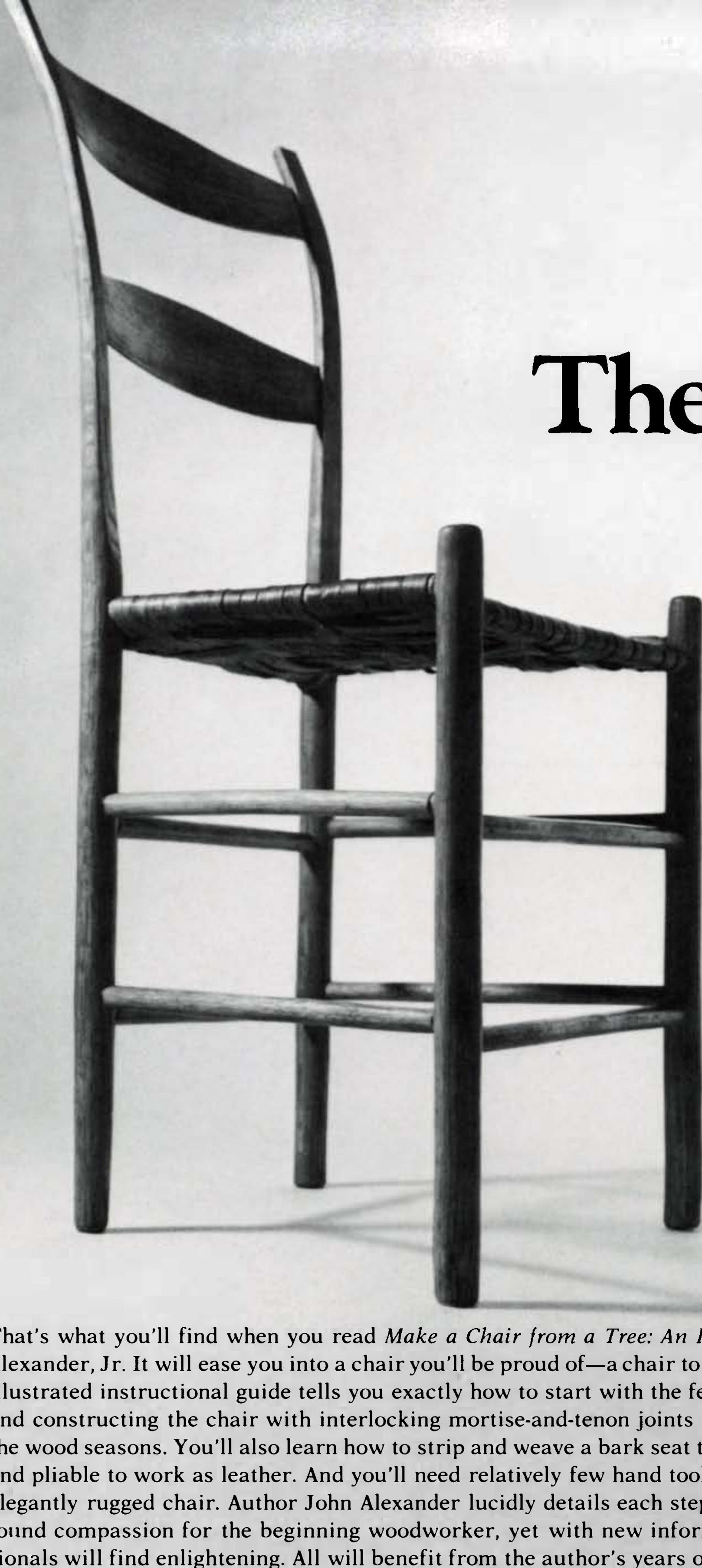
Fine WoodWorking

The Shape of a Violin

MARCH/APRIL 1979, NO. 15 $2.50



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Cover: "Strad" model violin, No. 62, made by Harry Sebastian Wake of San Diego, Calif., who explains the techniques by which the violin body is made on page 40. Cover photos: Gene Truax.

Fine WoodWorking®

MARCH/APRIL 1979, NUMBER 15

DEPARTMENTS

ARTICLES

Fine Woodworking (ISSN0361-3453) is published bimonthly, January, March, May, July, September and November, by The Taunton Press, Inc., Newtown, CT 06470, Telephone (203) 426-8171. Second-class postage paid at Newtown, CT 06470 and additional mailing offices. **Subscription rates:** United States and possessions, $12 for one year, $22 for two years; Canada, $14 for one year, $26 for two years (in U.S. dollars, please); other countries, $15 for one year, $28 for two years (in U.S. dollars, please). Single copy, $2.50. For single copies outside U.S. and possessions, add 25¢ postage per issue. Send to Subscription Dept., The Taunton Press, PO Box 355, Newtown, CT 06470. United Kingdom, £7.50 for one year, payable to The Taunton Press; mail to National Westminster Bank, PO Box 34, 15 Bishopsgate, London, EC2P 2AP. Address all correspondence to the appropriate department (Subscription, Editorial or Advertising), The Taunton Press, 52 Church Hill Road, PO Box 355, Newtown, CT 06470. POSTMASTER: Send notice of undelivered copies on Form 3579 to The Taunton Press, PO Box 355, Newtown, CT 06470.

I read with interest the critique "Five Chairs" in your Jan. '79 issue. I realize that commercial designers such as Robert DeFuccio have to appeal to the lowest common denominator and that their attitude is heavily influenced by this requirement as well as by the limitations of commercial manufacture. I am surprised, however, that you chose to publish this review without comments since it would tend to discourage the commission of custom-designed furniture.

Both chairs illustrated on p. 60 were made for me. Contrary to comments by DeFuccio, they admirably fill the purpose for which they were designed. Richard Kagan's chair was developed to be used in conjunction with a backgammon table and is extremely comfortable even when games go on for many hours. Alphonse Mattia's chair is a companion piece to a sofa previously made by him and a Victorian period piece. It is made to my personal measurements, and the upholstery is firm at my specific request. I can sit in this chair and read and be more comfortable than I have ever been. . . .

—Walter Rich, Philadelphia, Pa.

As Sam Bush points out ("Incised Lettering," Jan. '79), lettering is a form of chip carving. . . . The breakout problems he mentions can be avoided by the proper stop cuts. Before carving begins, a center stop cut must be made. This is accomplished by tapping a vertically held firmer chisel so as to score a straight line down the center of the particular letter bar. This cut, though it need not be deep, will invariably prevent breakout on the side opposite to that which is first carved, as the chips will break away along the line and will not extend to the other side causing damage and necessitating glue. The same end can be achieved when carving curved letters by making the center stop cut using gouges with a sweep appropriate for the curve of the letters.

Carving parallel to the grain is not more difficult than carving across if a center stop cut is made and the chisel is employed with a slicing action, rocking side to side. Also, I find that when carving curved letters, the inside face is much better performed using a small firmer or skew chisel. Unless one has gouges that correspond exactly to the curves of a letter, the edges of the gouge will score unwanted lines into the side of the letter. Furthermore, using gouges, the inside face of a curved letter will be convex, which is undesirable. . . .

—Christian W. Albrecht, Allentown, Pa.

Lest any readers of *Fine Woodworking* should panic at the benzene hazard as described by J. Kelsey in quotes from the U.S. Department of Labor, they should also know that the emergency regulation proposed by OSHA of the Department of Labor was turned down by the courts, which qualified its supporting data as unscientific and inadequate. Specifically, OSHA presented a bulging collection of cases, most of which were irrelevant to the focal point: cancer. Benzene, as any other hydrocarbons for that matter, can be harmful. But, if the OSHA "national emergency" arguments which the courts rejected had been true, people should have been dying like flies, and yet only six documented cancer cases were uncovered in the U.S., and these involved exposures 20 to 40 times as great as OSHA had declared, and for periods of 12 to 17 years, every working day. . . .

The woodworking amateur can be exposed to benzene by two sources: paint and varnish remover, and less likely, lacquers. Most flammable paint and varnish removers contain benzene as a main ingredient. These removers have no excuse for their existence, since nonflammable removers, based on

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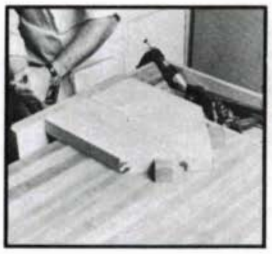

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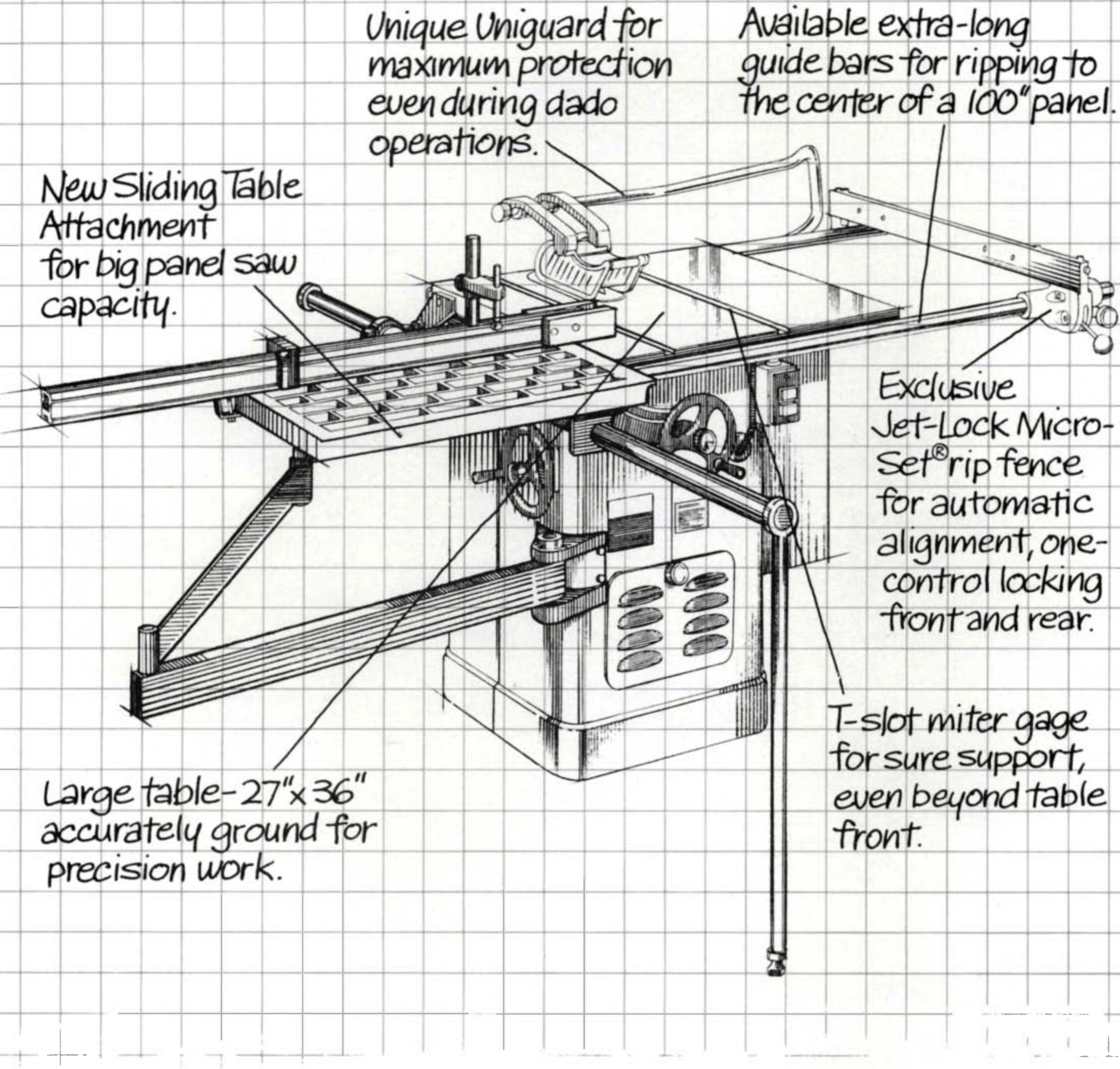

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methylene chloride, although more expensive, are safer and more effective. Lacquers, on the other hand, may contain hydrocarbon solvents that contain benzene as an impurity. Woodfinishing materials such as varnishes, Danish oils and mineral spirits are most unlikely to contain benzene because their solvents have boiling points that are too high. . . .

As a contaminant, benzene poses little danger to amateurs who use finishes with appropriate ventilation. . . .

—*J. A. Fernandez, Caledon, Ont.*

My husband and I read Mark Lindquist's first article on spalted wood in the Summer '77 issue, and I have since never walked into a woods or along a fence row without watching for all possible pieces of it. My first lathe project ever was a spalted beech lamp. My husband rough-turned it, and I fought my own battles with the subsequent chipping as the lamp took shape. He helped with the smoothing cuts and drilled the base after I sanded it. We sat on the basement steps and marvelled together over the rich coloring of this otherwise "trash" wood when we had applied the first coat of plastic finishing.

Lindquist's "Turning Spalted Wood," (Summer '78) was all it took to contribute to a total dedication to working spalted wood. A nearby beech woods is keeping me well supplied with material. My Christmas gifts to relatives and friends included spalted beech candleholders, vases and bowls, as well as a second lamp. Our six and seven-year-old grandchildren joined me in the shop to do all the sanding and finishing on a candleholder each for their teachers' gifts. They were both eager workers and turned out really nice original gifts with their own efforts.

No, I do not want a "women's section" in your magazine. Just keep inspiring all the novice woodworkers like me to go on to new and more exciting projects.

—*Marilyn Warrington, Tiro, Ohio*

. . . In Robert Foncannon's bit on planes (Jan. '79) he tells one to be very careful not to burn the blade while grinding and then he goes right ahead and gives an excellent recipe for blade-burning—a fine-grit wheel dressed with a silicon-carbide stick. That method of dressing will cause a glaze on the wheel, which will be magnified by the fact that the wheel is of fine grit. A much better method is to use a wheel of coarse grit (36) and a diamond dresser. If the dresser is passed slowly across the face of the wheel, it will produce a smooth wheel that will impart a fine finish to the tool with the incidence of burning greatly reduced. It will also result in a round, better balanced wheel, thus reducing vibration. If one wishes to reduce burning to zilch and owns an air compressor, use a misting device and direct a fine water-mist on the tool while grinding. The results will be truly amazing. Also, while the cloth buffing wheel will do a good job putting on an edge, it causes rounding of the blade side-edges. 'Tis better to use a felt wheel. They are expensive but last a long time.

—*Charles F. Riordan, Dansville, N.Y.*

I too have noticed the one-upmanship in the Letters section. What this really connotes, however, is not so much the fact that woodworkers are obstinate, self-centered, and opinionated (we are); but more importantly, that *Fine Woodworking* has finally made public property what individual woodworkers have come to regard as their special, personal, and "true" knowledge of the trade, garnered over years of experience and as a result of their own unequalled cleverness. This professional jealousy is a natural, universal feeling. The proper reaction to it, however, is not to cancel one's subscription to a publication that is helping to relieve it (in the

It was only a stool for my daughter. . . but you can't imagine how proud I felt when I gave it to her!

By Jim Howell

It was my first real woodworking project. My 3-year-old daughter, Becky, had outgrown her high chair. My wife and I shopped around for a stool so Becky could sit at the dinner table. But the prices shocked us. $40 to buy a rather skimpy-looking stool...that wasn't even finished!

So I decided to try to build the stool myself. I had just purchased a Shopsmith Mark V -- a unique 5-in-1 woodworking tool and I was, quite frankly, anxious to give it a try.

Now, making a stool "from scratch" may *sound* like a simple project -- but actually, it's rather complicated. You have to drill the holes for all the legs at *exactly* the same slight angle, so that the legs taper out perfectly. The seat has to be beveled and sanded just right for that professional look. And you sure couldn't make nice-looking legs without having a really fine power lathe!

In short, it's a project I *never* would have dared tackle with my old-fashioned saw and a few hand tools.

Well, I finished the stool and it was absolutely perfect! It actually looked a lot more professional than the unfinished one we saw for $40. Yet, it cost me only $11.00 for everything -- the wood, the glue, and the finish!

My Mark V made it easy. All I did was set-up for each operation and flip the switch.

But the *real* pay-off came when I proudly presented the finished stool to little Becky, and told her I'd made it just for her. I wouldn't trade the smile she gave me for a million dollars!

My wife is so impressed with the stool, she always brags to guests who stop by. Doing the project from start to finish gave me a real sense of accomplishment. That's the best thing about woodworking as a hobby -- you get back *something valuable* for your time!

Long before I ever heard about the Shopsmith Mark V, I had always enjoyed the relaxation of working with my hands after a day on my regular job.

But there were an awful lot of "do-it-yourself" projects that I simply couldn't handle with the small, hand-held power tools I owned. Whenever I tried a project with any complexity to it, I'd really botch it up!

When I read about the world's *only* multi-purpose power tool, the Shopsmith Mark V, I learned that it contains the five most needed woodworking power tools in one single, precision unit.

Getting a table saw, a lathe, a horizontal boring machine, a vertical drill press, and a disc sander all combined into a *single* tool made sense -- both because of the big savings in cost compared to buying five separate tools, and because of all the space it saved me!

I could see how it would save me a *lot* of money, and let me tackle those really professional-looking projects and home repairs I'd always wanted to do! So I decided to take advantage of Shopsmith's 30-day no-risk home trial. . .and I'm sure glad I did!

I recommend that anyone interested in a relaxing hobby -- that saves you money, and pays off in so many ways, consider setting up a *first class* woodworking shop with the Shopsmith Mark V.

Note: The above is a true story. However, the names have been changed on request.

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long term), but rather to regard such one-upmanship with the humor and tolerance it lacks. I would rather read some high-level bickering than good-natured articles on turning pool cues and building marquetry toothpick holders. . . .

—*Ted Stahly, Bloomington, Ind.*

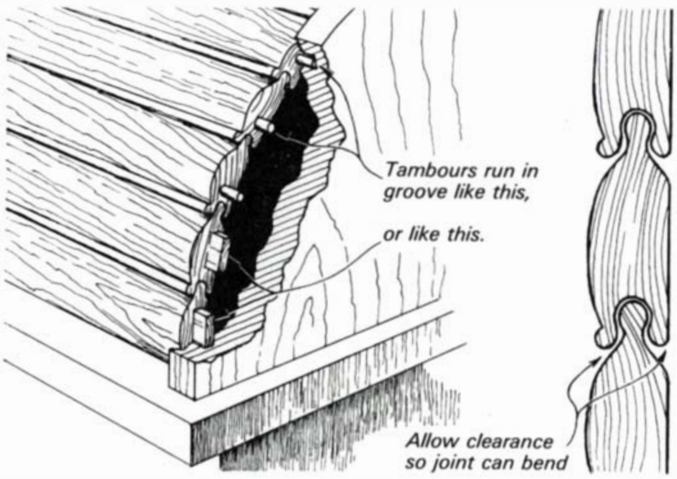

Illustration: Christopher Clapp

In his discourse on tambours (Sept. '78), Alphonse Mattia comments that the thin wooden slats "are either glued to a fabric backing or threaded together with wires." However, I can remember a huge oak roll-top desk in my grandparents' attic that had jointed tambours that were a variation of a hinged joint. To the best of my recollection, the tambours were jointed as illustrated in the accompanying sketch. I don't recall how the tambours tracked in the groove, but tongues or dowels are both possibilities, using the dimensions and clearances recommended by Mattia.

The female part of a joint such as this is cut in two operations. First, a groove is cut either on a table saw or with a straight router bit. Next, a ballnose router bit is run through the groove. The groove must be wide enough to allow the shank to pass through without binding. The ballnose cannot be withdrawn vertically once the cut is started—it must be run through from one end of the groove to the other. The bit can be backed out of the groove in order to clean out chips if they accumulate.

—*John R. Beck, De Kalb, Ill.*

I have a suggestion for Theodore Romaine of Tacoma, Wash., who asked about making a gunstock from a piece of burl walnut (Q&A, Nov. '78, p. 30). While I doubt the choice of wood he mentions, since burl would be very difficult to stabilize, there is a way to carve the barrel channel from the burl that has never been mentioned in any literature I have seen since the master stockmaker Alvin Linden passed the idea on to me years ago. It is very simple, just use a piece of ordinary cold rolled steel turned in a lathe or filed square across to cut out the wood for the channel. When he told me this I thought it ludicrous, but gave him the benefit of the doubt and tried it. I found it works beautifully, and cross-grained wood is just as easy to work as straight-grained, with tiny thin shavings rolling out from the cutting edge with ease. Also, since barrels are usually tapered, one can have several "chisels" of different sizes for just pennies, and it is almost unbelievable how long the cold rolled steel without any treatment holds its edge.

—*W. A. Haughey, Burlington, Colo.*

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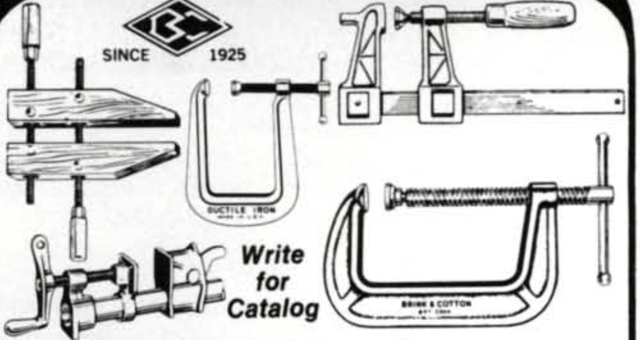

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—Ron Ginger, Framingham, Mass.

Thanks very much for publishing the last two of Lester Margon's measured drawings in the Jan. '79 issue. You mentioned his five fine books in which many other of his measured drawings have been published, but you didn't mention that well over a hundred were also published in the magazine *Home Craftsman* between 1937 and 1959. Most of the measured drawings that appeared in that magazine have not been reprinted in Margon's books—a fact that makes early issues of that magazine very valuable to those of us who wish to make accurate reproductions of antique furniture.

I have all but 22 of the 135 issues of *Home Craftsman* published between 1937 and 1959 and would be willing to swap duplicate copies I have or photocopies of the Margon articles I have for issues that I lack. Any readers of *Fine Woodworking* interested in making such a swap may contact me at 17 Fresh Meadow Drive, Lancaster, Pa. 17603. . . .

—William Pease, Lancaster, Pa.

Rarely have I been inspired to write to a magazine concerning an article, but I say "right on" to Stephen Hogbin and "The Purpose of Making" (Nov. '78), a bright star shining through the gloom of those who make a fetish of technique and remain artistically sterile. Esthetically, I can understand the study and perhaps even the reproduction of past styles as an educational base, from which one may project and reflect personal and social values of the present. Many may not agree with the overall permissive tone of today's society, but to retreat into the security of the past is to shirk reality. The fact is, we live in the present, and I give full support and encouragement to those who find the courage to deal with it, find meaning in it, and somehow through the medium of wood give positive expression to it. Hooray to Hogbin for being in the here and the now.

—John M. Pierson, Corpus Christi, Tex.

. . . a comment about the article "The Purpose of Making" by Stephen Hogbin. I refer specifically to three sentences: "To try and copy forms of another period is to take them out of context, thereby reducing their meaning. Nostalgia is a sentimental yearning and an evasion of the reality in which we live. It does little for the development of the human spirit."

Having chewed on that sophistry for a moment, I then turned to Andy Marlow's portfolio on page 70. Marlow "designs and builds period furniture in the classical style." I'll say he does! He's an artist with few peers these days, I would suspect. And if he is "reducing their meaning" or "evading reality" then I'm all for both sins.

—Fred H. Sides, Mt. Kisco, N.Y.

Errata: In "Air-Powered Tools" (Jan. '79) we omitted the address of Indiana Manufacturer's Supply, which sells flat-bladed rotary planer heads. It is Box 1385, 2260 Profit Dr., Indianapolis, Ind. 46206. The convex-blade rotary planer made by SME Corp. is sold through Sculpture Associates, 114 E. 25th St., New York, N.Y. 10010. The Compressed Air and Gas Handbook is available for $15 from 2130 Keith Building, Cleveland, Ohio 44115.

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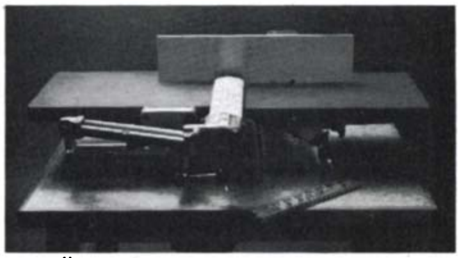

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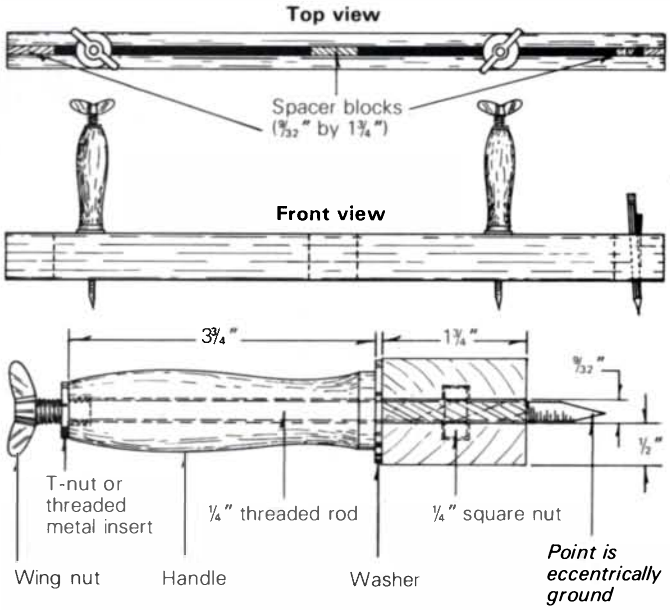
Beam compass

A beam compass is a handy tool, but trammel points are expensive to buy. My own version costs less than $2 and takes about two hours to make. The beam is milled from two pieces of ½-in. Baltic birch plywood, 1¾ in. by whatever length you want. The dado for the nut to slide in is cut to the inside of



Methods illustrations: Joe Esposito

both pieces. The sides of the beam are joined at the ends and on center with three spacer blocks 1¾ in. square. In one of the end blocks drill a 5/16-in. opening, in which a pencil will be wedged.

The handles can be turned from maple, birch, beech or similar hardwood. Drill a 9/32-in. hole for the rod, and insert a ¼-in. *T*-nut in the top. The rods are ¼-in. dia. by at least 8 in. Allow extra threading for resharpening the point, because this is not tempered steel. Grind the point eccentrically (off center) for fine adjustments. Then solder a wing nut on top of the rod.

Now thread the rod through the *T*-nut in the handle and the square nut that rides in the dado cut into the beam until the point is exposed about an inch on the underside of the beam. Slide both points to the desired arc (⅛-in. tolerance), then tighten the handles. With the wing nuts, you can fine-adjust the radius to the exact dimension. To mark with the pencil, raise one of the points above the pencil point. The only radius you can't get is from the pencil to the center block. In this case I remove one of the points and thread the pencil through the square nut by pushing down and twisting at the same time. The beam compass can also be used as a panel gauge if you attach a fence to the end.

—*Michael Lynch, San Francisco, Calif.*

Invisible edge joint

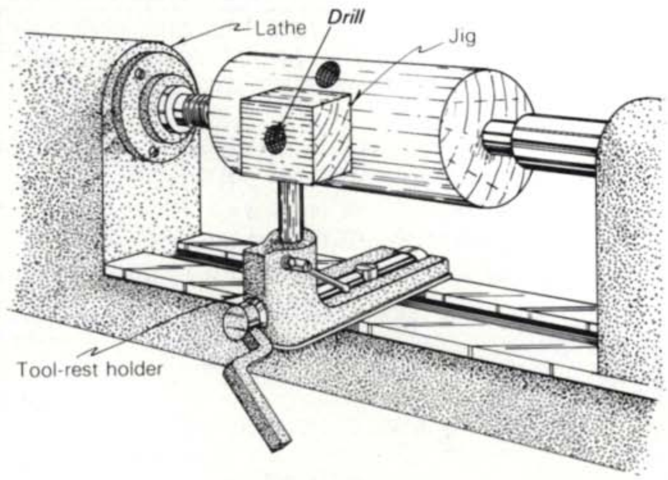
When I edge-join hardwood boards, I plane the edges by eye, then do one additional step—a technique I borrowed from the dental practice used to fit teeth and plates together. With the boards flat on a workbench, I fold ordinary typewriter carbon paper, place it between the edge surfaces and rub the

boards back and forth against each other. Any high spots or edge misalignments show up as black smudges. I snick them off with a plane set to cut a very fine shaving. Then I repeat the procedure until I have an even smudge all along the edge. The result after gluing is a joint that is almost invisible, except for differences in grain pattern.

—James V. Ralston, Murray Hill, N.J.

Spoke-hole jig

Here is a simple jig for drilling evenly spaced holes in turned goods. To make the jig, turn a dowel on one end of a scrap block to fit the hole in the tool-rest holder. Drill a guidehole through the block. To use the jig, mount the block in the tool-rest holder and lock in place at the right position. Drill into the work through the guide hole. Use the lathe indexing



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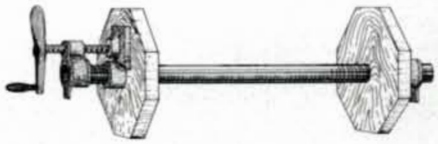
to hold the work and space the holes correctly.

—Jim Richey, Houston, Tex.

Clamp cushions

Octagonal pipe-clamp cushions of ¾-in. plywood with a hole in the middle eliminate the need for awkward

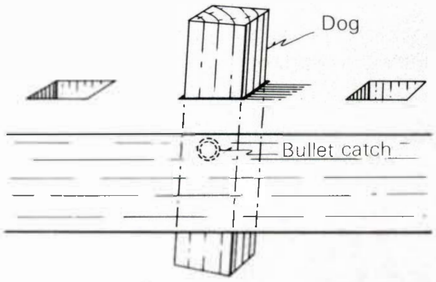


gluing blocks. The octagonal shape keeps the cushions from rolling.

—Thomas R. Wood, St. Paul, Minn.

Holding dogs

For those woodworkers who want to use a piece of hardwood in place of ready-made bench dogs made of metal, there is a problem of holding them in the rectangular hole in the workbench. A

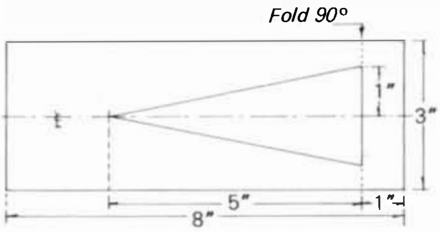


perfect solution is the bullet half of a bullet catch. The spring inside the bullet exerts enough force to hold the dog in place.

—Edmund H. Anthon, Akron, Ohio

Dovetail template

This homemade dovetail template was found among my deceased grandfather's effects. Its origin is uncertain,



but it's permanent and probably better than a bevel gauge. It can easily be duplicated with a 3-in. by 8-in. piece of thin aluminum (an offset printing plate is the right thickness), a steel rule and an X-acto knife. Draw a line 1 in. from and parallel to the bottom edge, then scribe a triangle with the desired tail and pin angles (I use a 1:5 slope). Cut out the triangle with the knife, using the rule as a guide, fold the aluminum at the base of the triangle, and there's your template. The triangle may be truncated at its top to leave a shorter piece to work with.

—Roger Schroeder, Amityville, N.Y.

Removing excess glue

Very often excess glue is not discovered until stain is applied to a project. Then it is not only difficult to remove, but the stain tends to appear darker in the spot where the glue was removed. This is especially true for polyvinyl resin (white) glue, which dries transparent and is difficult to see.

Many of us were taught years ago that excess glue around a joint or on the surface of stock should be wiped off with a wet rag. This is one of the worst things to do—it tends to dilute the glue and washes some of it into the pores where it cannot be sanded off. A better solution when gluing stock together is to allow the glue to gel for five or ten minutes, then scrape it off with a putty knife. Excess glue in difficult-to-clean areas, such as leg and rail joints where the rail or apron is set in from the edge of the leg, presents a challenge, especially for the beginner. A method I use is to dry-clamp first, apply a thin coating of paste wax around the outside of the joint, then remove the clamp, take the joint apart, apply the glue and reclamp. When the glue has dried the excess can easily be removed by lifting with a putty knife or chisel. The wax can be cleaned by washing the area with paint or lacquer thinner, or cleaning solvent. All will remove the wax without raising the grain or staining the wood.

Another good practice prior to staining that will make defects such as glue stains, dents or scratches stand out is to wipe the entire project with a rag that has been saturated in paint or lacquer thinner, or cleaning solvent. The defects should be noted by marking lightly with a pencil. When the surface is dry the areas can be scraped with a hand scraper and/or sanded.

—Eric Schramm, Los Gatos, Calif.

Fitting a froe handle

In splitting out billets, the froe is used for wedging, levering and sometimes even chopping. The handle must be fitted very securely to withstand the different strains caused by these varied functions. A traditional froe has a tapered eye, and the blade was slid over the handle like an adze or mattock. Froes sold by modern suppliers have cylindrical eyes, and the handle is usually held on by a wedge, as on a

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

Spring 1976, Number 2—Marquetry Today, Split Turnings, Eagle Carvings, Hand Dovetails, Mechanical Desks, Textbook Mistakes, Antique Tools, Spiral Steps, Gustav Stickley, Oil/Varnish Mix, Shaker Lap Desk, Chair Woods, Back to School.

Summer 1976, Number 3—Wood, Mortise and Tenon, The Christian Tradition, Hand Shaping, Yankee Diversity, Plane Speaking, Desert Cabinetry, Hidden Drawers, Green Bowls, Queen Anne, Gate-Leg Table, Turning Conference, Stroke Sander, Furniture Plans.

Fall 1976, Number 4—Cabinetmaker's Notebook, Water and Wood, Hidden Beds, Exotic Woods, Veneer, Tackling Carving, Market Talk, Abstract Sculptures from Found Wood, Workbench, Ornamental Turning, Heat Treating, Mosaic Rosettes, Shaped Tambours, Buckeye Carvings, Hardwood Sources.

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

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

Summer 1977, Number 7—Cooperative Shop, Glues and Gluing, Winter Market, Three-Legged Stool, Lute Roses, Bowl Turning, Wharton Esherick, Doweling, Spalted Wood, Antiqued Pine Furniture, Solar Kiln, Carving Fans, Bending a Tray, Two Meetings, Index to Volume One.

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

Winter 1977, Number 9—Repair and Restoration, Designing for Dining, Tall Chests, Entry Doors, The Right Way to Hang a Door, Drawer Bottoms, School Shop, Health Hazards in Woodworking, Basic Blacksmithing, Carving Cornucopia, Carving Lab, Routed Edge Joint, Shaker Round Stand, Cutting Corners, Small Turned Boxes, Unhinged.

Spring 1978, Number 10—Two New Schools, Wooden Clockworks, Hammer Veneering, Claw and Ball Feet, Block-Front Transformed, Hot-Pipe Bending, Furniture Galleries, A Two-Way Hinge, Laminated Turnings, Chain-Saw Carving, Circular Saws, Louvered Doors, Small Workbench.

Summer 1978, Number 11—Harpsichords, Spinning Wheels, American Woodcarvers, Drawers, Turning Spalted Wood, Scratch Beader, Leather on Wood, Notes on Finishing, Building Green, Parsons Tables, Hanging a Door, Pencil Gauges, Dulcimer Peg Box, Tiny Tools.

Septemb r 1978, Number 12—Community Workshop, Greene and Greene, Holding the Work, Scandinavian Styles, Tambours, Stains, Dyes and Pigments, Spindle Turning, Cleaving Wood, Whetstones, Sharpening, Cockleshell, Dust-Collection System, Sanding, Used Machinery, Wooden Wagon.

November 1978, Number 13—Making Ends Meet, Scientific Instruments of Wood, Making a Microscope, The Harmonious Craft, Laminated Bowls, Preparation of Stock, Tung Oil, Relief Carving, Roll-Top Desks, Shaped Tambours, Cylinder Desk and Book-Case, Basic Machine Maintenance, Portfolio: A.W. Marlow, End-Boring Jig, Scale Models, The Purpose of Making, Lumber Grading, On Workmanship.

January/February 1979, Number 14—Guitarmaking School, George Nakashima, Lester Margon's Measured Drawings, Tapered Lamination, Improving Planes, Restoring Bailey Planes, Box-Joint Jig, Five Chairs: One View, World Globe, Koa Table, Incised Lettering, Bolection Turning, Air-Powered Tools, Polyhedral Puzzles, Design Sources, Have a seat.

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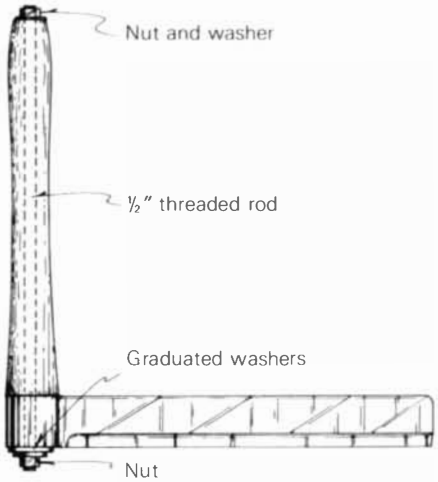


hammer. I've had trouble keeping the handle on using both these methods.

I solved this problem by passing a ½-in. threaded rod through a hole bored lengthwise through the handle. Nuts on both ends of the rod pull the eye of the froe firmly against the shoulder of the handle. I use hornbeam for my froe handles but oak, ash or hickory would do as well. Before turning a handle to shape, I bore it using a ½-in. shell auger on the lathe. Boring may also be done by hand using a long electrician's auger, which will chew right through end grain if the spurs are ground off. The handle is then chucked in the lathe centered on the bore, and turned to shape. The tenon is turned to a snug fit in the froe eye, and its length trimmed short of the bottom of the eye. The handle may be tapered back from the shoulder to make a comfortable grip, but avoid a sudden taper that would weaken the shoulder's ability to resist the tension of the threaded rod. A stack of graduated washers is needed to cover the end of the froe socket on the bottom end of the threaded rod.

—Richard Starr, Thetford Center, Vt.

Less is more

Old shoes nailed to the wall make great file holders.

—Christy Udell, Santa Rosa, Calif.

Books

Charles Rennie Mackintosh as a Designer of Chairs by Filippo Alison, *1977. $13.95, cloth; 106 pp.;* **Le Corbusier, Designer: Furniture, 1929** by Renato De Fusco, *1977. $11.95, cloth; 102 pp.;* **The Furniture of Gerrit Thomas Rietveld** by Daniele Baroni, *1978. $15.95, cloth; 178 pp.; Barron's Educational Series, Inc., 113 Crossways Park Dr., Woodbury, N.Y. 11797.*

Here I am in the Midwest. A few blocks away yet another Oldsmobile comes off the line, a group heads toward the market with the produce of another growing season, and state legislators meet again to consider the "crucial" issues. For one interested in high-quality wood craftsmanship and design, stimulation comes mainly from rare shows or issues of *Fine Woodworking*. Thus, when I heard of a series on famous furniture designers published by an art-book company, I was excited. The three volumes published so far seem a substantial resource to be shared with others who find themselves similarly isolated.

The intention of the Barron's series is to create an awareness of and appreciation for the works of the masters of modern furniture design. Each volume certainly meets this goal by presenting the designer and his work within the framework of artistic milieu and historical background. Although Mackintosh, Le Corbusier and Rietveld each have reputations in architecture as well, the titles reflect the books' focus on the furniture.

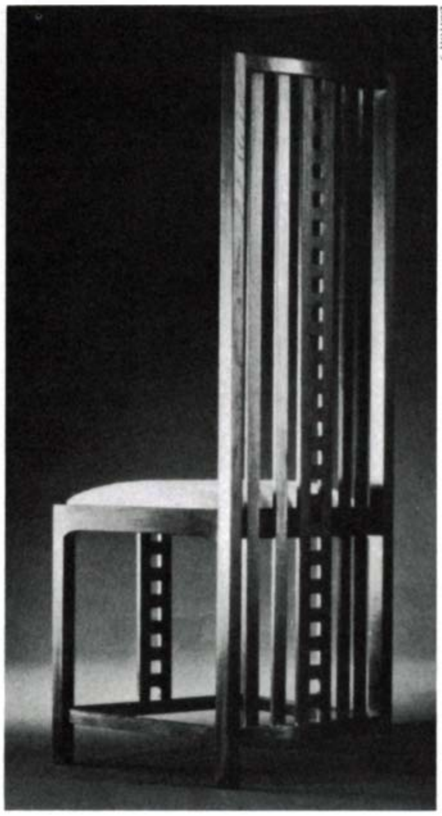
The authors are all Italian academicians with backgrounds in architecture, design and art history. This heritage is evident in the books—both in terms of a stylistic approach that is occasionally esoteric and in the awkwardness that can result from translation. However, their knowledge and expertise are obvious.

Each volume has a similar format: introductory overview, theoretical discussion, historical perspective, catalog of major furniture pieces, and evaluation. These are unmistakably "art-books," however, and the text is supplementary to the multitude of photographs, illustrations and scaled drawings. Printed on good-quality stock, the black and white and color plates vividly portray not only the furniture, but also the environments in which the works were displayed and many other features of the designer's world.

Mackintosh, credited with beginning the revolution in furniture design by integrating decorative arts with architecture, is portrayed within the 1890-1910 period in which he was most productive. Art Nouveau, characterized by flowing curves and organic forms, was the dominant artistic style of these years. Although certainly influenced by and linked with Art Nouveau, Mackintosh's work was distinct from it. As the leading proponent of what came to be known as the Glasgow style, Mackintosh's work combined rigorous linearity with flowing curves.

Both the illustrations of Mackintosh's work and Alison's analysis reflect the simple, massive and austere qualities of the furniture. The rectilinear functionalism and rigid geometric patterns are often balanced, however, by some sensual flowing curve or the touch of the craftsman. As the author notes: "There is always at least one decorative mark, or else a subtle characteristic in the constructive or structural nature of work. . .(that) demands the presence of the artisan." As will be evident below, this feature is in marked contrast to Le Corbusier's and Rietveld's insistence on machine production.

Mackintosh believed that the chair was the best delineator of space and, as such, was the fulcrum for environmental relationships. These tenets are portrayed in designs for specific functions (public dining-room privacy, the "welcoming womb," or "embrace of



Barron's

Mackintosh's chair with checkered vertical strips (1904), ebonized oak, 43¾ in. by 16 in. by 16½ in.

the arms") and in different solutions based on the same plan (experiments with variations in height or alteration of color). The critical relationship to the intended environment is also revealed in numerous sketches, watercolors and photographs. Indeed, the fullness of the documentation draws one in to such a degree that there is a real sense of participation in the milieu of the artist.

The main deficiency of this volume (and of the others) is seeming inattention to layout and details. Many illustrations are not only not matched with the text but even appear to be strewn about randomly. "Notes on Original Drawings" are provided and numbered, but it's a mystery as to where or to which drawings they refer. Continually having to flip the pages to search for the illustrations mars an otherwise precise and enjoyable volume.

The book on Le Corbusier is not quite the calibre of the other two in the series. Although this evaluation may partially reflect my personal bias against metal furniture, it is also the result of a less exciting and often esoteric text. There are no color reproductions. In spite of these limitations, however, one does get a presentation of Le Corbusier's best-known furniture (exhibited in 1929) and further understanding of his role in the development of modern furniture design.

Le Corbusier was an advocate of the machine. Wanting to be free of traditional approaches, which relied on wood, he used materials made available by the then-new industrial technology. This approach also meshed well with his emphasis on function determining form and his desire to provide for the masses. Part of the rationalist movement, Le Corbusier emphasized pragmatism, efficiency and simplicity.

These theoretical tenets and preferences are evident in the furniture shown. Basically, Le Corbusier's designs for interiors fall into two broad categories: standard units and furniture. The standard units are primarily cupboard/storage areas that can function as furniture, as an architectural component or as both. His furniture, like some of the bentwood work of his predecessor Thonet, uses very few elements and often makes the component parts and construction explicit. More specifically, one sees the distinction between the part that supports and the part that is supported—as in the *fauteuil grand confort* or "cube" chair. Lest one miss this characteristic, De Fusco belabors it endlessly under the guise of a "theoretical digression" on semiotic analysis (i.e., the philosophical study of signs).

The volume on Rietveld, although it has some of the same flaws as the others, is clearly a thorough treatment. De Stijl (the style) is the name taken from a 1917 art publication to refer to a group of Dutch abstract painters. Although not initially a member, Rietveld's first chair, "Red and Blue," became the concrete manifestation of many of the hazily defined De Stijl's theories. As Baroni says: Rietveld "knew how to transmute materials and aims into works of art." Once a member of the group, Rietveld's work clarified further De Stijl's aversion to naturalism, advocacy of machine production and geometric designs. Labeled "neoplastic," De Stijl's tenets include countercomposition of vertical and horizontal lines, use of primary colors and volumetric restructuring. The rationalistic principles of order, analytic method, universality and equilibrium were also emphasized.

Rietveld's inventiveness and experimentation are vividly portrayed in the varied designs shown in the evolutionary sequence in this book. His initial success, based upon geometric structure, typifies the extension of lines in space and the use of planes and open volumes for which Rietveld is famous. Although he worked primarily in wood, Rietveld also experimented with tubular metal, sheet materials and crate wood. The use of color according to neoplastic theory is evident in most of the designer's work. Its later evolution to more asymmetrical and abstract designs, such as the Berlin stool and zigzag chair, is superbly documented.

Baroni's book provides a rather complete overview of Rietveld's development. Like the work on Le Corbusier, there is substantial theoretical discussion—but given the nature of De Stijl, it seems more justified here. Like the work on Mackintosh, the author clearly places the designer in the various artistic moods of the first half of the 20th century.

These art-history and design books on the masters of modern furniture provide a wealth of information on their works and times, and on the close link between architecture and furniture design. Although one wishes for better synchronization of text and illustration, the works are informative, stimulating and forceful. If you find them in-

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EDITOR'S NOTE: Drake Inc., publishers of a great many woodworking books, has been acquired by Sterling Publishers, 2 Park Ave., New York, N.Y. 10016.

Books *(continued)*

teresting, you may want to keep a lookout for future volumes on Gaudi and Frank Lloyd Wright.

—John Bellingham

Lapstrake Boatbuilding by Walter J. Simmons. *International Marine Publishing Co., 21 Elm St., Camden, Maine 04843, 1978. $10.95 cloth, 172 pp.*

This useful book offers practical advice about selected aspects of building small wooden boats. It is not a step-by-step manual written to take the beginner from the woodlot to the moment of launching. The emphasis, as the title suggests, is on the construction procedures for lapstrake, or clinker-built, hulls. This is the way ancient Norse longboats were built and results in a light, strong and flexible hull. In the United States lapstrake construction has been used primarily for dinghies, canoes and similar small craft, the exception being the Jersey Sea-Skiff type, which has run to 50 ft. in length.

The author, not one to accept every tenet of traditional wood boatbuilding practice, expresses his likes and dislikes about past and present technology and materials. His preference for Philippine mahogany to African or Honduras, his opting for local lumber sources and his up-to-date use of polysulphide for caulking are based on his own experience. The book discusses the use of a hutchet (an elongated clamp pad) for fastening the hood end of planking and the treatment of natural crooks. It makes recommendations about lumber selection, fastenings (don't use stainless steel), specific building tips (beware of frost in planks when the temperature drops below 32°) and products the author has used and found satisfactory. The chapter on finishing is very complete, as might be inferred from the fact that of the five weeks Simmons takes to build a 16-footer, two are devoted to surface preparation, painting and varnishing of the hull.

This book is directed to the experienced builder of small wooden boats who is thinking of setting up a traditional shop. It passes along the shopwise lore gleaned by doing and by word of mouth from the old-timers that Simmons has sought out over the years.

—Roger Barnes

John Bellingham, of Lansing, Mich., owns a custom furniture shop. He expects to write a doctoral thesis on the psychological aspects of craftsmanship. Roger Barnes, art director of Fine Woodworking *magazine, is an avid sailor and boat buff.*

We welcome readers' questions about cabinetmaking, finishing, wood technology and machinery, and readers' comment on the answers. This issue, the answer men are joined by Lelon Traylor, associate professor of tool and manufacturing technology at Southern Illinois University—his comparison of thickness planers appears below. Our other answer men are cabinetmaker and designer A.W. Marlow; George Frank, a retired woodfinisher; R. Bruce Hoadley, professor of wood science; and Tage Frid, professor of woodworking and furniture design. Write Q&A, Fine Woodworking, *Box 355, Newtown, Conn. 06470.*

As shop tools go, the purchase of a woodworking planer represents a major investment, and selecting one that best satisfies your needs can be compared to buying a car. The same questions arise: what make, model and price range? The 12-in. and 13-in. planers are usually selected by the hobbyist or small shop operator—12 in. is about as wide as most lumber today, and glued-up panels are usually 24 in. or wider. This seems to rule out the 16-in. and 18-in. planers, and even the 20-in. The price jumps as the width increases, so we return to the 12-in. and 13-in. sizes.

Because Rockwell doesn't build a 12-in. planer and Powermatic doesn't build a 13-in. one, making comparisons is even more difficult. The 12-in. Parks is least expensive and the lightest in weight. The 13-in. Parks is second in weight and the most expensive. The Parks has both a 16-ft. and 25-ft. rate of feed per minute, which is important. The cutterhead on the Parks is larger than on the Rockwell or the Powermatic, which is also important, but not as important as the table feed. The Rockwell has an infinitely variable table speed—17 to 33 feet per minute—and a removable cutterhead for quick changing or sharpening. The price is $338 less than the Parks, and the overall workmanship appears excellent. I would rule out the Powermatic because it has only one table speed. Specs for these planers are in the table.

Parks 12-in. planer	
Max. thickness	4 in.
Feed	2 speeds, 16 & 25 fpm
Cutter	3 in., 4 knife
Roll	1⅞ in. dia.
Weight	#95—265 lb. #97—380 to 420 lb.
Hp	1 to 3
Bed	22 in.
Price	#95 less motor & base, $778 #96 w/2 hp motor, $1014 #97 w/3 hp motor, $1183
(Parks Nos. 95, 96 & 97 are the same basic planer but No. 95 is less motor.)	
Parks 13-in. planer	
Max. thickness	5 in.
Weight	450 lb., less motor
Price	$1880
Powermatic 12-in. planer	
Max. thickness	5 in.
Feed	1 speed
Cutter	2⅞ in., staggered knives
Roll	2 in. dia.
Weight	378 lb., with stand
Hp	2 to 3
Bed	24 in.
Features	Knife grinder $384
Price	$1370, less motor
Rockwell 13-in. planer	
Max. thickness	6 in.
Feed	Variable
Cutter	$2\frac{23}{64}$ in.
Roll	1¾ in. dia.
Weight	480 lb., less motor
Hp	3 to 5
Bed	26 in.
Features	Removable cartridge type cutterhead, table roll adjustment.
Price	$1542, less motor

If a home craftsman could not afford the better and heavier 13-in. machines, then the lightest-weight Parks would probably be his best choice. At $778, less motor and stand, and 265 lb., he would not be paying as much. Neither would he be getting as much machine, but the choice has to be the buyer's.

Broken down at a per pound rate, the prices are: Rockwell: $3.21/lb.; Parks 12-in.: $2.90/lb.; Parks 13-in.: $4.17/lb. The Rockwell would be my first choice. Astro Wood Planer Co., Inc. also makes a small planer. Its maximum stock width is 10½ in., and maximum stock thickness is 2¾ in. Its specs are: feed—15 fpm; cutter—3⅞; hp—⅓ to ¾; bed dimension—14 in. long; and shipping weight—105 lb. Without the motor the planer is $499.95. Price per pound is about $4.76. —*Lelon Traylor*

I recently made a set of kitchen canisters for my wife. The materials are kiln-dried cherry wood, white glue and three coats of polyurethane inside and out. My wife is quite proud of them but she can't use them because of a strong odor inside the boxes. The odor is picked up by the flour and sugar and is detectable in items made with them even after cooking. I first suspected the finish so I removed it. That made no change so I tried covering it with two coats of lacquer. This made no difference, so now I suspect the odor is coming from the wood itself.
—R. W. Bretthauer, Silver Spring, Md.

Healthy cherry has no smell, nor has lacquer after it is dry. The smell in your canisters must have another source. For reasons unknown to me, animals, mainly dogs and cats, have a predilection to urinate on lumber. If cat's urine is the cause, you'll have a tough problem getting rid of the smell. Regardless, you must first completely dry the area where the odor comes from. Hang a low-watt incandescent bulb in each canister, and leave it on for a few days. Then wash the canisters out with a strong solution of ammonia water or Lysol. Dry them with the electric bulb again. If the smell persists, wait until a snow-clad winter evening. Light a fire in the fireplace. Ask your wife to sit on your lap, and burn your canisters. There will be no odor left.

Problems of smell occur frequently in vineyards, where empty barrels may have unpleasant odors. The accepted remedy is to light a stick of sulfur and let it burn out inside the barrel.

—George Frank

I recently acquired a used Crescent 20-in. band saw, serial #57120, manufactured by the Crescent Machine Co., of Leetonia, Ohio. There seem to be some parts missing that would allow the motor to be mounted on the saw frame. When I got the saw, the motor was not mounted. I would appreciate help in obtaining an owner's manual so I can reassemble it properly. Also, could you help me locate a source for tires for the wheels?

—Billy M. Davis, Albuquerque, N.M.

Parts for Crescent band saws, and the owner's manuals for some models, can be obtained from the William K. Stanets Co., 338 S. Main St., Columbiana, Ohio 44408. They don't carry tires, but Woodworkers Tool Works, 222 S. Jefferson St., Chicago, Ill. 60606 can usually supply them, and replacement guides too.

I refinish and repair furniture and recently built a new workshop. I strip or repair furniture in a room with kerosene heat, finish in a room with electric heat, and store the finished pieces in a room with a concrete floor, unheated but insulated. Could you tell me if I will run into any problems with this process? —Steve Cole, Laceyville, Pa.

I'll suggest a few things to watch for. Try to keep relative humidity in the 35% to 45% range, and beware of winter lows and summer highs. Avoid "hot spots," and put up barriers to protect pieces from strong, direct air currents. Stay within recommended levels of temperature for application of glues and finishes. Avoid moving a piece from a cool area to a warm area just before finishing, especially in humid weather, for surface condensation can be disastrous, and can take place without you noticing it. A bigger problem is with air expansion in the cell cavities as the piece warms up during finishing—each cell becomes a "bubble pipe," causing terrible bubbles in any lacquer or varnish-type finish, or pushing out droplets of penetrating finish. It is best to keep the temperature even, or move a piece from a slightly warmer to a room-temperature area to apply finish. In your storage area, beware of drastic fluctuations, especially when warm, humid weather moves in during spring. Condensation, especially on incompletely cured varnish, can ruin a finish. —*R. Bruce Hoadley*

Please tell me how craftsmen of fine antique furniture such as desks and tables produced thin-line inlays on flat surfaces and drawers. What tools did they use to cut the intricate indentations, and what material was used for inlay? From work I have examined, it appears that materials other than wood were used and I understand that in some cases a sulfur compound was troweled into the grooves.

—*C. H. Morian, Jr., Beaumont, Tex.*

I have tried to find in print for many years how the cabinetmakers of old cut their inlay and especially veneer materials to thickness, but without success. I do know they were surprisingly skillful with a two-man bowsaw. As for thin lines, probably a veneer knife and straightedge were used. For more intricate shapes they used appropriately numbered carving gouges to chop to outline. Other than woods, good inlay furniture may show ivory and/or brass. I doubt you would find any compound used to fill excavations. —*A. W. Marlow*

Oil distributors in my area do not stock or know of machine oil. An inquiry to Pennzoil Company suggests their hydraulic oil, but machinists say not to use hydraulic oil as it is too crude. How does non-detergent machine oil vary from non-detergent motor oil? Where can I buy machine oil in quarts?

—*Melvyn J. Howe, St. Paul, Mo.*

Lubricating oils, unlike automobile engine oils, cling to a surface without running off because they have a tackiness not found in engine oils. Some special oils used on die-stamping presses feel almost like thin molasses. Gun oil, available at sporting goods stores, and sewing-machine oil are good machine oils. South Bend Lathe, 400 W. Sample St., South Bend, Ind. 46623 sells machine oil in quarts, but a minimum order of $10 is required. McMaster Carr Supply Co., P.O. Box 4355, Chicago, Ill. 60680 supplies machine oil in gallons. —*Lelon Taylor*

Follow-up

In Nov. '78 you want to know about a source for rubber tires for tea carts. I had the same trouble for the tea cart that I built, and the wheel dealer said that what I wanted came in 50-ft. rolls and is used by hospitals for repairing wheelchairs. Naturally I was not going to buy that amount of tire for two wheels. I thought I could use rubber hose, such as is used by paint sprayers, and when I wrote to the Ace Lite-Step Co., 1516 S. Wabash Ave., Chicago, Ill. 60605 and asked if they could sell me 6 ft. of ⅜-in. hose, they answered yes. They sent me not the hose that I expected to receive, but solid neoprene cord. I thought that was better than my idea, so I attached the cord by using Scotch-Grip Industrial Adhesive 847, made by the 3M Company, and a piece of wire on the underside next to the wooden wheel rim.

—Wm. V. del Solar, Westmont, Ill.

EDITOR'S NOTE: Contact 3M Company headquarters at 3M Center, St. Paul, Minn. 55101 for distributors.

You can make your own custom pattern router bits from a piece of power hacksaw blade or other steel, and a piece of ¼-in. round steel with a slot cut into one end. Broken power hacksaws can probably be obtained from a local machine shop. Use two blades in your hacksaw frame to get a slot wide enough to fit the piece of broken blade. Braze or silver solder in place. Grind to any shape you wish. For most portable routers, about a 1-in. diameter is the largest size the motor will handle. Each side does not have to be identical. It is best to have the saw teeth away from the shank because some sawblades are soft-backed.

—R. J. Crizer, San Francisco, Calif.

In Sept. '78 you had a question on the thickness of lumber. I believe the answer given was incorrect. I am a lumber inspector, and the National Hardwood Lumber Association requires that 4/4, 5/4, 6/4, 8/4 etc., shall be sawn "⅛ over designated thickness." So 5/4 is actually 1⅜, 4/4 is 1⅛, etc. Rough-sawn and green lumber should dry no less than designated thickness.

—Tom Lathrop, Bristol, Vt.

The half-round brass wire inlay on Mr. French's clock (Nov. '78) was undoubtedly formed on a drawplate, which is a hardened steel plate having a graduated series of tapered holes accurately sized and shaped on the small end. The plate is clamped in a vise and the material to be drawn, having been first tapered on the end to permit starting through the hole, is pulled through with pliers. Beeswax or grease may be

Q & A *(continued)*

used as a lubricant. The starting material may be a larger wire or rod, a strip or rolled piece of sheet or foil, or even a small billet. Most materials, including brass, will work-harden in drawing and will have to be annealed (which can be done by passing a torch over the material) between draws if more than one or two reductions are to be made. Copper can usually be drawn repeatedly without annealing.

Drawplates may be obtained from jewelers' supply houses. Shapes include round, half-round, oval, square, rectangular, triangular and diamond. Sizes run from rather stout rod down to filigree wire, and one plate may have from ten to forty holes, either all of one shape or assorted. Round and square brass wire is usually available from a well-stocked hardware store that caters to the industrial trade, and from model shops selling supplies for scale-model train builders.

I suspect that the reason for using half-round instead of rectangular wire is that if the inlay groove were not absolutely flat-bottomed the inlay surface would not be true if flat wire were used, whereas half-round wire could be pressed into trueness as it was laid. It does seem that half-round wire would be more difficult to retain in the groove. *-Lewis Garber, Pasadena, Calif.*

The table described by Raymond Gayle (Nov. '78) sounds similar to one that has been in my mother's family for several generations. We have always known this table as "the library table." When my mother came into possession of it, it was so black with age no one could tell what kind of wood it was (though we had been told it was walnut), nor could we tell what color the original leather inlay was. (The inlay was bordered by a narrow flat braid.) When the table was restored, it was found to be black walnut. The leather inset was removed, and my mother chose a leatherette of soft forest green to be laid in, with a narrow flat metallic gold braid bordering it. An elderly cousin viewed the restored table, and was astonished at my mother's choice of green leatherette and gold braid. The table had belonged, I think, to her grandmother. It turned out that the original leather inset was a soft forest green color, and the original braid trim metallic gold. Years later, I came across a similar table in an antique shop in Oregon. It, too, was of black walnut, with a green leather inset bordered by a narrow flat metallic gold braid. I am not sure whether the green leather/gold braid combination was the only one used for these tables, but the combination is certainly attractive with the black walnut.

—Marika Urso, Danville, Calif.

Supplies

Readers' inquiries about hard-to-find materials and supplies published in the Nov. '78 issue have unearthed the leads listed below. We'll be happy to publish a notice of what you can't find, and will verify any information before passing it along:

—Custom-made router bits in small quantities: Ekstrom, Carlson & Co., 1400 Railroad Ave., Rockford, Ill. 61110 (minimum order $20); Oakland Carbide Engineering Co., 1232 51st Ave., Oakland, Calif. 94601 (minimum order $5); and Wilson Davis, M & W Enterprises, 610 S. Maple St., Orleans, Ind. 47452.

—Oak dowels in various sizes, up to 6 ft. long: Woodworks, P.O. Box 79238, Saginaw, Tex. 76179.

—Leather seats for antique chairs: The Finishing Touch, 5408 College Ave., Oakland, Calif. 94618, sells pressed leather seats in three shapes, four patterns and four colors, in sizes from 12 in. to 16 in.; Richard P. Badke, 6664 N. 52 St., Milwaukee, Wis. 53223, custom-makes seats and desk-top inlays; Ritter and Son Hardware, 46901 Fish Rock Rd., Anchor Bay (Gualala) Calif. 95445, makes leather seats (brochure 50¢) in four designs and three shapes, in sizes from 12 in. to 16 in.

—Amboyna (also called narra): John Harra Wood & Supply Co., 39 W. 19 St., New York, N.Y. 10011. The Woodshed, 1807 Elmwood Ave., Buffalo, N.Y. 14207, sells amboyna burl.

—Potassium dichromate in small quantities: Earth Guild Inc., Hot Springs, N.C. 28743. Reader Charles F. Riordan writes: "Everyone has overlooked the most available source, namely Eastman Kodak Co. Any Kodak dealer can get it for you."

Readers can't find:

—A source for pure oil of lavender.

—A huge center slice of tree trunk, to be used for display and education.

—A source for traditional inlay (possibly English), such as eagle and serpent motifs for Hepplewhite furniture.

—Blades for scrapers made by Hook Scraper Co., since the Allway Tool Co. no longer makes them.

—A measured drawing of a four-legged saddler's stitching horse used for hand-sewing leather.

—Slide bars and slider locks for drop-side cribs. □

MAKING THE BIG TIME

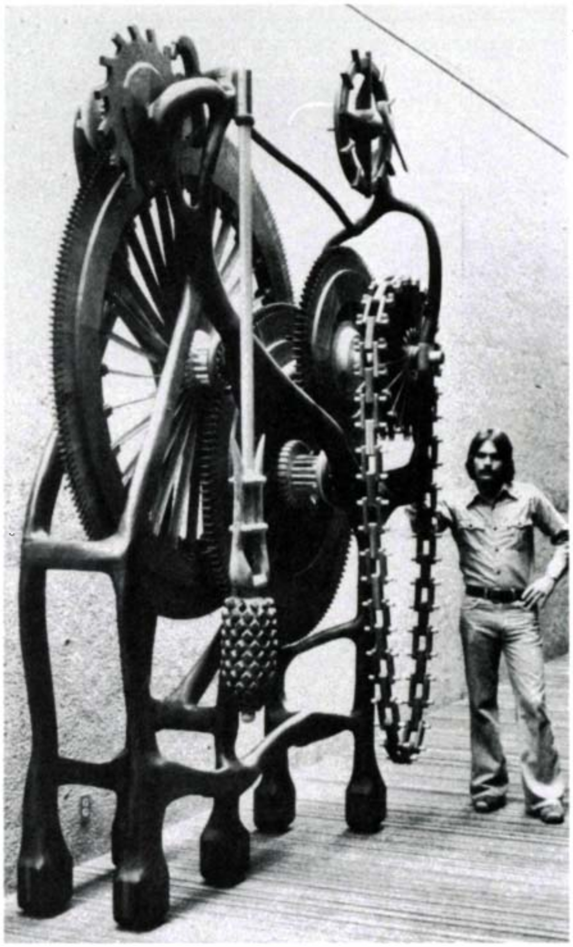
BY KENNY FISHER

I stumbled into clockmaking very much by accident. After enlisting in the Marine Corps for four years (where I got quite an education), I spent the next five as a professional student on the G.I. Bill. I studied biology, chemistry, math, physics, philosophy, sociology, sculpture and business, and finally received a B.S. degree from Indiana State University of Evansville in 1977. I took up sculpture after two and a half years of school. My first class was in clay, which I enjoyed, so I signed up for another semester. When I returned to school in August 1975, I found that a new wood/metal shop would not be needed for several years by the technology department, so the art department was allowed to use it. The shop was 100 ft. long and 50 ft. wide, and the ceiling was 18 ft. high, and full of equipment I had no idea how to operate. I did not know at the time that I would need a shop that size to make my project.

I spent the first week of class trying to decide what to make. I wanted to do something in free form, and my instructor, John McNaughton, wanted me to make a piece that would function using mechanical principles. We compromised—I decided to build a clock.

I had no plans on paper, not even a picture or a model to go by, but I did set some goals. I wanted a large clock, perhaps 8 ft. to 10 ft. tall, of my own design and construction, with all the mechanism exposed and a minimal frame, made only of wood and glue. Though it would run by a weight and keep close time, my main concern was its esthetic value. I did not consider how long it would take to complete. Many people would consider this a lack of planning, which it may have been. I figure that I spent 3,000 hours over a two-year period to finish my project.

The first semester was slow because I wasn't sure of what I was doing, but I also had to learn how to use the equipment and work with wood. Fortunately I have a fair mechanical aptitude, and it didn't take long to figure things out. I began with an old book on horology to understand the physics of the escapement mechanism. I knew I would have



Tony Velotta

Fisher, undaunted, and his magnum opus, 'Time Stops for the Artist,' of black cherry (gears and some hubs), hard maple and birch (most hubs, axles, bearings, lantern pinion, dowel rods and sprocket teeth), black walnut (spokes, trim, gear teeth, hexagonal pieces on pendulum weight, frame), red and white oak (pendulum wing-like structures) and sugar pine (pendulum arm). The gears are 6 ft., 4 ft. and 3 ft. in diameter; the largest has 252 teeth. The frame, of ⅞-in. thick laminated black walnut boards, was shaped with a body grinder. Fisher joined the 2,185 pieces of wood with Titebond glue, and in some places, epoxy. He finished the clock with several coats of Watco Danish natural oil.

to use a stable wood, so I picked the most accessible—black cherry. I arbitrarily chose a 2-ft diameter for the escapement gear. Little did I know that this would determine the size of the clock. During the first semester I was able to finish only the escapement mechanism and part of the pendulum.

I wanted only three major gears, so I decided to make one as large as I thought I could (6 ft. in diameter) and the other two smaller. By the third semester I had 90% of the working mechanism complete, and several ideas about a frame to hold the mechanism.

The fourth semester was to be my last because I was graduating, and the G.I. benefits were running out. I had no other shop to use, so I worked like a demon to finish the clock at school. Besides my regular classes, I sometimes spent up to 50 hours a week on the project. At the end of the semester it was almost done, and McNaughton arranged for me to work a month into the summer to complete it.

The finished clock is 12 ft. high, 8 ft. wide and 4 ft. deep. It weighs about 350 lb. Unfortunately, it won't run by weight as designed—that would take 900 lb. on the chain. When I discovered this I didn't complete the last drive chain to the hand. I had guessed at it, and my guess was about 200 lb. The pendulum swings accurately and smoothly, however, if weight is applied to the 6-ft. gear or escapement gear.

The clock is still on display at the university. I have no plans for it, but I hope that it gets enough exposure to create interest in monumental wood sculpture—a field I would like to enter. Moving the clock requires four people and three pickup trucks, and I can't afford to give it much exposure in this manner. I may be crazy for wanting to get into a market that barely exists, but people also told me I was crazy for making that clock. □

EDITOR'S NOTE: Adventures in Woodworking offers readers an opportunity to recount high points in their woodworking lives. This fling with clockmaking is excerpted from a letter by Kenny Fisher, 27, of Poseyville, Ind., who now works in a General Electric laboratory. For a more rational approach to designing and building a clock, see "Wooden Clockworks," Spring '78.

If you've had a woodworking adventure you'd like to share, write it down and send it in. A suitable length is between 500 and 1,500 words—between two and six typewritten pages, double spaced. If you have photographs or drawings, please include them. We'll pay $100 for each adventure that is accepted for publication.

College Dropouts

Wood lures professors to new careers

BY DAVID HABERCOM

David Habercom

Milton *Fischman* *Moser*

After twelve years, Thomas Moser gave up his career as a professor of English and linguistics to make furniture. After eight years as a professor of philosophy, Donald Milton did the same. And a young physicist at the Massachusetts Institute of Technology, Irving Fischman, is on the verge of a similar leap. What possesses three men to give up prestigious careers for the uncertainties of selling fine woodwork? Their answers say some things about craftsmanship and also about survival.

Thomas Moser, 43, had a difficult time surviving. When he opened his shop in 1973 in New Gloucester, Maine, he knew almost nothing about business. With some savings, four children and a supportive wife, he set out to make a living with his hands.

When Moser tells why he left teaching, he voices a frequent complaint of college teachers, that they are pressured to teach not what they know, but what someone else judges important. "I felt a constant need to apologize for teaching what I considered significant. Plato and Aristotle weren't 'relevant.' A lot of what I was interested in, others thought wasn't 'relevant.'"

Moser knew he would take a beating at first, and he was prepared for it, though he misjudged how much he would eventually have to invest—an amount he now calls "staggering." And he had to give up the pleasures of teaching, as well. "I liked to teach, liked to talk and debate. I have an ego, the way a lot of teachers do. I used to love a captive audience of 160! Now here I am breathing sawdust and banging on boards. You get very little interaction out of wood."

If scholarly debate has disappeared, intellectual challenges have remained. They focus now on technicalities of design and construction, but Moser finds them as demanding as ever. He is careful to hire thoughtful craftsmen who work with their heads. "There is a lot of intellectual activity in this place," he says. "Each person contributes. We argue, get involved in the whole process. And we're not at all competitive. There is a tremendous cooperative feeling. We all teach each other."

Mary, his wife of 21 years, manages the business, freeing him to concentrate on work at his bench. Without her, he says, none of it would exist. "If I had thought that I would have to sit at a desk keeping books, I would never have left teaching."

Moser's current catalog lists over 30 basic pieces, and his showroom is filled with one-of-a-kind designs. His book, *How to Build Shaker Furniture* (Drake Publishers, Inc., 2 Park Ave., New York, N.Y. 10016), has drawn the attention of artisans all over the country. In addition to skill, Moser has learned efficiency. "Half the craft of cabinetmaking is making a nice piece of work. The other half is making it efficiently. The 18th and 19th-century cabinetmakers we admire today, among other things, were quick. They had to be." The craftsmanship, he adds, must be almost second nature. "You either have an innate propensity, a natural covenant with wood, or you don't."

Donald Milton would agree that a "natural covenant" is not enough. He is in the middle of surviving. This ex-philosophy professor gave up his university life five lean years ago at age 37, and he is now at a crossroads. He has had to struggle longer than Moser, because his ambitions are more complicated. He does not want merely to make fine furniture: He wants what he calls a "harmonious life," and for Milton that includes homestead farming. So when he left the state university, he, his wife and two children moved to a farm at Nunica, Mich.

That leap required an immediate income, so he did not open his shop, but went to work for others. His first employer was a small maker of handcrafted Shaker reproductions, and there he acquired the crucial skills of a professional. The Shaker designs became a powerful influence. "They gave me the motivation of a style. I'm not wedded to them, but I felt an immediate attraction." But that shop was moving toward a larger volume, and after three years Milton felt, the owners were compromising craftsmanship. The invisible line between duplication of handmade quality and mass production had been crossed. Finally, although he was managing the shop, he left. Then a second employer, a retailer, offered him capital and a market—in exchange for financing he asked Milton to produce more Shaker designs. So Milton began again, this time learning how to start a business, and also learning the hopelessness of selling fine woodwork at wholesale. His retailer-investor soon wanted a larger profit, and that meant more speed and less care. "We were trying to make custom quality cabinetry and do it at wholesale," he recalls. "It doesn't work."

Milton has experience, knows how to start a business, apply production techniques, and where to draw the line. Meanwhile, he is unemployed and largely without capital. He has come a long way from teaching philosophy, but he describes the transformation as consistent. While teaching, he remembers, he slowly changed from a classical scholar to a "socially conscious philosopher." He decided to change his whole life, and this decision led him to what he saw as a "more basic" life: cabinetmaking and farming.

Like Moser, Milton does not miss intellectual stimulation because he still has it. He suspects, however, that he is less attuned to academic questions. "The academic debate of the university I look at now as being a little trite." Besides, he says, he enjoys the challenge of difficult design problems. "I feel better physically and mentally. It's invigorating." Despite having left the university, however, he values his broad education and hopes his two children will reach out the same way. Even at this point in his life, when the next step is unclear and he has not yet fulfilled his intentions, Milton seems confident and pleased. "I wanted to prove to myself that I could do it, and there's a lot of satisfaction in that."

Irving Fischman, 31, is a physicist who lives in Cambridge, Mass. He understands what Milton and Moser have been through, and he admits the prospect leaves him uneasy. He is about to make a similar commitment. Fischman's woodwork has already attracted wide attention. It has appeared in major juried shows, including Rhinebeck, and his checkered bowls made the cover of *Fine Woodworking's* first issue. He is writing a book on woodworking. But Fischman, who is single, has yet to make a living from woodworking, and he appreciates the dangers. "I've seen it a lot, people who do really nice work, and they fold because they can't manage the business aspect."

It was not until graduate school that Fischman became deeply involved in woodworking. He began to escape to the college shop to relieve the pressures of study. Soon woodworking assumed new importance, and he began taking custom orders. "Now I find that I'm trying to move away from physics and the orderliness—the compulsiveness—it requires. I'm trying to loosen up more, in my designs as well as in my life. I think the rules in physics are too strict for me."

Yet, like the others, he does not see his schooling as a waste, and the problem-solving aspects of the training apply to woodworking. "I don't consider myself an artist or sculptor. I consider myself a designer and problem-solver."

Fischman has thought a lot about making his move, partly, he says, because "I'm trying to avoid starving for five years." Nonetheless, he wants to avoid production work altogether. That puts him under additional pressure and will limit his marketing techniques. "Word of mouth will be the important thing," he says.

For the moment, Fischman is marking time. He saves as much as he can, spends carefully and ponders. When he finishes his book, he will make the break. And in the interim he hardly has time to get his hands on wood. "Right now what I do is come down and spend my lunch hour in the shop. You don't get much accomplished in your lunch hour. It's very frustrating."

The life of an artisan holds powerful appeal, sufficient that these three men would exchange prestigious careers to have it, despite the sacrifices. But prestige exacts its own price. Moser puts it this way. "I spent two years writing a Ph.D. dissertation that eight people read. It was an exercise in boredom. It was really dull. Last year I wrote a book on cabinetmaking. It has gone through two printings already. I get letters from Canada, Japan. I get arguments, I get flak. Nobody ever replied to my doctoral dissertation. They couldn't care less. Now you tell me, which is more rigorous? Which is more real?" □

David Habercom, 37, of Bay City, Mich., teaches English at Delta College. He is also an amateur woodworker.

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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.

Selections 1979: Wood—May 7-25. Julian A. McPhee Gallery, California Polytechnic State University, San Luis Obispo 93407.

1st Invitational Woodworkers Show—April 3 to May 3. Kiva Artisan's Gallery, 37 Popham Rd., Scarsdale, N.Y. 10583.

Sidewalk Superintendent: A Look at Building in America from 1719-1830—Through May 11. Fraunces Tavern Museum, 54 Pearl St., New York, N.Y. 10004.

Marquetry: Pictorial and Applied Workshop—Part I, April 14; Part II, April 21; Part III, April 28. Marquetry Society of America 1979 Exhibition, April 21 to May 5. Albert Constantine & Son, 2050 Eastchester Rd., Bronx, N.Y. 10461.

Young Americans: Fiber, Wood, Plastic, Leather—April 8 to May 20, Botanic Hall & Art Gallery, Nashville, Tenn. 37205.

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

St. Louis Spring Market of American Crafts—juried, open to trade May 3-4, open to public May 5-6. Convention and Exhibition Center, 81 Convention Plaza, St. Louis, Mo.

Pacific States Craft Fair—all media. Entry deadline March 24, open to trade Aug. 2, open to public Aug. 3-5. Fort Mason Center, Pier 2, San Francisco. Contact: American Craft Enterprises Inc., P.O. Box 1106, Saratoga, Calif. 95070.

Renwick Multiples—Contemporary pieces now on national tour. Last stop: April 14 to May 13, Erskin College Exhibition Center, Main St., Due West, S.C. 29639.

California Crafts XI—Toys, games and other playthings, juried, March 24 to April 22. E.B. Crocker Art Gallery, 216 O St., Sacramento, Calif. 95814.

The Enchanted Object: Toys and Games—March 17 to April 28, Birmingham Bloomfield Art Association, 1516 S. Cranbrook, Birmingham, Mich. 48009.

Central Pennsylvania Festival of the Arts—Entry deadline April 15, show dates July 8 to Aug. 25. The Museum of Art, Pennsylvania State University, University Park. Contact D.A. Shimel, 332 West College Ave., #2, State College, Penn. 16801.

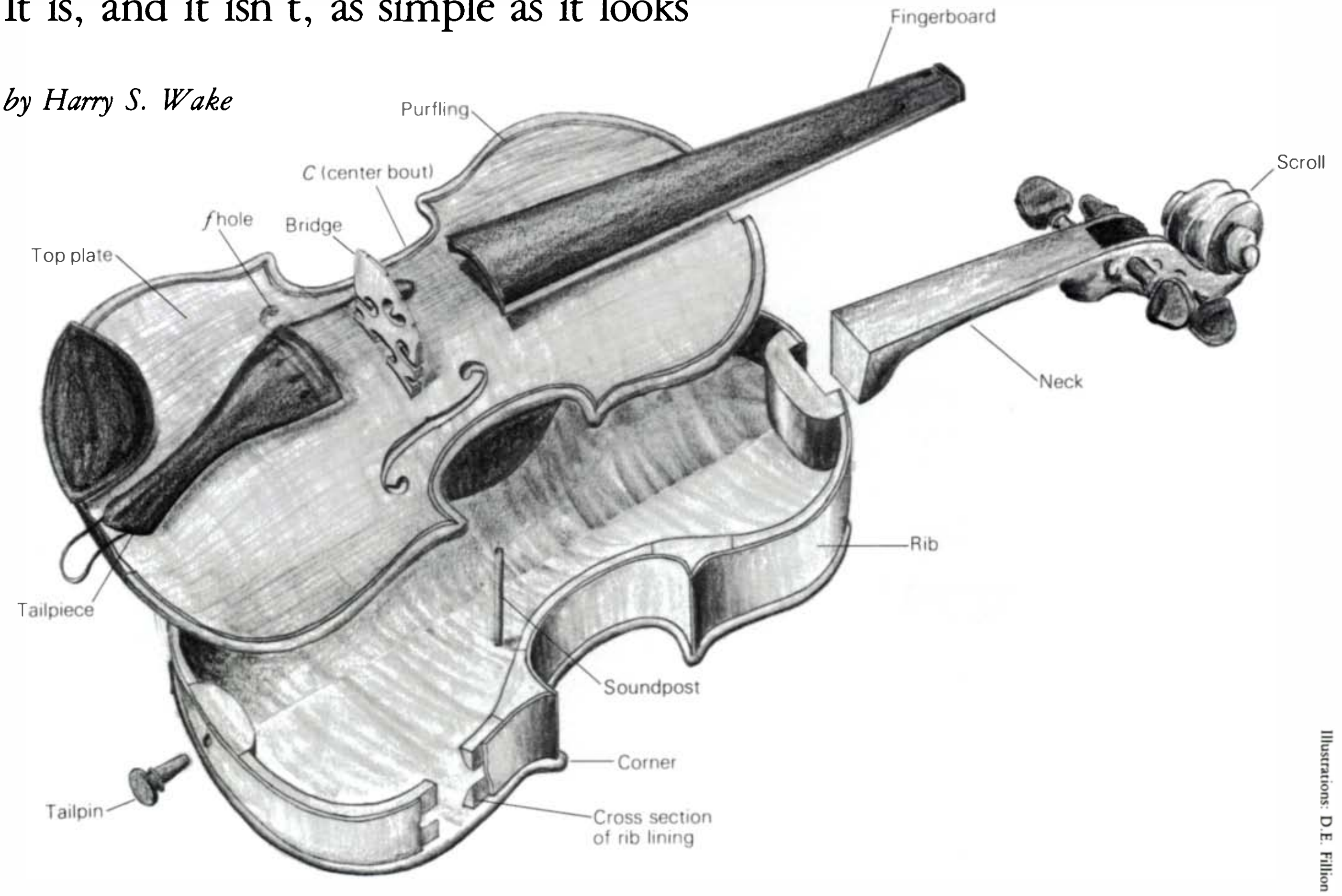
Quebec-Ontario Crafts/Ontario-Quebec Artisanat—Now assembling to tour Ontario and Quebec beginning Dec. '79, entry deadline July 1. Contact A. Jarry, Centrale d'Artisanat du Quebec, 1450 rue St. Denise, Montreal, H2X 3Z8 or P. Bennett, 11 Water St., Stratford, Ontario N5A 3B9.

Sixth Woodturning Symposium—Instructors include Mark and Melvin Lindquist, Alan Stirt, Jay Weber, Garth Graves and Richard Starr. March 23, 24, 25. Contact A.B. LeCoff, 2500 North Lawrence St., Philadelphia, Pa. 19133.

The Shape of a Violin

It is, and it isn't, as simple as it looks

by Harry S. Wake



Illustrations: D.E. Fillion

There has always been an aura of mystique and romance about the violin, and it is surprising how relatively simple its construction is. On the other hand, it is not quite as simple as some are apt to believe—for example, the top and back plates are not given their delicate contours by moisture, heat and pressure; they must be carved with chisels and gouges and measured to micrometer thicknesses. This is the question: "How is the shape of a violin arrived at?"

The violin as we know it was established in the 1600s and except for a couple of minor changes conducive to improved playing technique has remained unchanged for over 300 years. The conventional materials used for the body of the instrument are quartersawn maple for the back, neck, head (or scroll) and ribs or sides, and quartersawn straight-grain spruce for the top or table. The fittings—pegs, tailpiece and fingerboard—are usually made of ebony, although other hardwoods are sometimes used. The bridge is always made of maple or sycamore.

The back and top plates are usually made of two pieces of wood joined on the centerline. Quartersawn maple with nice grain markings joined in this manner creates a beautiful effect. Sometimes a piece of maple can be found that is wide enough to make a back without a centerline joint, but these pieces are much prized and quite expensive.

All wood for violin-making must be air-seasoned and at least 10 to 15 years old. European suppliers have been cutting and seasoning wood for violin-making for a couple of centuries or more, and most of the wood used today originates there. It appears, however, that their supplies are running low: German suppliers are now buying Oregon maple and British Columbia spruce and sending it to Europe for processing, then returning it to us for violin-making.

The maple and spruce logs are cut to suitable lengths and split into wedges. These wedges are split again and put together in pairs to make one violin top or back. They are then trimmed—sufficient material is sliced off the top face of the maple lengthwise of the grain to make the violin ribs, which eventually finish to a width of about 1½ in. and a rough thickness of 3/32 in. or less. This width allows enough material for trimming after the ribs are bent and formed on the mold. The finished depth of the violin ribs will be 1¼ in. all around; some makers modify this a little by reducing the depth slightly at the upper end.

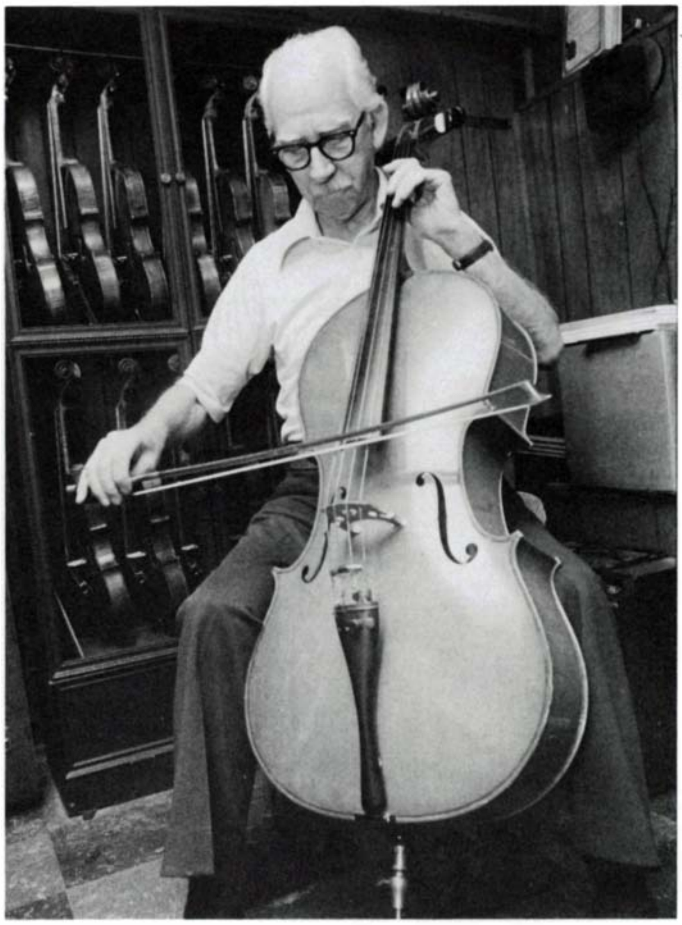
The two halves of the top and back are trimmed and joined on the centerline. One half of the wedge is placed in a vise with the thicker edge uppermost and quickly brushed with a plentiful coat of glue. Traditionally, hide or animal glue was

For violin top or back, split wedge from a log, then split wedge into two. Trim, place thick edges together, join on centerline.

Photos: Gene Truax

Front, back and scroll of violin No. 62, made by Wake.

Tony Doubek



Wake playing cello he made in 1976.

used in violin-making. Today, plastic resin glue can be used for the centerline joint, and for a few other places. The top plate must be glued to the ribs with hide glue, however, because someday the top will be taken off for repairs. I object to the use of common white household glue anywhere on a violin, because most parts of a violin are under constant tension, and white glue will not hold. I've seen too many violins with their necks pulled out of their mortises. The glued halves are rubbed together and left to set overnight. This is better than using clamps, unless you devise a special frame. Top and back pairs are now joined, but before going further with these we will go to the mold on which the ribs will be built. These ribs will be used as a template to develop the outline of the top and back plates.

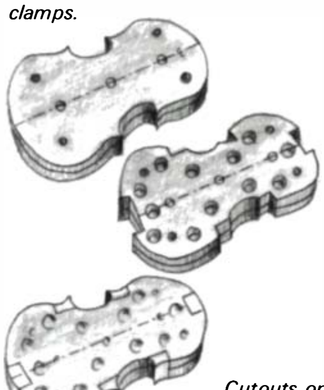
Of all the different variations of the basic violin outline that have been developed, those of the Italian makers Amati, Stradivari and Guarneri are probably used most. After the violin-maker has decided on a model, he prepares a pattern for the mold. Allowing for the thickness of the ribs and for overlap of the edge of the plate, a half-pattern is made from thin-sheet aluminum or plastic. This is actually a pattern for the inside of a violin. The half outline is transferred to the mold wood, then flipped over and the other half drawn. This ensures that both sides from the centerline of the violin will be the same, in opposite.

The mold is a sandwich of two pieces of plywood, measuring about 9 in. by 15 in. Use pieces that are each 5/8 in. thick, or one of 1/2 in. and one of 3/4 in. The mold must be a sandwich because it will be separated later on, as the violin is being assembled. Many different types of mold are used, but all act as a foundation on which the violin is built.

The two pieces of plywood are held together with four bolts. In addition, the top piece has three tapped holes on its centerline for push-out bolts that will help separate the two plates. The half-pattern is used to draw the outline on the mold, which is then carefully sawn and finished true and square to the line.

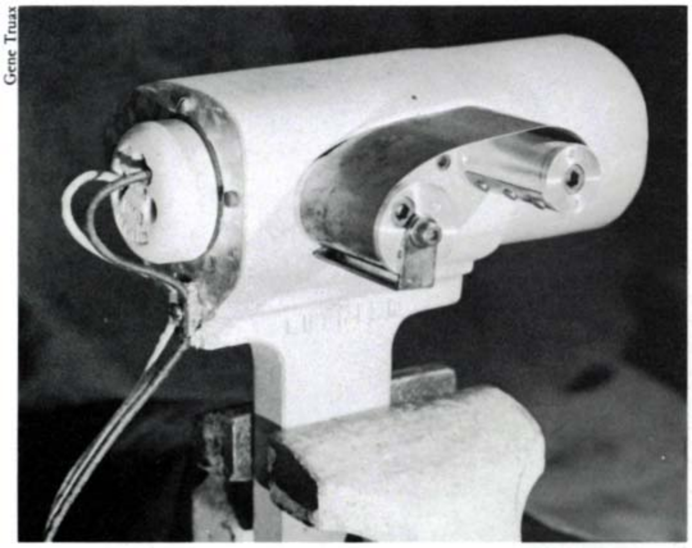
Some means must be provided for attaching the bent rib pieces to each other at the corners and at the top and bottom of the instrument. With the two plates of the mold firmly bolted together, holes are drilled to accommodate clamps, and cutouts are made at top and bottom and at each corner, as in the drawing. Squared blocks of willow or spruce are then attached to the mold in place of the cutouts, with the wood grain running vertical to the face of the mold. In the end, these blocks will become part of the violin and remain inside it. Therefore they are attached with only a small touch of glue, and they are fastened only to the lower section of the mold. The blocks must be finished flush to the top and bottom of the mold. Now the half-pattern is used to transfer the outline to the top face of the blocks, so they can be trimmed to the drawn outline.

Bolt two pieces of plywood together for the mold. The three holes down the centerline are through only the top half of the mold and will help separate it later on. The other holes accommodate clamps.



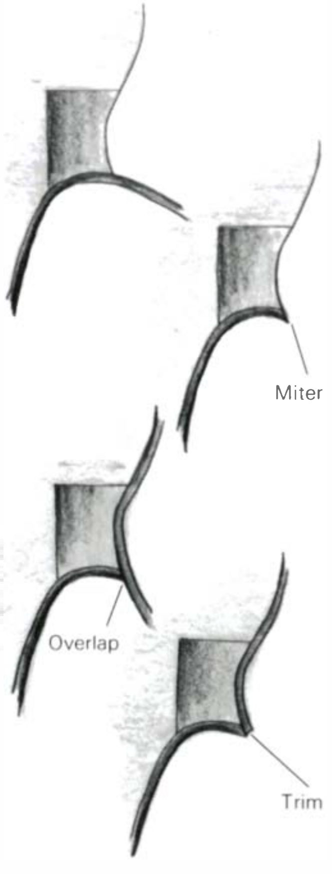
Cutouts on mold hold wooden blocks that separate from mold to become inside gluing surfaces of violin.

Gene Truax



Electrically heated, adjustable bending iron, designed by Wake, can bend C's for any size violin.

The next operation is bending the ribs, the stock for which, it will be recalled, was cut from the wedge-shaped maple bottom plate. Six pieces are cut to lengths sufficient for upper and lower right and left sections and the two *C*'s (center bouts). They will be sanded down to a final finish of 0.040 in., or about 1 mm. These pieces are soaked in water for about a half hour and formed by wiping them over a hot iron or pipe section; each maker develops his own methods, and it becomes quite simple with practice. I have designed and patented an adjustable, electrically heated bending iron that makes it possible to bend *C*'s for any size violin or viola.



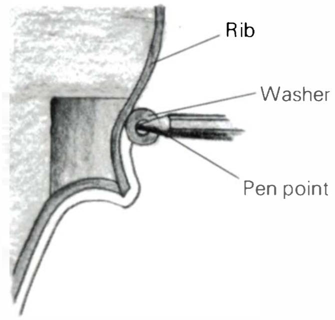
The ends of the bent C-pieces are mitered to accommodate overlapping of the upper and lower sections.

The mold is prepared by applying a coat of soap or silicone grease adjacent to the blocks, to prevent any excess glue from sticking where it is not wanted. The *C*'s are glued in place first, clamped securely and left to set. The ends of the *C*'s are trimmed to a miter at the corners to accommodate the overlap of the upper and lower sections of the ribs, and those sections are next glued in place only at the corners of the *C*'s. The left and right upper sections of the ribs are trimmed at the ends, brought snugly around the mold and glued to the upper block. The ends don't have to come close together because a mortise will later be cut here for the neck.

Gluing the lower rib sections to the bottom block is a little different, because a perfect butt joint must be achieved right on the centerline. Bring one of the ribs down tightly around the mold and clamp it at the bottom. Make a mark right on the centerline and trim off the end of the rib square and true. This end will not be glued down yet, but the other lower rib will be brought down and around and the end of it placed underneath the one that has been cut. Use a sharp knife to score a line on the rib underneath, using the upper rib as a guide. The second rib is then cut off at the scored line, and both can be glued in place.

The corners are trimmed off square and at a true right angle to the face of the mold. The completed rib assembly is then put aside, and work resumed on the top and back.

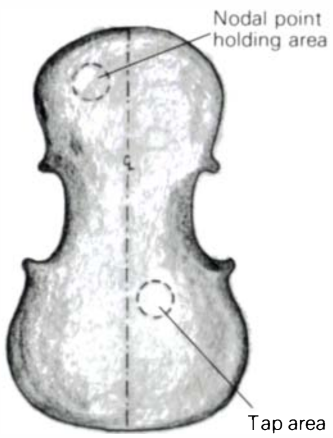
The bottom of the top and back plate assemblies is now cleaned up to a flat and level surface. The mold assembly top face is laid face down on the flat face of the top wood, centerline to centerline, and secured with a clamp at each end. The mold face should make close contact all around on the face of the wood. The overhanging edge of the finished violin top should be just about 3/32 in.; if a small washer with this wall thickness is placed against the rib and a pencil point placed in the hole, the pencil point can "ride" the washer completely around the ribs to mark the top outline on the face of the wood. The back plate is laid out the same way and an extension is left at the top center that will be finished later as the base of the neck.



With the point of a pen, ride a washer around the ribs to mark the outline of the top of the violin on the face of the wood.

The plates are bandsawn, but not too close to the line at this stage, taking care not to cut off the extension at the top of the back. The outside surfaces of both plates are next brought to final dimensions and contours and the edges finished to the line with gouges, finger planes, scrapers and sanding. The arching and thickness patterns are different for top and bottom plates, and an experienced maker doesn't use guides or patterns for the outside contours. Some makers, however, use transverse and longitudinal arching guides. The average height of the plates from the bottom face to the highest point of the arching is about 5/8 in. After the outside arching and contours are finished, the undersides of the plates are scooped out with the use of the same gouges, finger planes, etc., and carefully calibrated—the top plate to a thickness of less than 3 mm. The exact thickness depends on the density of the wood being used: It should weigh about 68 grams, and by working with the weight, a plate that is denser will finish thinner than one of a less dense wood. The thickness of the back plate will be different, because the central area is usually left fairly thick, about 4 mm to 5 mm, and the plate gradually thins towards the outer edge to 3 mm or less. It will weigh about 110 grams.

During this stage, the violin-maker suspends the top plate by forefinger and thumb and taps it lightly in the central area, listening for the "tap tone." This is an important procedure, and as the work is brought to final thickness he will continue to monitor it in an effort to bring it within desired frequency. When the plate is finished, he will note the tap tone frequency for future reference. The back plate should have a finished frequency just about a half tone higher than the top. If the top tap tone, for example, was *F*, than the back would be *F* sharp. If the top was *E*, the back would be *F*.



Through the research of scientists and violin-makers in recent years, new electronic methods have gained wide use in frequency testing and matching top and back plates of violins. The sensitive ear is no longer essential, although it still helps a great deal.

With the top and back plates having clean, scratchless surface finishes both inside and out, the next step is inserting the three-layer purfling trim into a shallow groove cut just inside the edge. The purfling material can be purchased either in wood or fiber. It has a white piece sandwiched between two black pieces, and is supplied in strips about 1/16 in. wide and deep, by about 3 ft. long. Although it is brittle and more difficult to work, I prefer wood purfling.

Different methods are used to cut the purfling groove: Some makers draw a two-bladed cutter around the edge, then use a narrow chisel to remove the wood, forming a channel just a little less deep than the material to be inserted. Others, like myself, devise machine methods for cutting the groove.

It is difficult to fit the purfling into a tight groove that is swollen with glue, so the groove should be wide enough so that the purfling will drop in easily. In fitting wood purfling, the corners are critical and can make or mar a piece of work. All pieces are bent over a hot iron, but cannot be presoaked in water because the layers will separate. Considerable care must be taken while bending.

The pieces should first be fitted into the grooves dry and neatly mitered at the corners. When all the pieces fit, glue them in, pressing them down with a smooth round object like a wooden tool handle, and wipe away the glue with a damp cloth. The plates are then put aside for the glue to set. Cleanup is next, then the edges all around are neatly rounded off. The back plate is now finished. The top plate has yet to have the *f*'s or sound holes cut and the bassbar fitted.

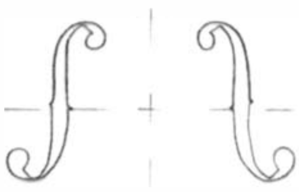
The *f*'s will be centered at a point 7⅞ in. down from the top edge; the *V*-nicks on the inside edge of the *f*'s are the index points. A template for a single *f* is positioned with the index nick of the *f* on the crossline marked lightly across the top. The *f* is traced through the template. Then the template is flipped over and the opposite *f* traced. Cutting the *f*'s requires care for a neat job with a sharp clean outline, but with a little practice and a sharp blade it becomes routine.

The bassbar is a longitudinal support that is fitted and glued to the underside of the top at a slight angle to the centerline, almost in line with the *G*, or lowest string. Along with the soundpost, it supports the top against the pressure of the strings on the bridge. Some makers put counter-tension into a bassbar by leaving a slight gap under each end before gluing the bar down.

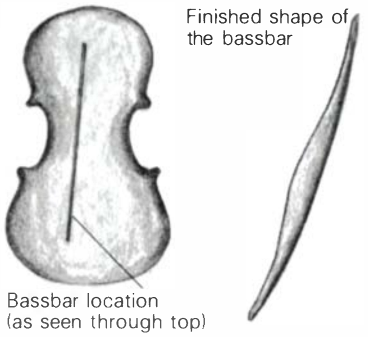
The tap tone or frequency of the finished plate will probably be lost when the *f*'s are cut. However, by careful trimming of the bassbar and constant checking of the tap tone, the clear ring of the original frequency can be restored.

Harry Sebastian Wake, 78, of San Diego, Calif., makes, restores and appraises violins. He has written extensively on the making and repair of violins, and was a founder of the Southern California Association of Violin Makers.

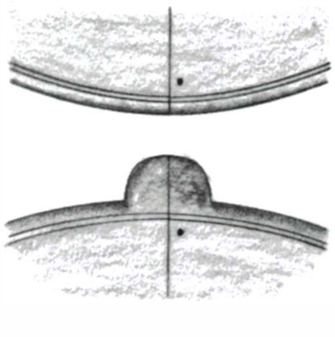
Wake's purfling machine cuts a narrow channel a ound edge of violin plate.



V-nicks on the inside of the f are index points: The V is positioned on a line, the f traced and flipped, and the opposite f traced.



While the sides are still secured on the mold, the finished top plate is placed in position and secured with a clamp at each end. A small hole is drilled at the bottom and top just to one side of the centerline, through the top and into the blocks on the mold about 1/4 in. deep. Round toothpicks are thinned slightly and pushed into the holes, then cut off, leaving a short end projecting. The same procedure is performed on the violin back—these small dowels position the top and back plates when the assembly is glued together.

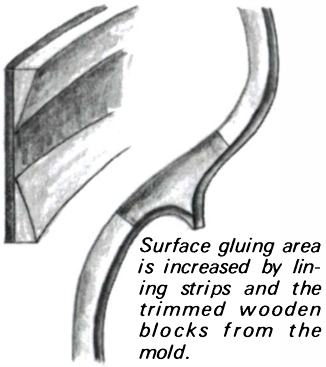


Bottom and top, back and front holes hold tiny positioning dowels.

Remember that there are three tapped holes on the centerline, through the mold's top plate only; inserting machine screws and tightening them down after the four bolts that hold the two sections together are removed, pushes the upper plate of the mold out of the rib frame. The lower section of the mold remains attached to the ribs at the blocks.

The now exposed upper edges of the ribs offer too little surface area for gluing, so lining strips are prepared and glued inside the edges. There are six pieces: two for the upper sections, two for the *C*'s and two for the lower sections. These are preferably willow, in strips about 3/32 in. thick by 5/16 in.

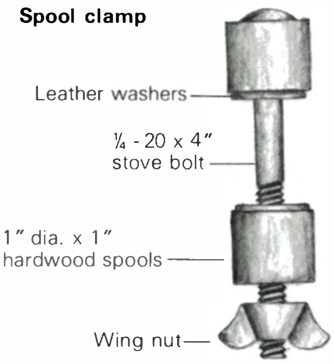
wide, bent with heat to conform to the curvature of the inside of the ribs. They are glued in place using spring clothespins for clamps and left to set. The top edge is cleaned off flat and true to leave a good gluing surface, and the linings are tapered down to a thin edge on the inside.



Surface gluing area is increased by lining strips and the trimmed wooden blocks from the mold.

With a thin knife blade the blocks are carefully separated from the mold, and the lower section of the mold is removed from the rib frame. Six more linings are fitted to the lower edge, the blocks trimmed to the inside contours and the rib frame cleaned up for assembly with the top and back plates.

The back plate is glued onto the rib frame first, using bobbin-type clamps all around and C-clamps at the end blocks. Bobbin or spool clamps are easy to make. They consist of two freely moving spools mounted on a threaded bolt together with leather washers and an easy-running wing nut. About fifty of these clamps are required to go around the corpus when gluing the top or bottom plate to the ribs. The clamps are usually set close together with light pressure. A violin-maker can make his own spool clamps from 1-in. diameter dowel rod and ¼ in. by 4 in. stove bolts. The stove bolts have squared shoulders underneath the oval-type head and prevent the lower spool from turning when the clamp is tightened.



The toothpick dowels now are useful in positioning the plate for gluing. Before the top plate is attached, glue a label showing the maker's name and the date to the inside of the back where it will be visible through the *f* hole on the bassbar side. Gluing the top on completes the assembly.

For the neck and head or scroll, a block of quartersawn maple, 2½ in. by 2½ in. by about 10 in., is trued up and all layout lines are drawn directly on the material. A band saw is used to remove most of the excess wood and the profiles of the scroll are traced on opposite faces of the block. Pilot holes for the peg holes are drilled through while the block is still square. Dimensional tolerances are carefully observed and the heel of the neck fitted into a mortise cut into the top center of the violin body.

All fittings, such as pegs for tuning, bridge, fingerboard and tailpiece, can be purchased ready-made for fitting to the instrument, but some makers prefer to cut these parts themselves. The violin can be completed and set up for testing in the unvarnished condition. Then it will be stripped down and the maker will use either his own formula or a commercial varnish to finish his masterpiece. Many commercial brands are available from violin-making materials suppliers, but I make and formulate my own. It's no secret, but the basic ingredient might be a little difficult to come by—I was given a supply a few years ago. I crush fused fossil amber to a fine powder, dissolve it in turpentine and blend it with linseed oil with or without heat, depending on the color desired. □

Stalking Mesquite

Sleek sculpture from scrawny trees

by Stanley T. Horn

Rock collecting may seem distant from woodworking, but there are times when the two interests are complementary and produce unexpectedly pleasing results. After many years of field trips for gems and minerals, I am well aware of the eccentricities of collectors. Even so, I was amazed to watch otherwise normal rockhounds working hard to gather gnarled, weathered branches of scrawny desert trees they called ironwood or mesquite. Some were so happy that they nearly neglected the usual target material of the area, agate and jasper. The wood certainly did not look like potential lumber or anything useful, even firewood. The scene was near Blythe, Calif., in the Wiley Well area. Trees either don't exist or are scarce in the deserts of southern California, Nevada and Arizona, but here there were many, following dry washes and underground water courses. They seemed to be about equally divided between mesquite and smoke trees. Both run about 12 ft. to 15 ft. tall, with mesquite a dusty grey-green color from small leaves. Branches are twisted, with no main trunk after the first few feet from the ground.

The best I could get when I cautiously inquired as to why the excitement over the mesquite was that it was "real purty." I dismissed further interest and turned to more serious and sane activities. Too bad. Months later I began to notice at various shows small Navajo sculptures of birds and animals carved from a dark, chocolate-brown wood, sculptures that took advantage of the wood's wild and twisted shape. It was the same mesquite I had snubbed, and it was a lot more than "real purty." Its subtle colors sing out with grain patterns to wood lovers, and I had been in that fraternity long before discovering the parallel joys of lapidary art.

Mesquite is not usually available from exotic wood dealers, so one must gather it oneself. It is widely distributed in the Colorado River basin, Arizona, New Mexico and Texas. Therefore, some months later I returned to Indian Pass, east of El Centro, Calif., and north of Yuma, Ariz. Rocks and minerals were still the primary objective, but this time mesquite had equal time. One looks for branches long dead on living trees, or unattached branches or roots—scarce because previous collectors have picked up all the easy pieces. There are two reasons for gathering dead wood only: It's already cured, and live trees are protected in some areas, such as Wiley Well, and a citation and fine could be expensive.

The best saw for cutting the mesquite is one designed for cutting firewood, with widely spaced teeth and plenty of set, but in dire emergency an ordinary saw may do the job, with time and patience. An ax is useless—mesquite's alternate name of ironwood is well earned. Even with the right saw, be prepared for a lot of work. My usual performance is about a half-hour for a 6-in. limb—three minutes of sawing and three

Stanley Horn, a retired aeronautical engineer, pursues woodworking, lapidary and silver work, and no work at all.

'The Spirit soars, and returns to the source,' Horn's Moebius-strip sculpture, carved from mesquite. Base is dumortierite, a desert stone.

minutes of puffing recovery, in cycles. Even winter days on the desert can be warm, and at other times, forget it.

Because the wood may have been drying for 50 years or more, the usual problems of curing self-collected wood do not exist. Mesquite can be used as soon as you want. I tried some small natural shapes and trays to get the feel of it (and the deep tannin stains on my hands), and found that ordinary woodworking methods apply almost to the end. Traditionalists may cringe, but at this point metalworking files are the most practical tools, because the wood responds much the same as medium brass. It even takes on a polished appearance with fine-cut files, but successive grades of abrasive paper, ending with wet-or-dry #600 used dry, provide the ultimate base for final polishing. Plain carnauba wax, lightly applied and vigorously rubbed with an old wool sock, gives a beautiful deepening of tone and a fine lustre. Your own pet schedule of finishing would probably work equally well, but I've never wished to go beyond this, in view of the results.

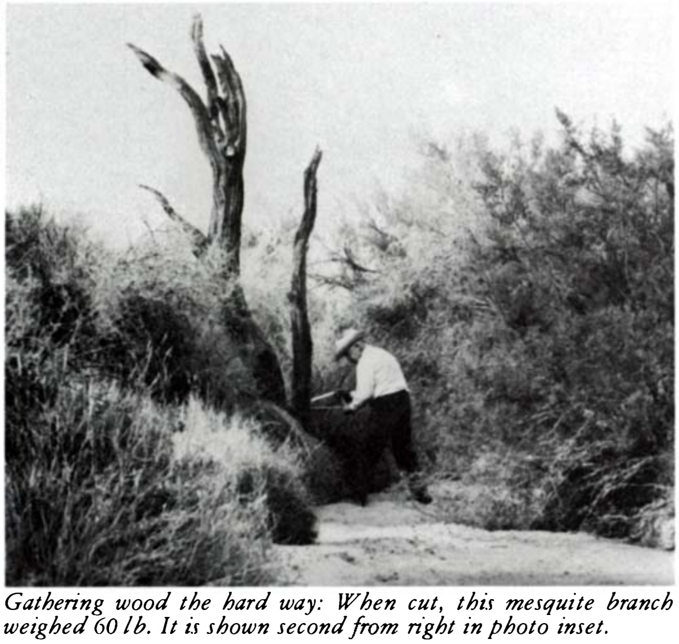
The photo at left shows one of my efforts that had a most satisfying end. The basic idea is an adaptation of the old Moebius strip, dearly loved by topology and math buffs. The natural branch had just the right amount of undulation, and luckily there were no voids or inclusions at the wrong places. As most art texts insist, the material itself will pull the craftsman inevitably toward a fine result. It seemed to here. The human element is there to respond of course, but it is the man/material combination that is required. Synergy is becoming a cliche, but is the only word to describe what happens in the process of developing a piece such as this. Part of the pleasure at the last stages of refinement is the tactile thrill of smoothly flowing surfaces and clean sharp edges that please the eye at the same time. The exact shape is not definable before starting, nor is a theme necessarily in mind. The finished piece may suggest a name or title, as mine did.

This mesquite harvest is the result of several field trips.

What, then, could be more fitting than a base of dumortierite, from the same earth that nurtured the branch? This stone varies from an almost black-purple through blue as bright as lapis lazuli and on into a granite-like grey. So as not to distract from the sculpture, the brightest blue was passed over in favor of a subdued shade, with veining suggestive of the distant galaxies of the Milky Way. A less-than-intense polish was given the stone, again to avoid overpowering the main item of interest. The combination of weathered branch arising from the Great Void, developing into the smooth Spirit shape and returning to the origin, seems a natural flow.

If you can acquire a piece of mesquite, try it for an interesting experience. It is a challenge any woodworker can enjoy. □

Photos: Stanley T. Horn



Gathering wood the hard way: When cut, this mesquite branch weighed 60 lb. It is shown second from right in photo inset.

EDITOR'S NOTE: One source of mesquite is Dubose Architectural Floors, 916 Jackson St., San Antonio, Tex. 78212.

The Mortise and Tenon Joint

Best results come directly from chisel and saw

by Ian J. Kirby

The mortise and tenon joint is used to bring two pieces of wood together, usually at a right angle, as in frames for carcases and doors, table legs and aprons, chair legs and rails. It is fundamental to woodworking and is made in innumerable variations, either by hand or machine. This discussion will focus on the basics of designing mortise and tenon joints to fit their purpose in a structure, and on making a single joint with hand tools. When there are only a few to do, a skilled workman will hand-cut them in the time it would take to set up machines.

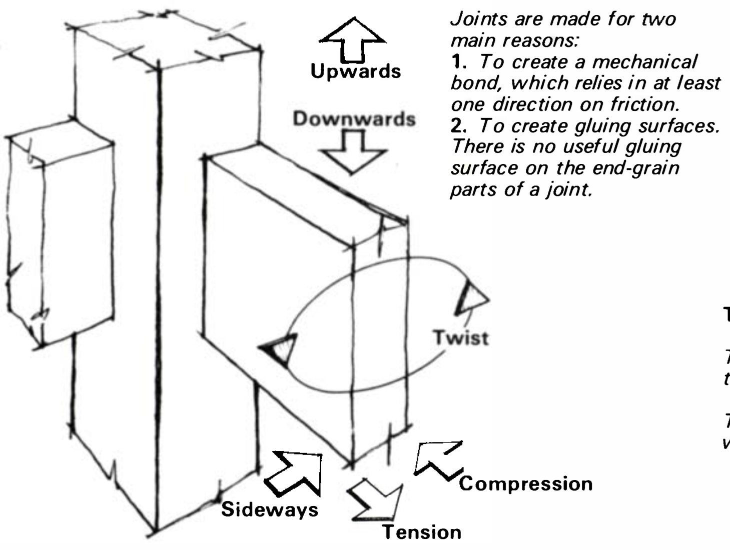
A mortise and tenon joint gets its strength from the mechanical bond of letting one piece of wood into another, and from the adhesive applied to closely fitting long-grain surfaces. The craftsman must design the relative proportions of the mortise and tenon in order to best resist the forces the joint will encounter in service, to balance the wood tissue between the mortise and the tenon, and to maximize the long-grain gluing surfaces. Then he must make the parts accurately and cleanly, in order to achieve a close interface and thus a strong glue line.

A common mistake is to search in books for formulae and schematic diagrams of universal application. Instead, one should analyze the function of the joint in the structure one wants to make, and the loads it will have to bear. Does it have to resist downward pressure, or tensile load, or bending and twisting forces, or as is frequently the case, a combination of a number of forces? Knowing exactly what performance one wants from the joined pieces should be the first step in designing the joint.

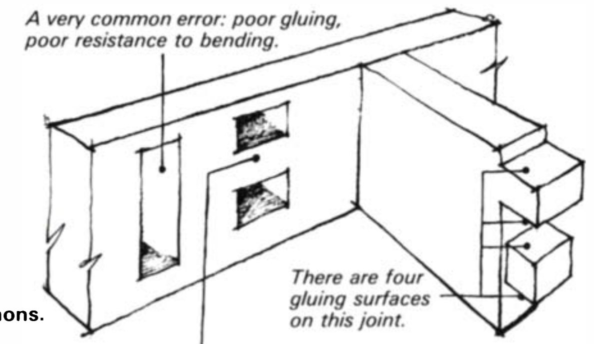
The general rule is that there must be enough wood on the tenon, both in length and in section, to withstand the load it will have to bear. If the load is exclusively downward the tenon should be thick, but there is no need to have thick mortise cheeks. On the other hand, if there will be twisting forces, both the mortise cheeks and the tenon must be thick enough to withstand them. If the force is an outward pull or a pivoting, the tenon should be long enough to provide ample gluing area, or long enough to pass right through the mortise so it can be wedged on the other side.

The old rule of thumb when the mortise and tenon members are the same thickness is that the mortise should be one-third the width of the stock. This makes the tenon and each of the mortise cheeks the same thickness. Slavish adherence to this rule often leaves the tenons cut too mean, imbalancing the wood tissue between the tenon and the mortise cheeks. It would be better to say that the tenon thickness should about equal the thickness of the mortise cheeks added together. Thus in the example of a 1½-in. thick rail and stile, make the mortise cheeks each ⅜ in. thick and the tenon ¾ in., instead of making each ½ in. thick. The accompanying diagrams illustrate some of the forces such a joint commonly encounters, and some of the ways of keeping the joint strong where it needs to be strong. Notice that where twin tenons are used to resist bending and pivoting forces, as where the seat rail

Illustrations: Ian J. Kirby



Design the joint so that the remaining tissue on both mortise and tenon will best resist the expected strain or load.

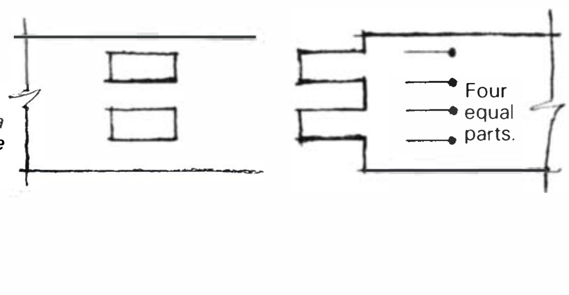


This bridge piece is usually the same width as mortise.

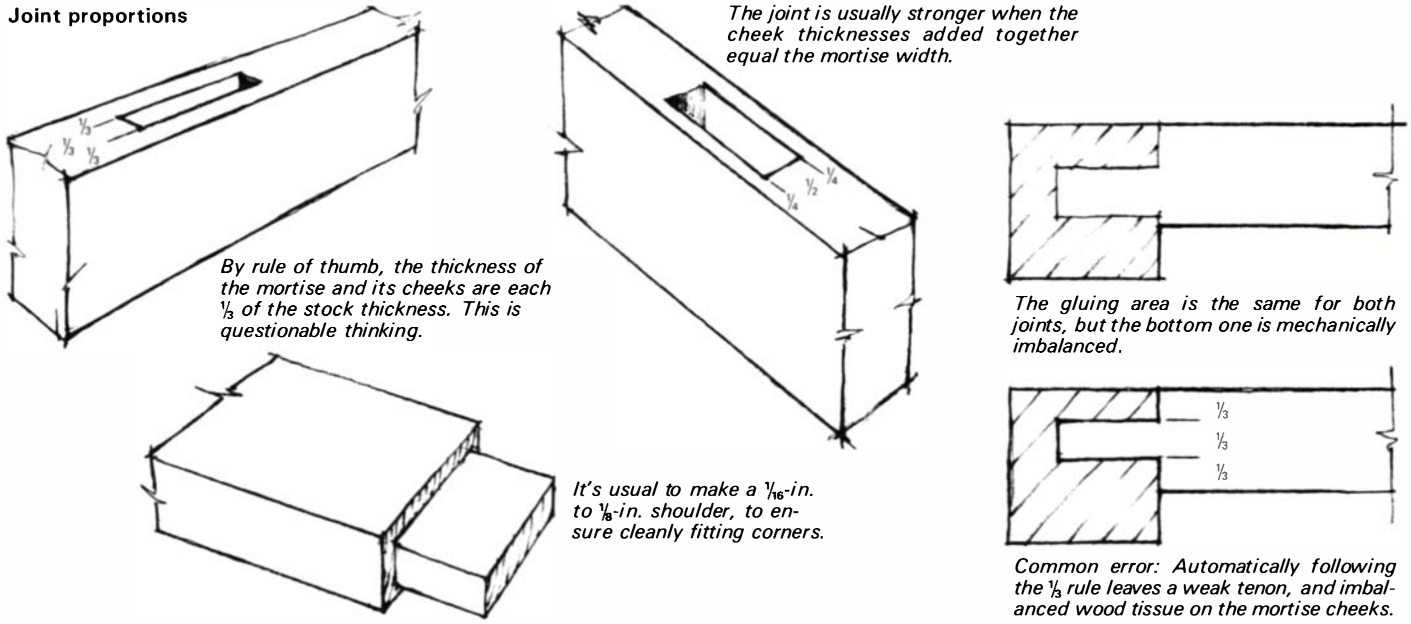
Tenons are usually wedged when through.

The tenon may be bare-faced, which means the mortise must be very accurate or a gap will result. This gap may not be present when the joint is made, but the tenon piece becomes thinner when its face is cleaned up. Or it may have a side shoulder, which slightly reduces gluing area.

If pressure on this member is mainly downwards, such as a chair seat rail, then leave more tissue at the bottom of the joint than at the top.



Joint proportions



By rule of thumb, the thickness of the mortise and its cheeks are each ⅓ of the stock thickness. This is questionable thinking.

The joint is usually stronger when the cheek thicknesses added together equal the mortise width.

It's usual to make a 1⁄16-in. to ⅛-in. shoulder, to ensure cleanly fitting corners.

The gluing area is the same for both joints, but the bottom one is mechanically imbalanced.

Common error: Automatically following the ⅓ rule leaves a weak tenon, and imbalanced wood tissue on the mortise cheeks.

meets the side rail of a chair, the object is to increase side-grain to side-grain gluing area. A common error when joining two pieces of wood this way is to make the tenon so that long-grain gluing surface is reduced and end-grain surface is increased—no help at all. Another consideration in maximizing gluing area is the depth that the tenon goes into the mortise member. If it is not to be a through tenon, one can safely mortise to within ¼ in. of the far side of the stock.

The simplest form of the joint is a *T*, where the mortise is somewhere in the middle of a length of wood—as in the lock rail of a door, or between the side rail and back leg of a chair. This article will focus on that situation, leaving the added complexities of joints at corners (which are usually haunched), joints in grooved or rabbeted pieces (usually with long and short shoulders), and joints that are wedged or pinned, for a subsequent discussion.

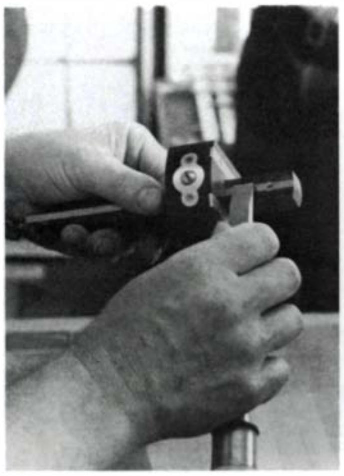
Tools for mortising — For accuracy, the mortise is usually cut first and the tenon cut to fit it. The essential tool is a mortise chisel, which determines the width of the mortise and therefore of the tenon. The mortise chisel differs from an ordinary bench chisel in that it is stoutly constructed to withstand heavy pounding with a mallet and levering, its blade is precisely rectangular in cross section, and there is no narrow waist where the blade meets the handle. The rectangular section of the blade makes the chisel somewhat self-jigging in action, so it will cut an accurate mortise. Its stout shoulder allows levering out of the waste. The ordinary bench chisel with beveled sides is most inadequate for mortising because it will twist, and may snap off at its narrow neck. Beyond this, there are various chisel patterns evolved by the branches of the trade, which amount to two main types: socket, where the handle fits into a socket in the blade, and tang, where an extension of the blade enters the handle. A tang chisel usually has a leather washer between the blade and the handle to cushion the recoil after the chisel is struck with a mallet. The socket also offers resilience and thus performs a similar function. The handle may be of a ring-porous hardwood such as ash, which is prone to splitting and therefore will be bound with metal ferrules top and bottom. Or, it may be a denser diffuse-porous wood such as box, and no ferrule is used at the top. Or it may be a high-impact plastic, which is quite satisfactory.

The details of the handle and how it fastens to the blade are matters of personal preference. What does matter is that the blade be stout, truly aligned with the handle, and truly rectangular in section. All too often, even new chisels fail to fulfill these requirements, but they can usually be put right (see box, page 51).

The other necessary tool is a mortise gauge, and you cannot make the joint reliably accurate without one. It differs from an ordinary marking gauge in that there are two spurs, one of them movable. The distance between them is struck from the chisel itself and transferred to all the pieces of wood at the same setting. This critical distance can be maintained even when the position of the fence needs to be altered to account for mortise and tenon members of different thickness. A good mortise gauge is expensive, but it will last a lifetime if it is reserved for marking out mortise and tenon joints. To try to manage without one, by resorting to two settings of a marking gauge, is futile and plain bad practice. A mortise gauge often has a single spur on the side of the beam opposite the double spurs, apparently an encouragement to use it as an ordinary gauge as well. I usually remove or grind off this spur. In view of the expense of the gauge and its importance, it should not be expected to withstand the robust usage that a marking gauge is liable to receive.

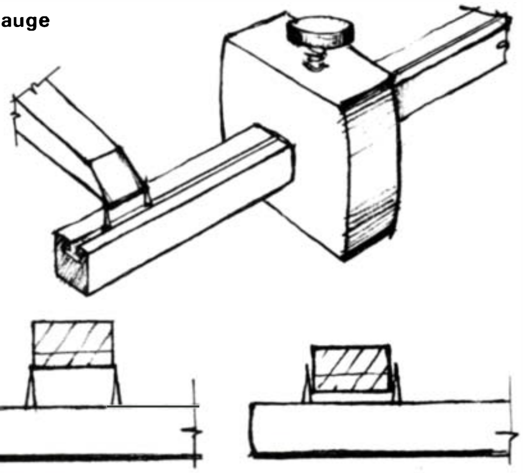
Whether the fence is locked to the beam by means of a thumbscrew or a slotted screw is not important, but the life of the gauge will be considerably extended if this screw is not overtightened. It bears on the brass sliding strip that houses the moving spur, and there should be two small protective pellets of soft metal between the screw and the brass strip. If you have occasion to take the tool apart, be sure not to lose the pellets. If they aren't in there already, then make two and put them in. The spurs on the new gauge are usually ground to a cone-shaped point, as on a pencil. Although some workers like to sharpen them as if they were tiny knives, I believe the gauge is more accurate if they are left alone.

Cutting the joint depends on the direct relationship between these two accurate tools, the mortise chisel and the mortise gauge. No other tool need intervene between them in



Setting the mortise gauge

When setting the mortise gauge, the depth of the chisel between the spurs is a matter of personal preference. The effect of this setting is felt in the positioning of the chisel when chopping the mortise and the positioning of the saw when sawing the tenon. Will you try to split the line or saw to one side of it?



quickly producing the most accurate joint. The mortise should not be widened by moving the chisel out of alignment at each cut, nor is it wise to adjust the width by paring its sides. Design consideration notwithstanding, one chops the mortise to the width of the chisel one has. The need for a set of several chisels quickly becomes apparent.

Setting the mortise gauge —There is a need for some fine judgment in deciding exactly how to set the mortise gauge from the chisel. It depends on how you intend to go about sawing the tenon: Will you try to saw to one side of the gauge line, or will you try to split it? To be in a position to be able to split the line, the spurs are set with the chisel between them, rather than with their very points exactly coincident with the chisel's extreme corners. This may seem like the workmanship of risk gone mad, but it does amount to the thickness of a line and can mean the difference between a good fit straight from the saw or one that needs further adjustment. The chisel should sit between the spurs about as deeply as the spurs will sink into the wood as they mark. This affects only the sawing of the tenon, not the width of the mortise, which is determined by the width of the chisel alone. The chisel will just touch the inside of each line and some of the gauge lines may remain visible after the cutting.

Having set the spurs, set the fence relative to the nearest spur to determine the cheeks of the mortise and the shoulder of the tenon, and mark them both on all the pieces of the wood. If the mortise member is thicker than the tenon piece, the fence setting will have to be changed, but on no account change the spur setting.

Shoulder lines — Shoulder lines are knifed round deeply with a try square from the face side and face edge. In the end, this knife line is the part of the shoulder that will show. It should be made with a thin knife sharpened flat on one side, like a chisel. I keep a small pocketknife for this job alone. The line should be crisp and deep, made with one pass of the knife. Shoulder lines are never made with a pencil since it leaves no register for subsequent paring with either chisel or shoulder plane. Scribing across the grain with a pointed tool is equally worthless, because it merely scratches the surface and drags up the wood fibers rather than cutting them.

Chopping the mortise — The mortising chisel, once it is correctly started, is self-jigging: each cut tends to follow the previous cut. However, care must be taken to chop vertically or the mortise will wander. The important thing to get right is stance and body position relative to the workpiece and to the tool. The tool is held almost at arm's length and aligned with the center of the body. This way it is easy to see that it is vertical. It cannot be seen by standing over it. A good aid for the beginner is a straight piece of wood clamped to the face side of the work as an extension of its known accuracy, in advance of the joint itself so it doesn't get in the way. A less good aid is a try square resting on the bench against the work. This relies on the assumed flatness of the bench, rather than registry on the known accuracy of the workpiece. The square tends to fall over when the chisel is struck.

In any event, the workman must stand far enough back to sight the chisel properly, and to strike it hard with the mallet while continuing to sight it. The diagrams on the next page show the orientation of the chisel and the strategies for enlarging the mortise once it is begun. The most common fault is to strike too lightly. Cutting a mortise is quick, once one has enough confidence to strike each blow hard.

The best mallet for mortising is the cabinetmaker's or carpenter's type, which has a heavy rectangular head and a large, flat striking face. It has little tendency to deflect. One can confidently deliver a substantial blow and still keep one's eye on the cutting end and alignment of the chisel, not on its handle. Many people try to use the common cylindrical carver's mallet, which is meant for light tapping. Since the chisel handle is also domed, a good smash is likely to deflect onto the hand, also bruising the confidence.

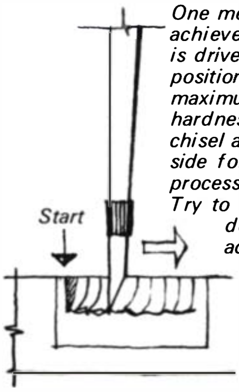
Obviously, the workpiece has to be placed on the bench so that the correct stance can be taken, but its position is also important in other ways. The process involves heavy impacting with some risk to the bench surface, especially if the chisel accidentally cuts right through. The crucial part of the bench, for me anyway, is the surface in front of and around the vise, where the bench stop is. This should always be in perfect condition and truly flat, so it makes sense to do heavy pounding over the leg away from the vise. The workpiece can be clamped down, but with experience this becomes unnecessary. There is no need to support the cheeks of the mortise with clamps because the direction of the impact and of severing the fibers is such that (unless the grain is very wild) little strain will be put on the cheek tissue.

Because levering out the chips bruises the fibers at the end of the mortise, work it to full depth but to within only ⅛ in. of the ends. The ends may then be squared up to the line with one clean cut.

Align the chisel with the center of your body, strike it hard, and then lever out the waste.

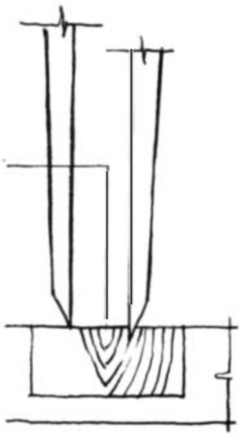
Chopping the mortise

When the chisel is struck, it tends to cut into the wood tissue in the direction away from the sharpened side. A scooping action results, giving rise to two different methods of removing the waste from the mortise.



One method is a form of layering to achieve the required depth. The chisel is driven to the same depth in each position, with about ½ in. being the maximum depth, depending on the hardness of the wood. Move the chisel about ⅜ in. away from its flat side for each new cut. Repeat the process after the first bottom is made. Try to keep a level bottom without deep troughs, to avoid inadvertently chopping through.

A common depth gauge is a piece of masking tape wrapped around the chisel.



The second method begins in the center of the mortise, turning the flat face of the chisel toward the center in each new position. The aim is to achieve the final depth with a wedge-like cut, and then to remove waste from top to bottom with each new position.

In either method leave the ends until last. Place the chisel in the knife cut you made when marking out the mortise, and use a small square to make sure the face of the blade is vertical. Drive the chisel accurately and hard; do not undercut the ends.

There are other methods of removing the waste, the most popular being with a drill the same diameter as the mortise width. This is to introduce yet another tool, which itself requires a setup and jigging to ensure exactness. Then the chisel has to be used anyway, whereupon the holes and the shape of the remaining waste encourage the chisel to twist. Others drill the waste and remove the residue by paring the cheeks with a wide bench chisel, invariably leaving the cheeks out of square or twisting or uneven. It is probably lack of confidence that persuades people that these other methods are safer and quicker when in fact they are neither. They invariably leave a worse result than that achieved straight from the mortise chisel. Resorting to such methods means only that the confidence that comes through practice is never acquired.

Sawing the tenon — Offer the tenon member up to the mortise to see how the gauge lines correspond to the actual hole, and to remind yourself of the decision you made when setting the marking gauge: Will you try to split the line, or to saw along one side of it?

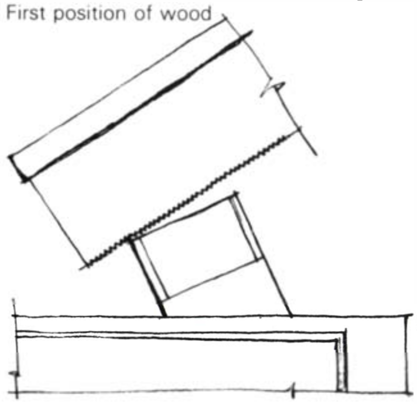
Put the wood in the vise sloping away from you at an angle of about 60°. With the back (tenon) saw, begin the cut at the far end of the line across the top, that is, on the end grain. Watch the cut as it proceeds across the top to the near corner, and saw down the grain parallel to the end surface for about ⅛ in. This will create a good kerf in which the saw can be constantly registered as the cutting proceeds. Now saw down the long grain to the shoulder line on the face nearest you, without going any further down the back face but without lifting the saw out of the kerf at the back corner. This requires practice—the idea is to saw down only one line at a time, while keeping the saw correctly positioned at the start of the line to be cut next. Now turn the wood around in the vise and cut the other diagonal, keeping the saw teeth inside the kerf all the time. Finally, put the wood upright in the vise and saw straight down to the shoulder lines. The diagrams on the next page should make the procedure clear. This method, once mastered, permits very fast and confident cutting. If you begin the cut at the top corner and proceed across the top and down one side at the same time, the saw is liable to wander, and corrective adjustment on one line usually puts the saw off on the other line.

To cut the shoulders, remove the wood from the vise and place it on a sawing board. Train yourself to saw about 1/16 in. away from the knifed line, in order to finish back to the line with a 1-in. paring chisel. The original knife line should be deep enough to locate the chisel as much by feel as by sight. Don't try to cut the full inch of chisel capacity, which with most woods takes too much pressure. Cut a half-inch of shoulder line, then move across half an inch. You'll find, of course, that the first cut will register the chisel for the next, a most helpful guide. The amount you can cut at one time depends on the species of wood, but the aim is to saw close enough to the line so that one chisel cut will finish the shoulder, yet not so close that the chisel can't easily click into the knifed line. If the tenon is wide, a shoulder plane is more practical than the chisel. But less than 4 in. of shoulder makes holding the plane somewhat more difficult.

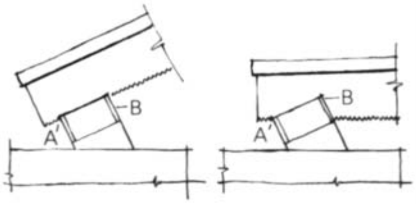
Many people reason that a fine dovetail saw will produce a cleaner surface on the tenon. The Western-style dovetail backsaw, however, cuts on the push stroke and simply isn't stiff enough for the section of wood normally encountered in tenoning. The blade tends to buckle, inducing wander. The Eastern-style dovetail saw avoids this problem by cutting on the pull stroke, putting the blade into tension. However, it is

Sawing the tenon

First position of wood

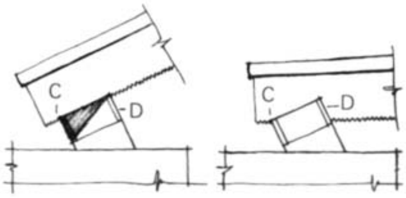


Place the workpiece in the vise at an angle of about 60°, and low enough to get at comfortably. Stand with your feet apart as in walking, your body weight equally distributed, but stand far enough to the side to clear your right arm and allow it to work like a piston. Align the saw with your forearm, in both front and side views; the wrist shouldn't be bent. Use your left thumb and index finger to guide the saw, but don't lean on your left hand.



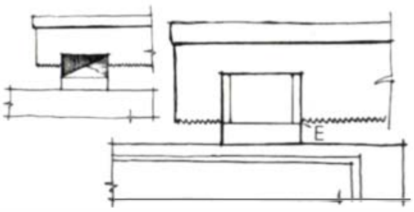
Begin the cut on the edge away from you, at Point A, and saw down about ⅛ in. Keeping the saw in the original cut, saw straight across the top of the wood, then pivot around Point A to saw down the line facing you at B.

Second position of wood

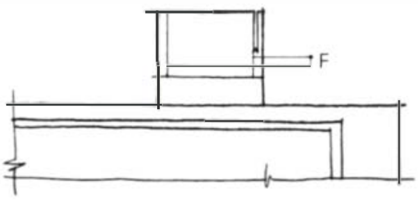


Now turn the wood around in the vise, at a similar height and angle to the first position. The area already cut is shaded. Place the saw in the kerf across the top of the piece, and saw down the line D. The saw pivots around Point C, and again must not be lifted out of the wood at C.

Third position of wood



Place the wood upright in the vise to saw down the remaining triangle to the knife line at E.



Keep the work upright in the vise to saw down the side lines at F.

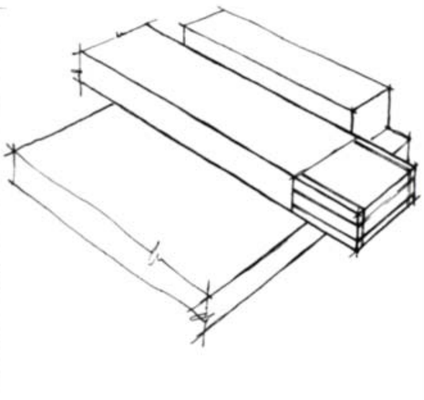
still a good deal slower than a tenon saw and has a distinct tendency to wander when sawing through a large section. The improvement in surface quality is marginal.

Other than the shoulders, the joint should not need trimming. The tenon should come directly from the saw and the mortise straight from the chisel. It is wrong to adopt the notion that on one hand it cannot be done, or on the other that one should leave a margin of safety by cutting everything oversize, to be trimmed right. The paring of a tenon, other than to make a minor adjustment, almost always puts it into twist, or removes too much from one side and thereby offsets the shoulders, or puts it out of alignment so it won't enter the mortise at 90°. It is far better to practice sawing and learn to saw correctly in the first place.

Checks — There are several ways to check the accuracy of the joint before it is put together. First verify that the faces of the tenon are in line by holding a rule against the side of the wood and sighting the tenon against it. Twist or angular misalignment will be apparent. For the mortise, first check the cut ends by placing a rule into it (or through it) so that it registers against the end-grain surface. The rule should touch the whole face at both ends—watch for a bump and make sure these surfaces have not been made concave by angling the chisel back. Next, make sure the ends are vertical by holding a try square up to the rule. Finally, check for twist in the cheeks by sighting into or through the mortise.

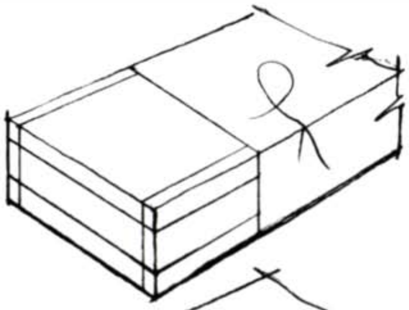
The joint should now be assembled and checked again, although a limited amount can be learned from a single practice joint. The real test is assembly of four joints into a rectangular frame, to which the following operational checks apply. First, hold a rule across the joint to see whether both mortise and tenon are in the correct plane. If they are not, subsequent gluing and cleaning up will be very difficult. See whether the shoulders pull up tight, that the shoulder lines are even and not offset, and that the whole assembly (or subassembly) is not in winding. Finally, see whether the two pieces (or all four in a frame) come together at a right angle.

Minor adjustments to correct any of these conditions can be made by careful paring with a wide bench chisel. There are pros and cons as to whether you adjust the mortise or the tenon, and it depends on the condition you are trying to put right, but in the main the tenon is easier to adjust. You can see more easily where the correct areas are from which to work, and where wood needs to be removed. The important

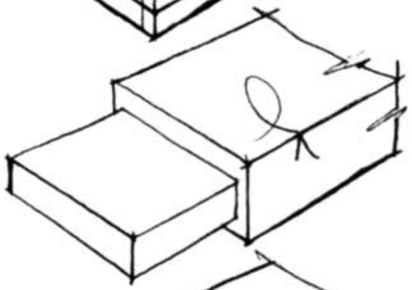


Place the workpiece on a bench hook and cut the shoulders with a tenon saw, leaving about $\frac{1}{16}$ in. for paring with a wide chisel or shoulder plane.

Checking the tenon

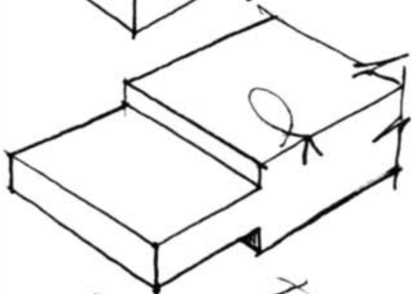


The tenon will look like this when it is marked out prior to cutting.



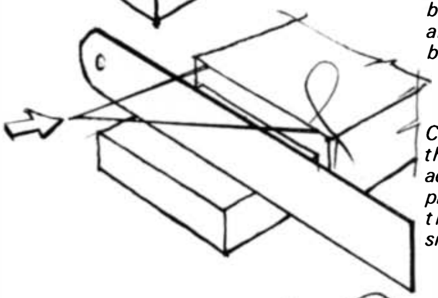
The tenon will look like this after it has been cut.

The shoulder will give a cleaner finish to the joint, hiding any tissue you may have bruised when chopping the mortise. It also eliminates the need for a too-tight fit in width, a problem when the joint is made bare-faced.

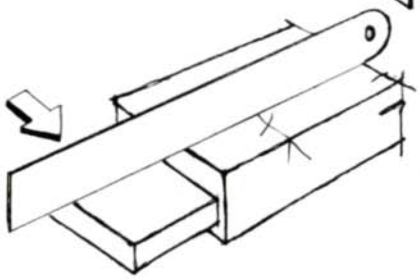


If the joint is very tight on entry, find the tight spots by examining its surfaces. The edge will often show signs of compression or have a glazed appearance, indicating that the mortise is too short or that its ends are not vertical.

The saw marks on the face will show how well it has been cut. Check with a rule and remove excess wood by horizontal paring.



Check the surface quality of the tenon by placing a rule across it. Check for twist by placing the rule parallel to the shoulder line and sighting over it.



Check accuracy of alignment by placing a rule on the face of the tenon wood and sighting the gap between it and the tenon.

Correcting new chisels

With an understanding of how the mortise chisel is used, it is easy to see that the tool's handle and blade ought to be in line, so it can be sighted vertically, and that the blade has to be exactly rectangular in section, so it can chop a square mortise. Many of these tools come from the factory out of line and out of square, inadequate for the task they are made to do. They can usually be put right, and it is crucially important to do so, but it may take several hours of corrective work.

If at all possible, buy mortising chisels in person, not by mail, and have an accurate try square with you. A 4-in. engineer's try square is most useful for this. Make sure that the back of the blade (opposite the sharpened bevel) is flat, then check that the handle is in line with the blade both in front view and side view.

An out-of-line chisel isn't useless, since you can compensate each time you sight up, but it is an added difficulty you could well do without. Repair it by removing the handle and fill the tang hole, then redrill it. This is not an easy task, and you may be better off making a whole new handle.

Now check the sides of the blade against the back. If the two sides and the back are not at right angles, the chisel will twist as it is driven, making the mortise wider than it should be, leaving a poor face on the cheek and inducing wander. No amount of compensating by gripping the handle tightly will stop this twisting. An out-of-square chisel is the result of sloppy manufacturing standards at the finishing stage. The only way to correct it is to grind the back face perfectly flat, and then to grind the two sides until they are at right angles to the back face. The front face is not as important, but it might as well be right as not since it will help in sharpening the edge square. A machine shop will be able to do the grinding for you, or you can do it on a coarse oilstone, or on a piece of carborundum cloth glued to the flat bed of a machine and lubricated with a little oil. Removing metal from the edges will make the chisel a little narrower than its nominal size. This is of little consequence. There is no good reason for the chisel to match any particular linear measurement, whereas it must be correct to angular measurement to perform.

thing is to analyze exactly where to remove fiber, and not to attack willy-nilly. The most controlled way to adjust a tenon is to put the work horizontally in the vise and pare horizontally across the grain. Do not pare in the direction of the grain, because the chisel will want to follow the long fibers and you are liable to remove far too much wood.

The crispness of the shoulder line is generally held to be the mark of success, but in a rectangular frame it is by no means the only thing. In particular, whether or not the frame actually is rectangular depends in part on the distance between shoulder lines. This makes adjustment of shoulders a very tricky process involving more than one joint that happens not to fit crisply. Check for squareness, not with a try square but by measuring the diagonals of the frame, which should be exactly the same.

In the glued-up frame, faults that arise from small inaccuracies within each joint manifest themselves dramatically as twist or wind or lack of flatness. For example, a tenon cut on the angle will result in a badly angled stile and probably a twisted frame. The frame should be checked by sighting across from one member to another to ensure that they are parallel. If they are not, the correction, once the frame is glued together, requires planing the whole thing flat, a considerable task. Paying attention to the checks made on the individual joints can prevent such problems.

Clamping — The work is best clamped together on an already flat surface. Clamping blocks should be used to protect the wood and to direct the pressure to the shoulder lines. The more important interface, however, is the effective gluing surface between the sides of the tenon and the cheeks of the mortise, and it is usual to use a *C*-clamp and a pair of blocks to apply some light pressure here. All the places that cannot be reached by the plane after glue-up should be cleaned and polished before glue-up. □

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

Portfolio: W. A. Keyser

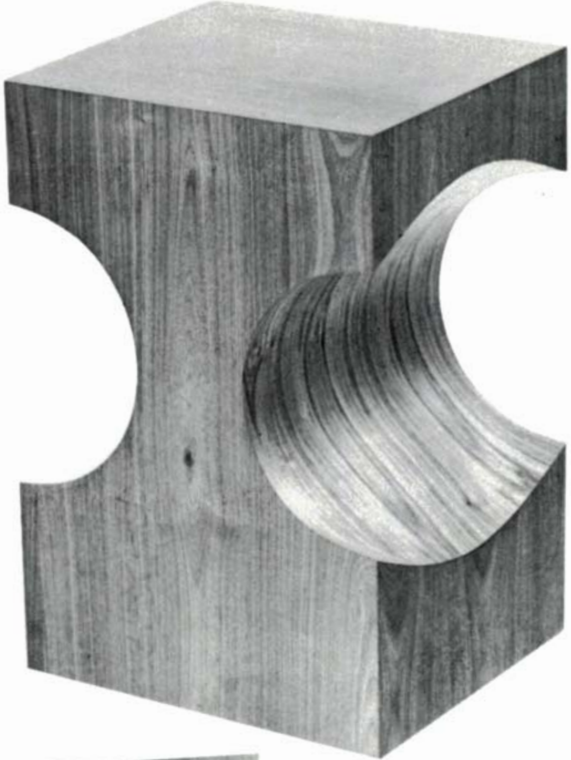
The challenge of churches

EDITOR'S NOTE: Bill Keyser, 42, is professor of woodworking and furniture design at the School for American Craftsmen, Rochester (N.Y.) Institute of Technology. Over the past 16 years, Keyser has become known for his experiments with construction techniques for achieving curved forms, notably steam-bending (*Fine Woodworking*, Fall '77, pp. 40-45), coopering, the lapstrake approach of the boat builder, and the plywood-skin-over-curved-ribs of the airplane wing. Besides furniture for homes and offices, Keyser has also designed and built furnishings for a number of contemporary churches of various denominations.

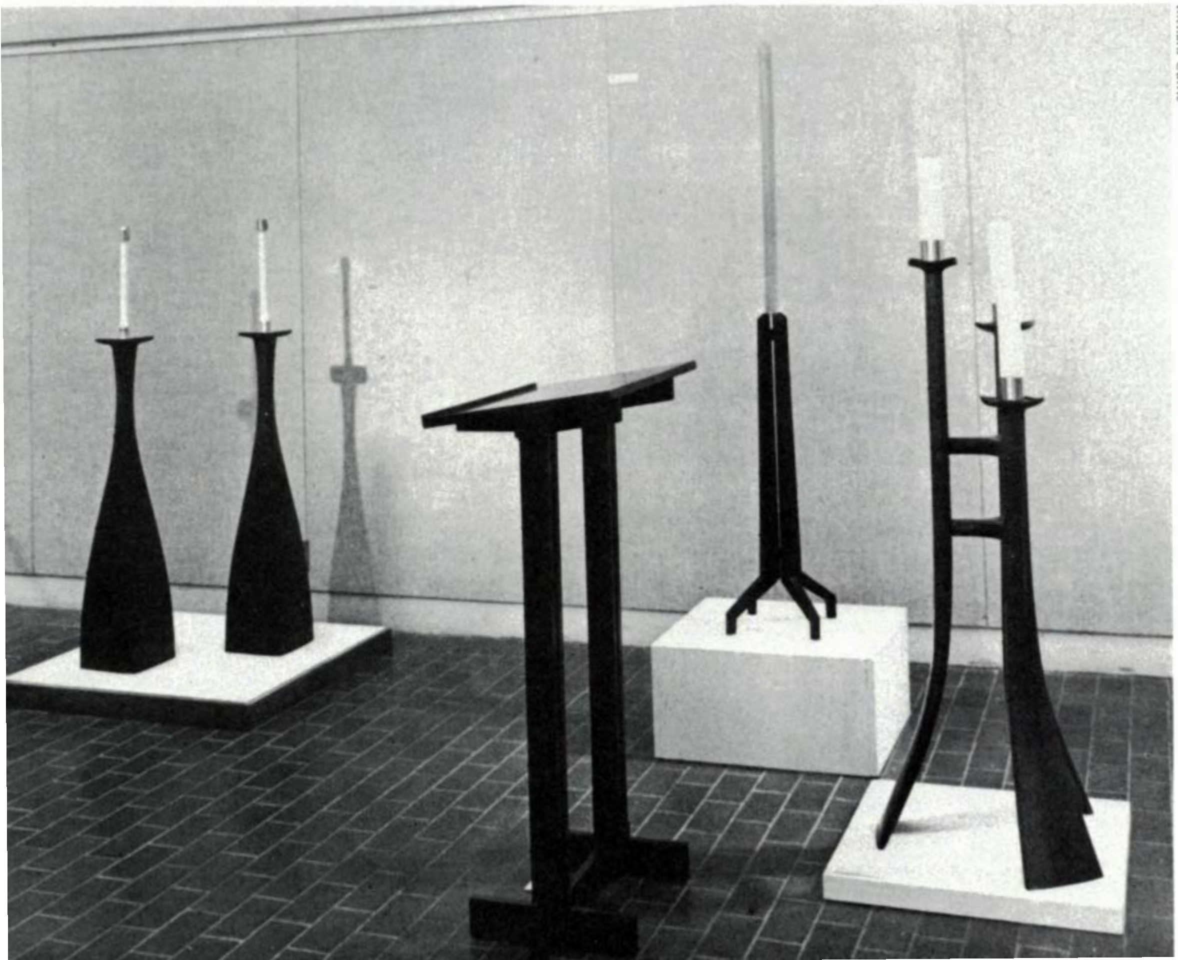
He explained that one of his first commissions was for a set of candlesticks for a seminary chapel. "The priest responsible for the commission has since recommended me to several of his fellow clergy. I've also been fortunate through the years to work with several architects who have regularly built or renovated churches. Somehow one job leads to another."

Last fall, RIT's Bevier Gallery organized a one-man retrospective exhibition of Keyser's work. The 85 pieces on display included portions of altar groupings lent by ten churches—a rare opportunity to see so much liturgical furniture in one place. We decided to emphasize the church work when selecting these photographs, and asked Keyser to concentrate on it in his remarks for the photo captions.

Photos, except where noted: R.B. Kushner, Richard Kautz, Jack Darginsky

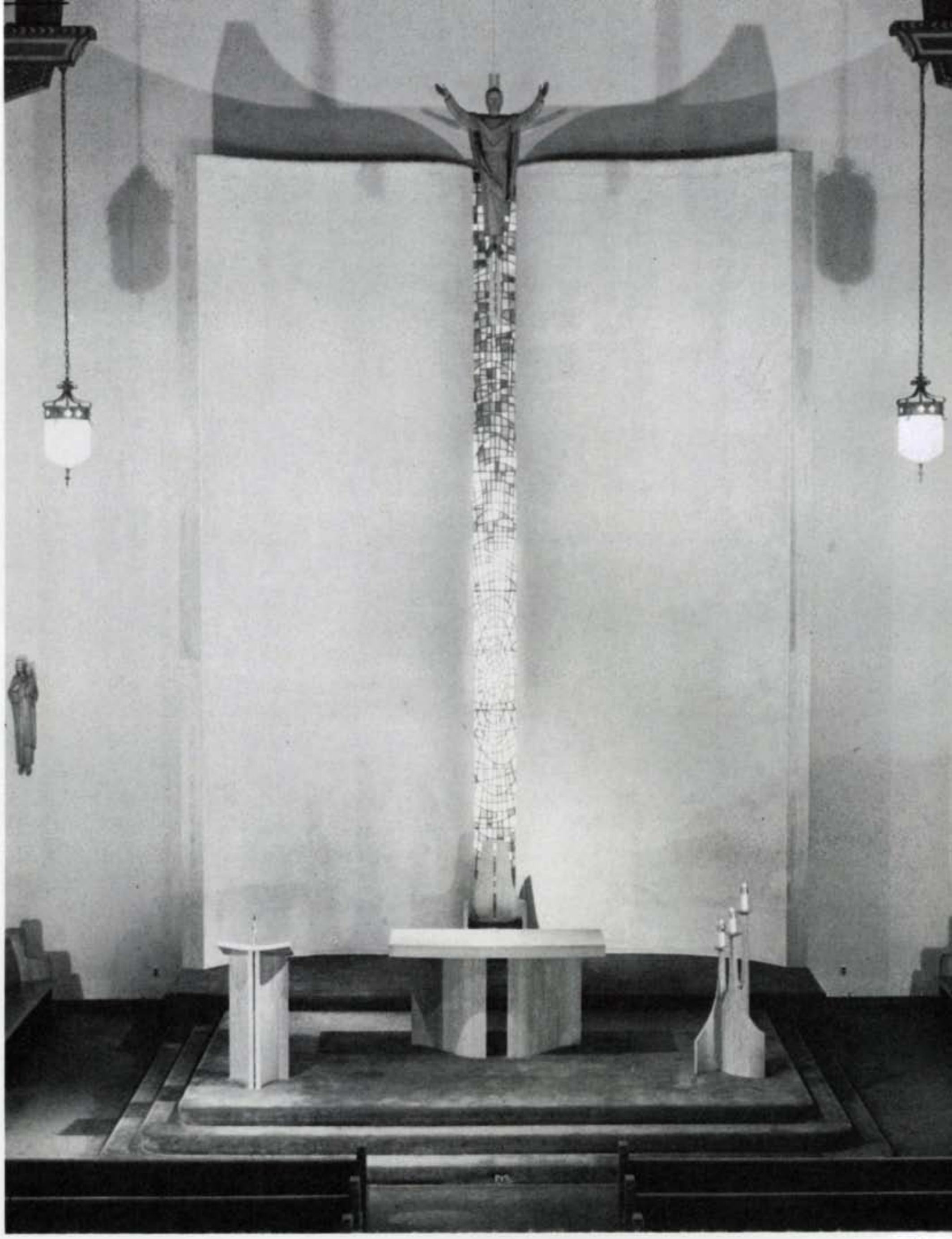


Above, credence table. A speculative, experimental piece, executed in 1966. The intent was to achieve a lightweight, hollow, yet monolithic form using fabrication techniques rather than stacking solid wood. The curved areas are three layers of 1/8-in. poplar plywood and 1/28-in. thick face veneer of tulipwood, formed over a male mold in a vacuum press. These bent planes were glued in the openings cut into a hollow particle-board box. Then the flat outside surfaces of the particle board were veneered with 1/28-in. walnut veneer. The lectern at left was made in 1967 for St. John's Lutheran Church, Victor, N.Y., of quartered white oak, using the same technique.



Richard Currie

Candlesticks and a rosewood registry stand from several churches.



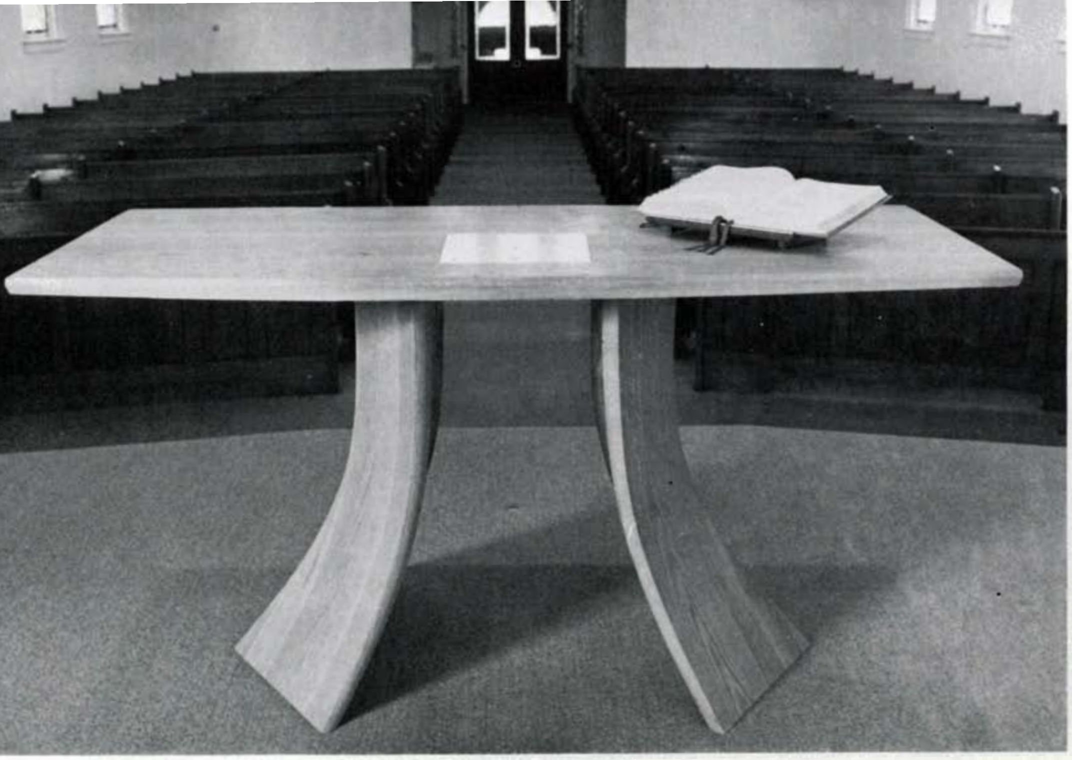
St. John the Evangelist, Rochester, N.Y., is an older Roman Catholic church that was undergoing renovation. The architect had designed the sanctuary, above, to feature a 22-ft. high white carpeted reredos (the large screen behind the altar) divided by a vertical slice of stained glass. In plan view the reredos curves forward from the stained glass window, runs parallel to the rear wall, and then bends forward again as if to envelop and present the raised sanctuary. The vertical stained glass window, the center line of the church and the main aisle define an axis, which I used along with the vertically extruded shape of the reredos as primary points of departure in designing the furniture. I looked upon the furnishings, all red oak and made in 1976-1977, as forms existing in the space created by the reredos and the raised sanctuary platform.

The altar, bottom left, is the pivotal piece, and its shape somewhat mirrors the curves of the reredos and encapsulates the space between it and the reredos. Within this space, in the alcove of the stained glass, the chair, top left, was fashioned. A risen Christ figure, left, was suspended away from the front of a cross whose arms echo the upward sweep of the arms of the figure. The cross, chair and altar each have a vertical slot of negative space to reinforce the central axis.

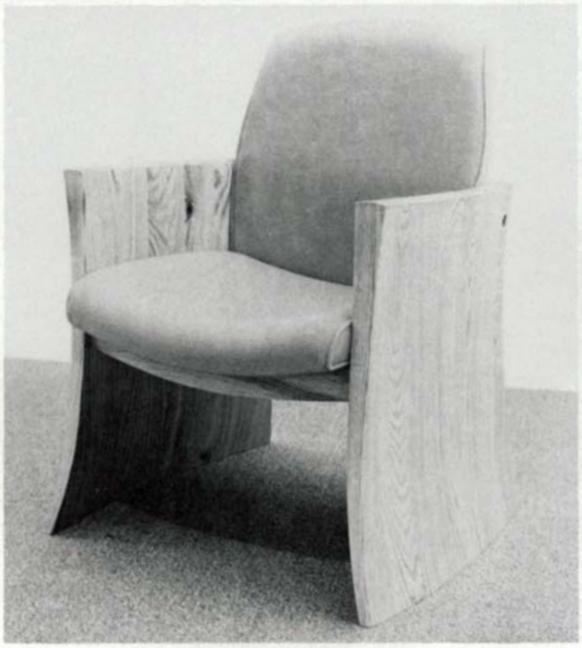
The lectern base (the Word) has a plan view that points outward toward the congregation (photo left, second from top). The three planes of the candlestick (the Light), shown above at right, spiral the eye upward and also symbolize the Trinity.

A 1-in.-to-1-ft. model of the sanctuary and reredos was built, and all designs were presented to the church committee in the form of models. In addition, many of the pieces were rendered in full-sized cardboard mock-ups to resolve scale uncertainties.

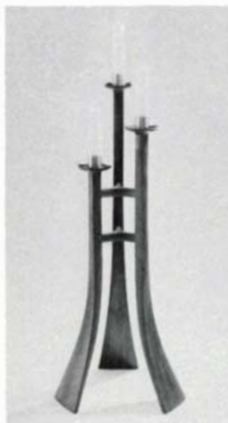
The curved planes of all the pieces were coopered, that is, constructed of narrow vertical strips of wood, angled and edge-glued together to approximate the curve. Cove-cutting on the table saw, special jigging for the router and hand-planing with curved-sole planes helped complete the forms.



Clockwise from above: Altar, baptismal, lectern and chair, 1974, red oak, from the Church of the Good Shepherd (Roman Catholic), Henrietta, N.Y. The lines of the chancel furnishings were derived from the form of the tabernacle, which swoops out from the rear sanctuary wall (not shown), and from the stylized tester ceiling over the sanctuary. The bases of the altar, baptismal and lectern are steam-bent pieces, edge-glued into bent planes, mitered at the corners and tenoned into the tops.



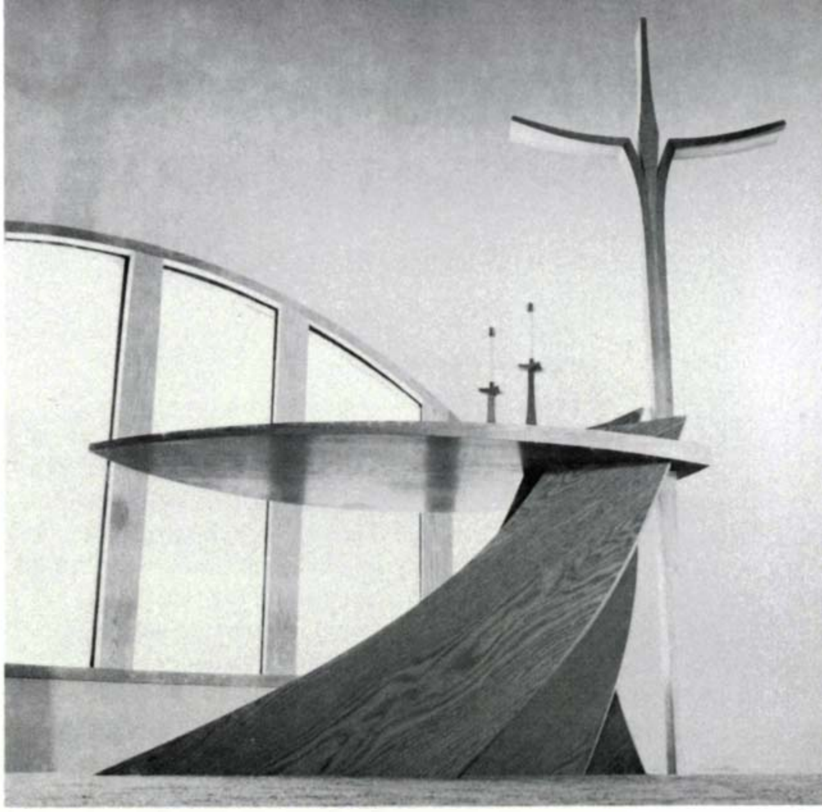
Lectern, altar, cross, credence table (left) and candlestick (right) for the Newman (Interdenominational) Community, State University of N.Y. at Geneseo. The first four pieces were designed and executed in 1969, the candlestick in 1978. This is typical of ecclesiastical work, where pieces must be coordinated and made as funds become available. Lacking any strong architectural statement to serve as a point of departure, the forms were generated from a desire to effect an uplifting feeling. The understructure of the altar, table and lectern are steam-bent, then tenoned into the tops.



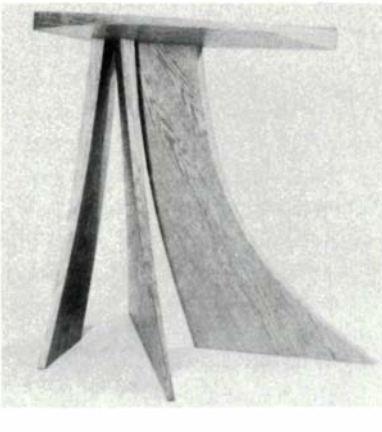
Donald L. Smith

The design parameters involved with ecclesiastical objects are very specific and challenging, and I find they frequently lead to formal solutions that I never would have created otherwise. The differing beliefs of the various faiths, the resulting liturgies and the ever-present opportunity for abstract symbolism continue to be an inspiration. I try to work within the architectural concept of the specific church, creating forms that present a unified statement with the structure. It's a little like stage-set design. The problem is a grouping of objects in space, which among themselves must have a hierarchy of importance or focus, and which must be meaningful but yet subservient to the liturgical drama choreographed around them. Working within these parameters dictates fresh solutions.

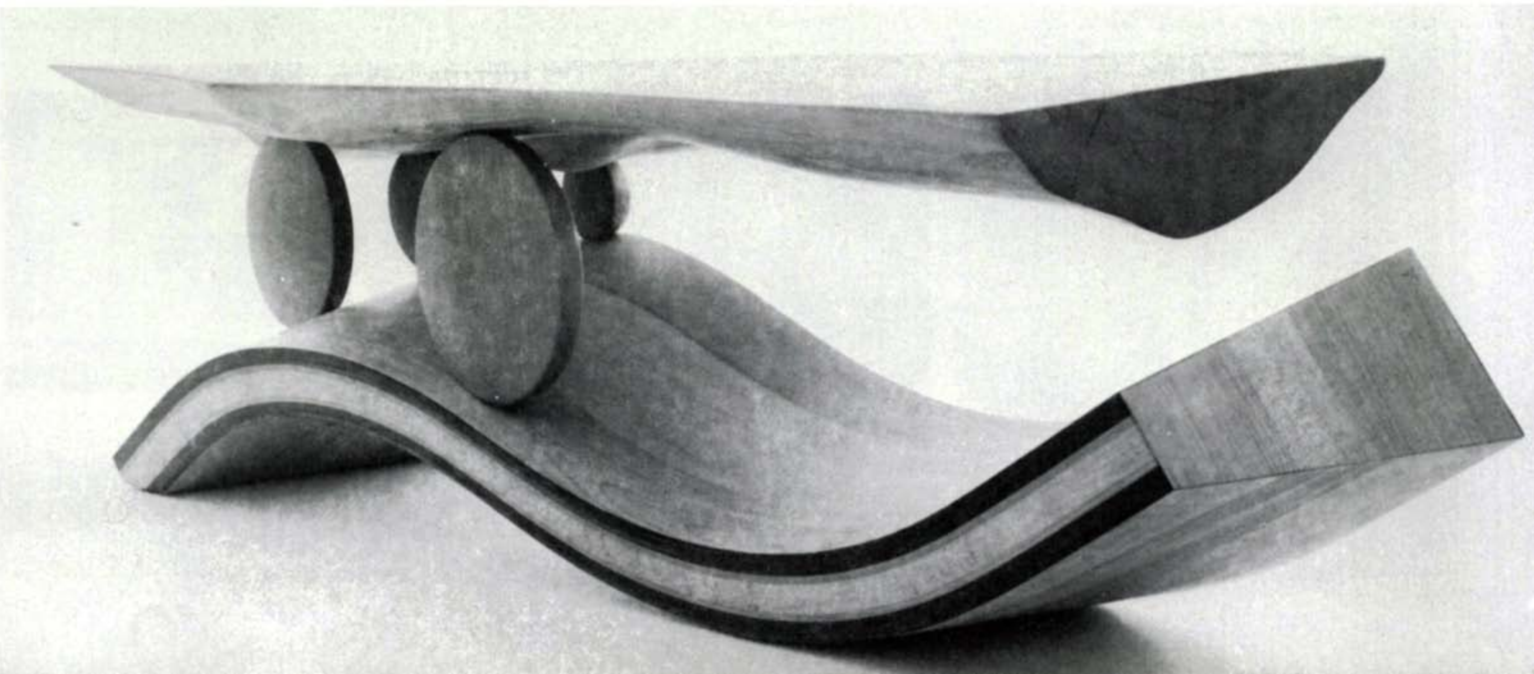
Ecclesiastical commissions almost always involve committees. I enjoy working with these groups, getting their views, designing the objects, and then doing whatever is necessary to communicate my ideas back to the group. But it takes care—the situation can easily get out of control. I'm often reminded of the old joke about the camel being a horse designed by a committee. —*W. A. K.*



Altar with cross, candlesticks and pulpit, red oak, 1977, for the Risen Christ Lutheran Church, Perinton, N.Y. The plan view of the altar top derives its shape from the semicircular plan of the sanctuary, which features a curved rear wall punctuated by a semicircular window. My fascination with Alexander Calder's stabiles prompted the concept of supporting a horizontal surface with vertical and/or angled planes, rather than legs or pedestals. The sweep of the altar understructure, as well as that of the pulpit, inset, culminates at the cross, upswept to suggest the departure of the risen Christ. A hollow-core construction (similar to residential door construction) used pine ribs between skins of 1/4-in. commercial red oak plywood, with 1/8-in. thick solid red oak edging glued around the perimeter of all the planes. This technique allowed me to build warp-free and lightweight planes, and it also accommodated internally the large bolts connecting the planes. □



Coffee table, below, 1978, of cherry, elm, maple and walnut. Although I usually work using drawings, models and/or mock-ups to predict the outcome of a piece before starting, occasionally I'll respond to cast-off or leftover raw material in a much more spontaneous way. This piece originated with a slab of an elm log and some serpentine stripes laminated of cherry, maple and walnut, left over from another piece. The slab was refined by allowing its natural shape to dictate the final form. The base was constructed hollow by using molded plywood veneered with maple for the top and bottom, placing ribs internally and veneering the serpentine stripes on the sides. In cross section, the base has a distinct slant, which empties the space between the base and top out to one side, and ultimately makes it a much more dynamic component. The base and slab were carried almost to final shape without my knowing how they would be connected. As a transition piece, I tried organically shaped carvings, various pedestal forms and cone-shaped elements to fill the converging void. While cutting cardboard discs to determine final sizes for these cones, I suddenly thought 'why not just bridge the gap with various-sized discs?' These discs had all the dynamics of the cones and also permitted a freer flow of negative space through the opening. The various-sized discs were composed within the most constricted portion of the Venturi-like space, which allowed one end of the slab top to cantilever out dramatically over the base. Bolts hidden within the discs connect top to base.



Router Tables

Build one you can't buy

by Wallace M. Kunkel

We have three completely equipped shops at our woodworking school, yet there's no spindle-shaper in any of them. We have so many ways of getting around its inflexibility that we've never succumbed to buying one. For a lot of operations a shaper can't do (and was never meant to do), we are addicted to 1-hp portable routers—hanging their motors under table surfaces of all kinds, on radial drill presses and radial saws, and in the usual over-arm devices. For heavier moldings, straight or irregular, as are required on bonnet-top highboys and tall-case clocks, we rely completely on shaping with a DeWalt radial arm saw of one size or another, using a Rockwell 3-knife molding head.

Router tables can go from the ridiculous to the sublime—the really ridiculous being ready-made of fabricated metal with a table about 12 in. square. The four types of tables you can build, described later, work miracles as straight-line shapers, as large-capacity dadoing machines, as splining machines, and as irregular shapers, especially for small parts, using a ball-bearing pilot. We've gone a step beyond these simpler tables, putting the router table into what we call the "sublime" category.

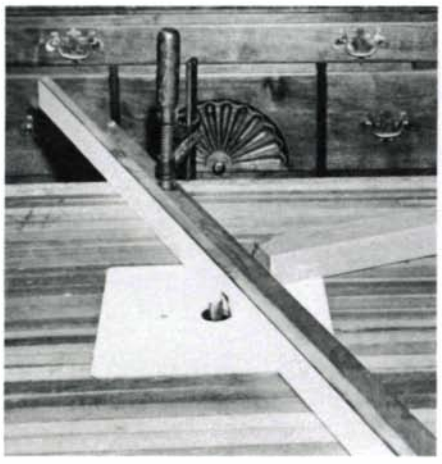
A few pointers about router features seem necessary before discussing tables. I've learned that the fewer gadgets, the more useful the router. The versatility of being able to use a router motor without its base is defeated by the switch-in-handle variety. The motor must be a self-contained unit—the base only as an accessory. When it comes to the motor and long life, I've found the old Stanley model #90008, with the dome top, to be the finest. It costs a little more, but the unit is Model-*T* simple and unbeatable. My next choice is the Rockwell #6300—probably the best buy for the money. However, we've been having trouble with their collets allowing bits to creep out—a very dangerous surprise.

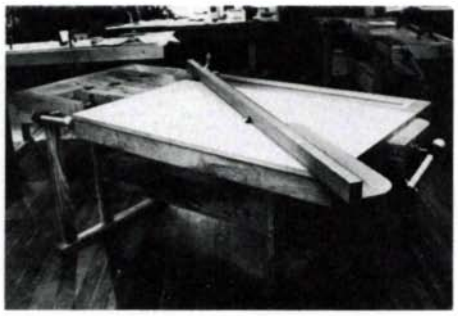
A simple and accurate router table can be made from a 3-ft. square piece of ½-in. thick phenolic (the same material used for router bases). The surface is flat as a die and with the router base (better yet, an extra router base) secured under the surface in the center (take off the disc that comes with it), this table is rigid. It can be clamped to a workbench and allowed to cantilever over the edge toward the operator, or quickly clamped to a pair of sawhorses. (When not in use, hang it on the wall.) For a fence, use a hardwood 2x2 with a jointed face, about 4 ft. long, and clamp it wherever you choose. For working over the bit, using partial profiles of bits, a 1¼-in. wide dado, ¾ in. deep, cut across the underside of the fence, will allow chips to pass through, not clog up around the bit. Recutting clogged chips will affect the quality of your cut.

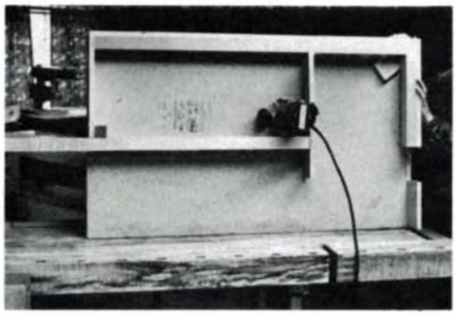
A piece of phenolic, which can be purchased from large plastics distributors, will cost $40 to $50, and it's worth it. However, a reasonable substitute can be made of high-density particle board (Novaply), laminated with ¼-in. tempered Masonite. It must be strengthened underneath with straight 1x2s, at least. Good dimensions for the table are 30 in. by 60 in., with the router base centered at the 40-in. mark nearest the operator. If you're using a Stanley router, a hole must be cut out of the particle board large enough for the router base to go through. The base is then suspended under the Masonite, which is the work surface. For a Rockwell router, bore a 1½ in. hole through both the particle board and the Masonite, and suspend the base under the particle board.

The wood fence should be straight and rigid, and works best if it is 6 ft. long, pivoted on a bolt at the far corner of the table and clamped in position at the short end. The size of the table and the sweep of the fence determine how many parallel dado cuts you'll be able to rout across panels. In every case, your fence will need to be of ample length, so it can be clamped to the table edge at any position.

In the category of simple router tables, the best of all is a router base secured to a 12-in. square of ¼-in. tempered Masonite, laminated with Formica. This square is then inlaid into any large, flat work surface in the shop. This is convenient







Best of simple router tables, left, is a square of Masonite inlaid into a large, flat work surface, under which a router motor is hung. Fence is clamped to edge of table and supported at the bit by scrap board. Chips escape through opening in fence. Center, router table clamps into the three vise openings of a Scandinavian-style workbench, and was the genesis of Kunkel's convenient, 'sublime' table, which clamps almost anywhere. Right, underside of table. Block in upper right-hand corner strengthens stud bolt on which fence pivots.

and economical. All adjustments are made above the bench, then the power cord is thrust ahead of the router as the square is put into place. The only time you have to reach under the table is to turn the motor on or off.

The category which we call "sublime" is our latest adaptation of these tables—and works like a charm. It all started with the Fall '76 issue of *Fine Woodworking*, which featured the Scandinavian-style workbench. We made four of them. The benches have two vises, and the end-vise on the right has two openings. In fitting the vises, we insisted that both openings in the right vise must securely clamp a piece of paper when the vise was closed. This raised a question, "When, if ever, would you use both openings at the same time?" Late one night, we realized that if all three vise openings were used at once, we could clamp a fine router table into a fine workbench without impairing the bench.

As our table design developed, certain requirements became obvious and the answers possible. We wanted a fence that could be adjusted and clamped without having to move bodily to the back side of the table. The answer: Secure ⅜-in. strips of maple along the inside top edges of the tool trough, which act as guides for a large maple block that carries the pivot point and clamping device to the desired position. The strips don't extend to the left end of the trough—for entry of the pivot block. This operation is controlled from the front of the fence. The pivot stud for the fence rides in a ½-in. slot, and is ⅜-in. machine bolt threaded up through an undersize hole. The exposed threads are covered by a ½-in. o.d. bushing made of copper pipe with a 1/16-in. wall. A *T*-shape in the slot is for adjusting the fence across the router bit.

The router table is 27 in. by 42 in. by 4 in. deep, with a surface of matte-finish Formica. The maple piece that extends into the front vise opening measures 1½ in. by 3¼ in. The router is centered 20 in. from the right end and 10½ in. from the front edge. This table has a 12-in. width capacity for dadoing, but a second router base can be positioned on the left side, giving a 36-in. width capacity. Shims must be used if the faces of the end vise don't contact the structural members under the table with the same pressure.

What we call the "sublime" in router tables is also our showpiece. We had created a fascinating, well-functioning device for use in our school, but it was designed for use with a workbench of unusual quality. None of our students, at that time, had one. The big question became, "Why can't we have all the features of this table—without the bench?" And, of course, the answer became very simple and very realistic: A rigid work-surface, with a pivoting fence. Big capacity. And a structure that could be clamped onto any work surface or onto saw-horses. Why not? The result is shown in working drawings on the following pages so that anybody can build it, clamp it almost anywhere, and hang it on the wall when not in use.

The fence has the *T*-slot, which allows fine adjustment across the router bit for profile cuts, parts of decorative profiles, and rabbet cuts within the capacity of a ¾-in. straight bit. Moving out of the *T*-slot and allowing the fence to move away from the bit, you will have dadoing capacity from 0 in. to 20 in. For accurate distance between dado cuts, measure with a steel rule from the bit to the fence, always at 90° to the fence. As the fence is moved farther and farther from the bit, it appears to be a set-up for dadoing triangles. Not so, it's an optical illusion. The purpose of moving the fence to measured positions is to make parallel cross-dado and plough cuts (for shelf ends, dust-separators, drawer bottoms, partitions, etc.). These cuts can be open or blind by completing or not completing the cut.

Tricks to be played with a router in a good table are without end, and we are constantly learning new ones. A vertical pivot guide, for example, has many uses, but most important is in the splining of boards that are not flat but are to be glued up into panels, tabletops, etc. (Most of our students purchase hardwoods pre-dressed to thickness, that were never jointed before going through the planer.) Ordinarily, with today's glues, we do not spline at all. However, splines can be used to force boards that are not flat to work against each other. This, of course, means that the spline cut must run parallel to the surface of the board, usually defining a gentle curve the length of the board. Sometimes the result is an elongated, flattened ogee curve. To make this cut with a dado head on any kind of saw or with a spindle-shaper would result in building in the natural distortion of the board. The cutter performs in a straight line. The line of the board goes its merry way.

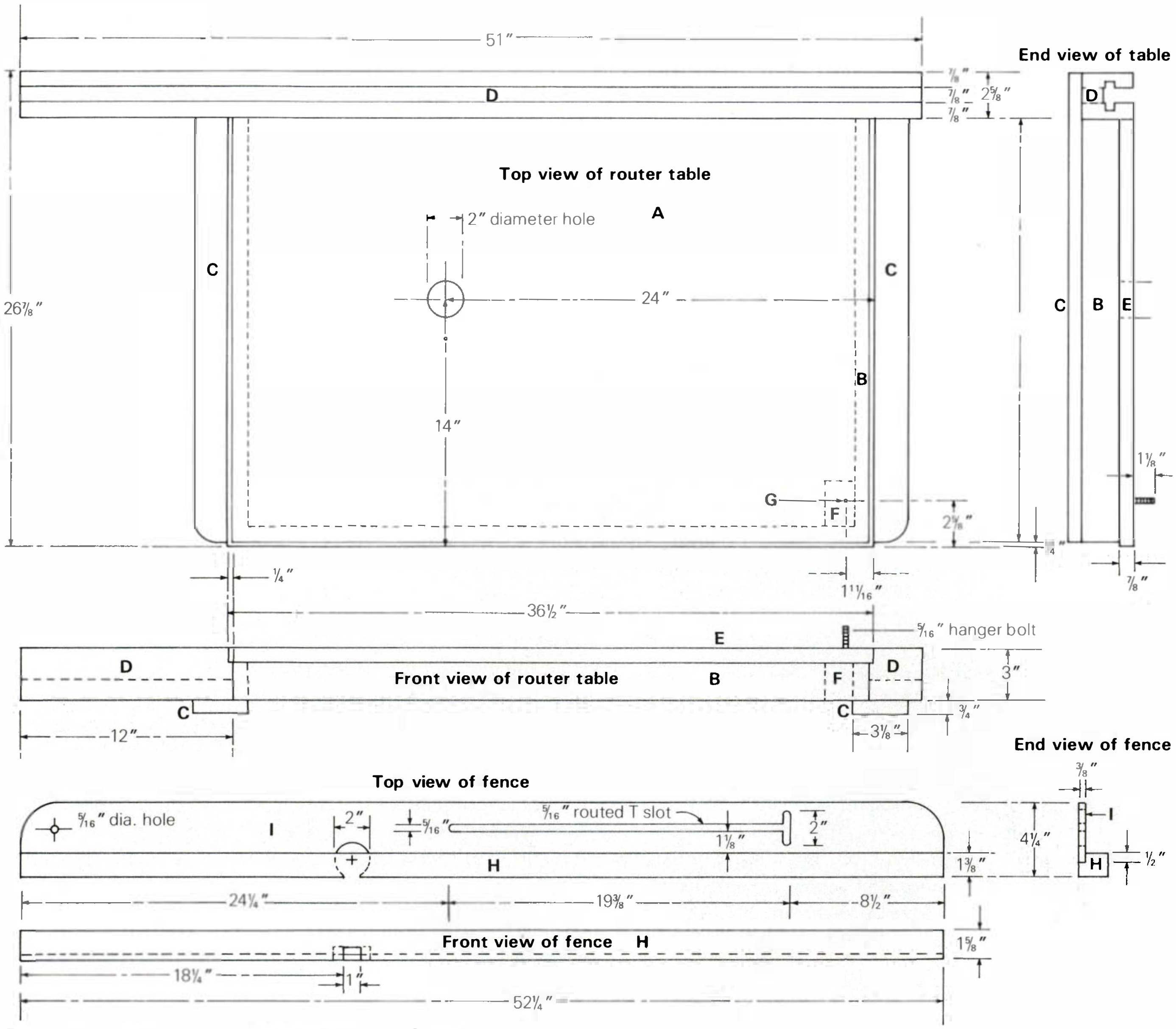
By placing the board on edge, against the blunt edge of the vertical guide, the cutter will follow the contour of the board. It is not necessary for the cutter to actually be centered (but near) in the edge of the board, as long as the top of the board (the surface that will be viewed) is placed toward and against the vertical guide. Thus, all spline cuts will match. In making the curve of one board work against another, it is ideal if the curves can oppose each other. This is not always possible—just ideal. By using a ¼-in. straight bit and splines made of exactly ¼-in. material (tempered Masonite or fir plywood), the result will be a perfectly flush surface when the boards are clamped together.

For this splining operation, a hold-in is a necessity. You must have accuracy and control at all times—whether you're moving forward to make the cut, or moving backward to clean out impacted chips. The hold-in need be nothing more complicated than another board, clamped securely to your table edge, pushing its "nose" against the board you are working. When using a fence that is secured at the ends only, it is very important that the fence be supported at the bit. Simply use a board with a squared end, move it to the back of the fence at the bit, and clamp the other end of the board to the table edge. It's not hard to distort even the most rigid fence with hand pressure while feeding material through the cut. After all, we are talking about accuracy (within a couple thousandths of an inch, if you wish), and we are talking about control, which is the basic advantage of the router table in every operation.

This is only the beginning of the story about the router table's many uses, and the many kinds of tables that can be devised. Actually, it's this simple: Whenever you buy a router, stay away from the switch-in-handle, and buy two bases. Hang the extra base under any flat surface (that will stay flat) and clamp a fence over that surface. Bore a hole for the bit to come up through, and go to work.

Or, you can hang that extra base under a very unusual router table that clamps into a most beautiful workbench—and live a little. *(turn page)*

Wallace M. Kunkel runs the Mr. Sawdust School of Professional Woodworking, Schooley's Mountain, N.J.



Portable router table—description of parts

A 24" x 36" x 3/4" particle board laminated with Formica

B 7/8" x 2 1/4" hardwood frame—3 pieces

C 3/4" x 3 1/8" x 26 1/2" hardwood cleat—2 pieces

D 7/8" x 3" x 51" hardwood—2 pieces 7/8" x 1 1/4" x 51"—1 piece/Trough

E 1/4" x 7/8" hardwood edge trim—3 pieces

F Hardwood corner block for solid support of hanger bolt

G 5/16" diameter hanger bolt for fence pivot—2 pieces

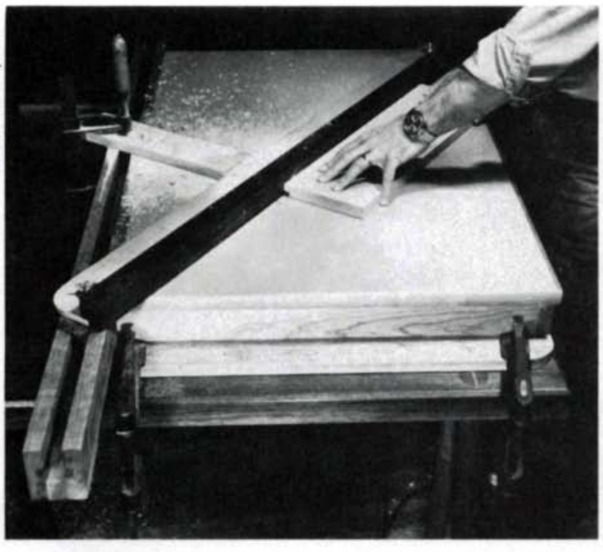
H 1 3/8" x 1 5/8" x 52 1/4" hardwood fence—1 piece—must be straight

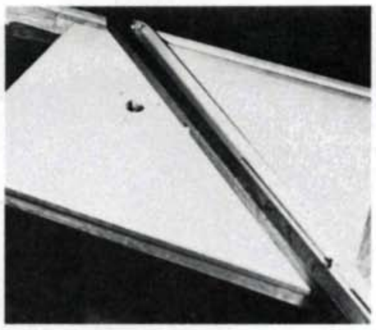
I 3/8" x 3 1/4" x 52 1/4" VC plywood fence base—hole and routed slot must work smoothly with 5/16" hanger bolt

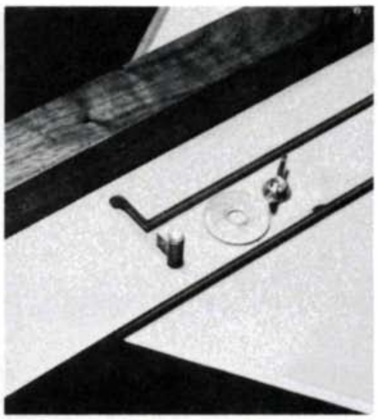
J 6" long slide block with 5/16" hanger bolt—fitted to slide smoothly in trough

K Wing nut and washer to fit 5/16" hanger bolt—2 of each

Photos: Geoffrey Kunkel

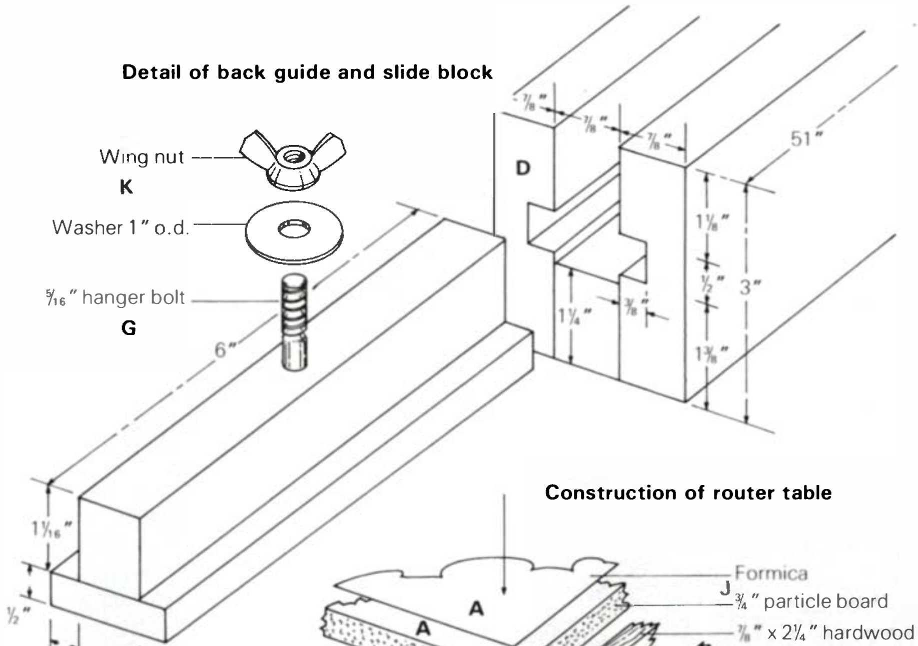




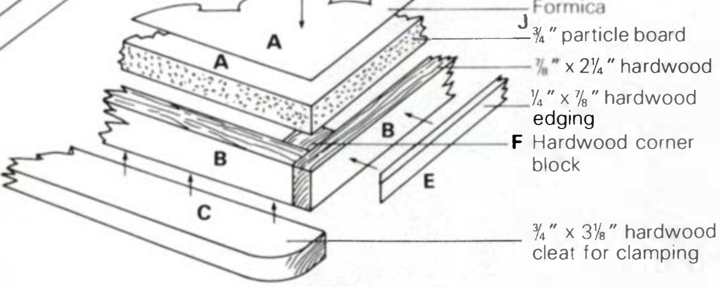


Kunkel's 'sublime' router table. T-slot (above) lets fence move toward or away from the bit, for fine adjustment of profile cuts, parts of decorative profiles or rabbet cuts (left).

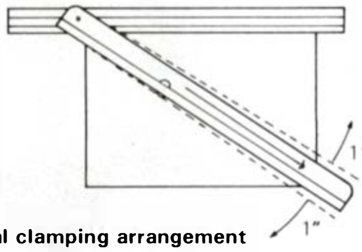
Detail of back guide and slide block



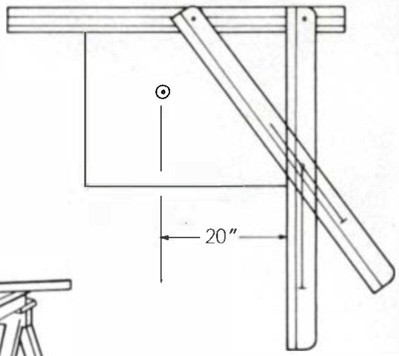
Construction of router table



Fence adjustment for rabbeting



Intermediate and maximum fence adjustment



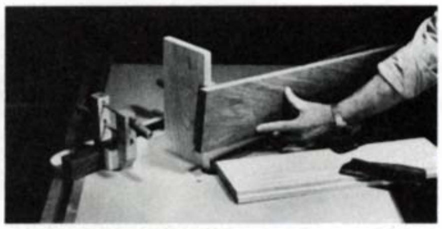
Typical clamping arrangement

Illustrations: Bruce Kunkel

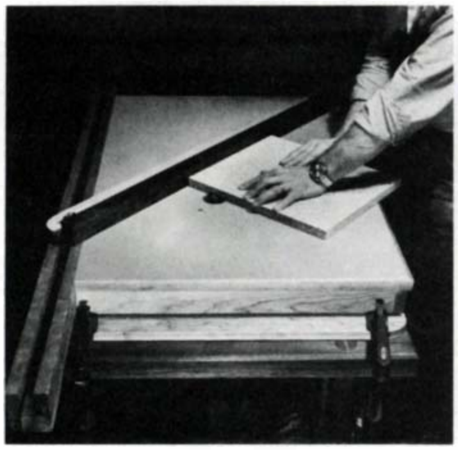
Construction Tips

1. Secure frame pieces (B) to underside of particle board (A) *before* laminating with Formica—to cover countersunk screws. Matte-finish, solid-color Formica is best.
2. Flush-trim Formica to (A) with router—all four sides.
3. **Back Guide Assembly:** Secure slotted piece (D) to back edge of (A)—flush with Formica surface. Then secure 1¼" spacer (D) as shown. Then secure remaining slotted piece (D). Stagger screws in each step, countersink and glue.
4. Apply trim pieces (E) with brads and glue.
5. **Clamping Cleats** (C) must be secured at contact points with screws and glue.
6. **Slide Block:** Make certain each piece (J) will slide easily in trough before securing together.
7. **Fence:** (H) must be accurately jointed and dressed. Use 2" Irwin Speedbor bit to bore hole through table (A) from top, and to drill router hole in fence from underside. (Smallest size bit: 1½".)

How to hang router: Remove phenolic disc from router base (leave it off). If your router base has projections that hold templet-guides (Stanley), you will have to rout out the underside of top (A)—½" deep and slightly larger than diameter of base—to give adequate up-and-down adjustment. If your router base is open (Rockwell, templet-guides are locked into phenolic disc), no rout-out is required. In either case, use phenolic disc for drill-jig. Center over 2" hole in table, drill *from top* through Formica and particleboard. Countersink for bolt heads *very carefully*, not too deep. (Suggestions: Buy an *extra* base. Leave it permanently in place. Avoid switch-in-handle routers.)



Top, vertical pivot guide keeps spline cuts parallel to the surface of boards that aren't flat. Flat surface of board should always be placed against the guide, so all the splines match. The hold-in clamped to the table edge pushes against the board being splined for accuracy and control. Above, the finished groove follows the bow of the board.

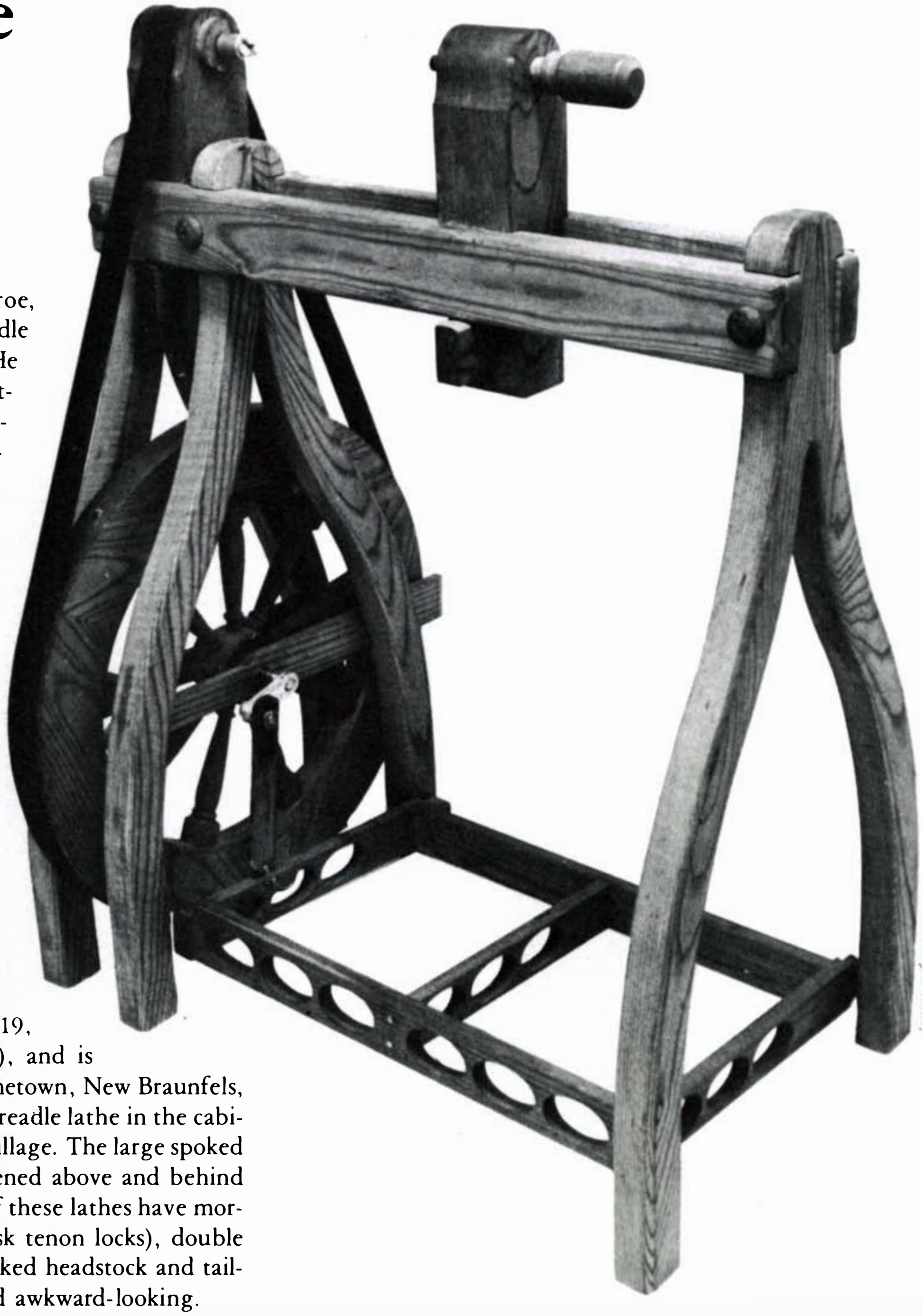


Dadoing capacity is from 0 in. to 20 in. when the fence is moved out of the T-slot and away from the bit. Pivot block rides between rails of back guide (at left of photos) and carries fence to desired position.

Treadle Lathe

Build your own

by Jim Richey



Photos: Jim Richey

When Chester Knight of Conroe, Tex., built his wooden treadle lathe, he had several goals in mind. He wanted it to be lightweight and portable, easily knocked down to its components. He wanted something pleasing to look at, clean and balanced with subtle curves. But most of all, he wanted a functional, mechanically sound tool capable of producing, on a smaller scale, the same high-quality turned goods as a modern power lathe.

The design is Knight's own, but he readily admits borrowing a few ideas from early treadle lathes. Heinrich Scholl's Texas-German treadle lathe, built in the 1870s, was especially influential. That 9-ft. monster has a heavy, solid wood flywheel that can be worked from the treadle or belted to a motor. The lathe is pictured in *Texas Furniture*, by Lonn Taylor and David B. Warren (University of Texas Press, Box 7819, University Sta., Austin, Tex. 78712), and is occasionally displayed in Scholl's hometown, New Braunfels, Tex. Knight also borrowed from the treadle lathe in the cabinet shop at Old Sturbridge (Mass.) Village. The large spoked flywheel on this reproduction is fastened above and behind the lathe bed. Like Knight's, both of these lathes have mortise and tenon construction (with tusk tenon locks), double beam bed and solid wood, wedge-locked headstock and tailstock, but both are more massive and awkward-looking.

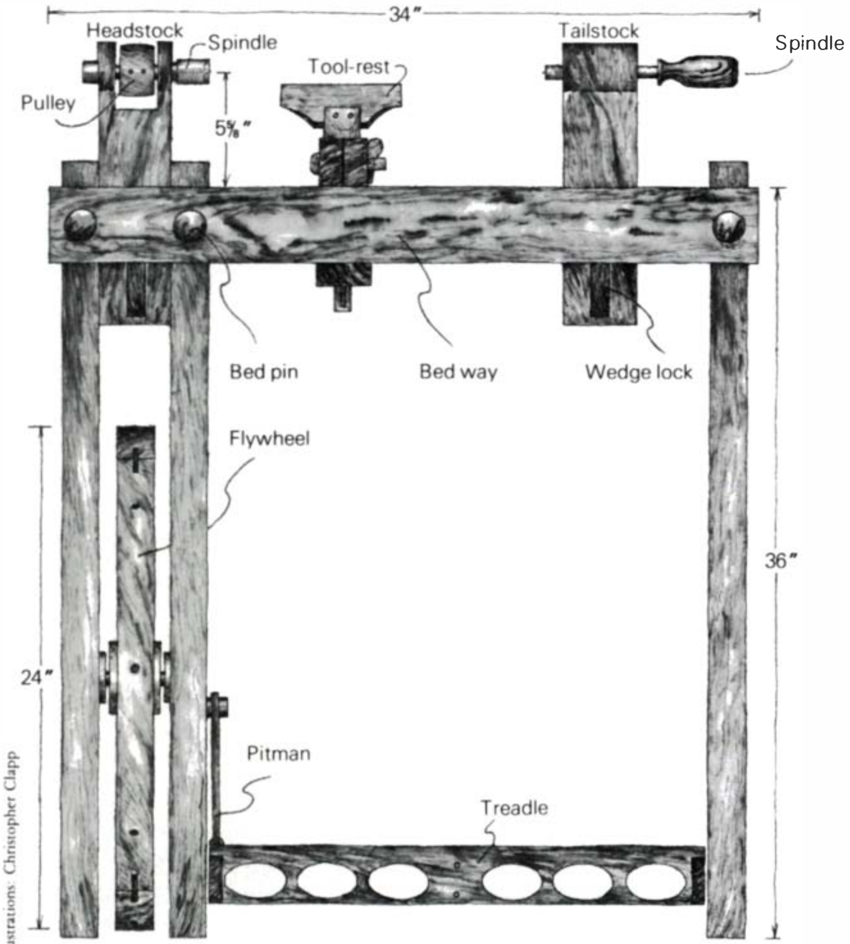
Except for a few templates and overall rough measurements, Knight didn't make or use plans. He explains, "I feel better about the end result—there's more a feeling of creativity and accomplishment." Knight roughs out the main dimensions of a project, and the remaining parts are "cut to fit." He urges other woodworkers to use this approach if they decide to make a treadle lathe—many non-critical measurements have been left off these drawings, in hopes that the woodworker will rely on his own sense of scale.

Knight used ash throughout the lathe. It's tough and springy, and has a flashy grain. It's also available in the 3½- in. squares necessary for the tailstock and headstock. Curiously, the bed ways are yellow pine. Knight wanted to experiment with the bed length, so he designed the leg notches to take a garden-variety 2x4 bed way. After he found the right length he just never substituted ash for the pine. For consistency and bed "spring" (a reputedly important attribute of wood-bed lathes) ash would be marginally better than yellow pine. But consider the flexibility of a 2x4 bed. A few bucks buys a new bed of virtually any length.

The only metal parts are the headstock and tailstock spindles and the flywheel shaft and crank. Knight owns a small metal lathe and he has 40 years of metalworking experience—all the metal parts (with the exception of the spur center he bought from Sears) were custom-machined. Each woodworker should choose metal parts on the basis of his preferences, projected uses of the lathe and access to metalworking machines. The choices range from simple solid shafts running in wood bearings to more advanced hollow shafts with Morse taper sockets running in bushings or ball bearings. You'll also need access to a wood lathe to turn the hub and spokes of the flywheel, and the spindle pulley.

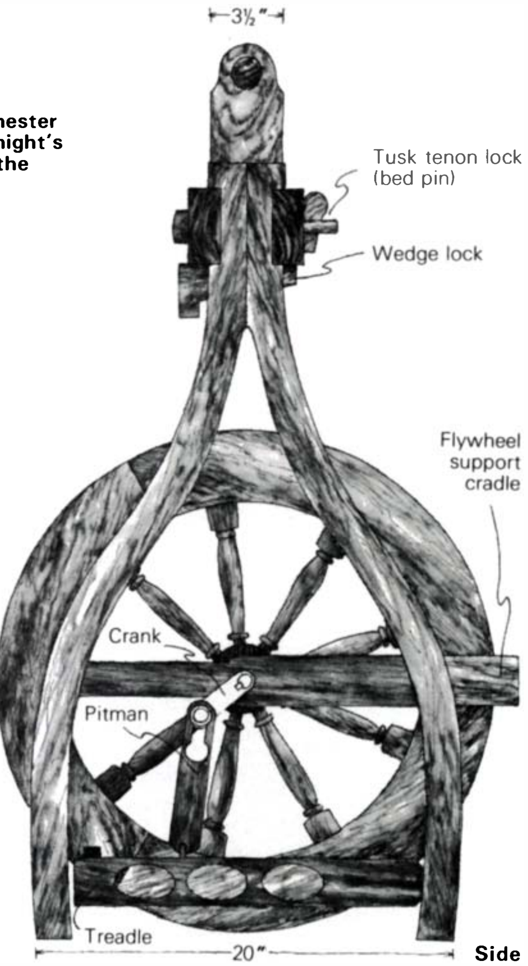
Frame — The first step in making a treadle lathe is building the frame—legs and bed. Start by bandsawing the legs

Chester Knight's lathe



Illustrations: Christopher Clapp

Front

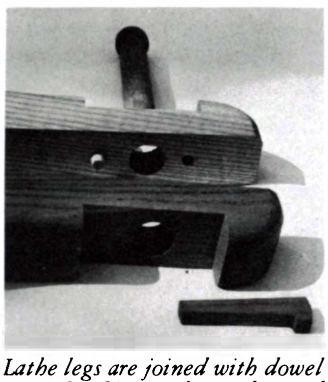


Side

from 1¾-in. thick by 8-in. wide ash planks. The wishbone profile causes a lot of waste, but most of it will be used later for flywheel spokes and smaller parts. Cut the notch in each leg a little small so that it can be trimmed to a snug fit with the ways. Leg pairs are not permanently joined to each other, but dowel pins are glued in one leg and mated to corresponding holes in the other leg to keep the leg halves from shifting.

After the leg pairs are ready, trim the notches to accept the bed ways. This operation is more important than it seems. The depth of the notches will determine the spread of the bed ways (2½ in.), which should be exact and consistent from head to tail. Also, any slop in the fit of the bed in the notches will translate to side-to-side racking later on.

With the bed ways installed in the notches, drill the 1-in. bed pin holes through both ways and the leg pairs. Position the outside legs about ½ in. from each bed end. Position the middle leg so that the gap between the two left legs will fit the headstock (3½ in.).



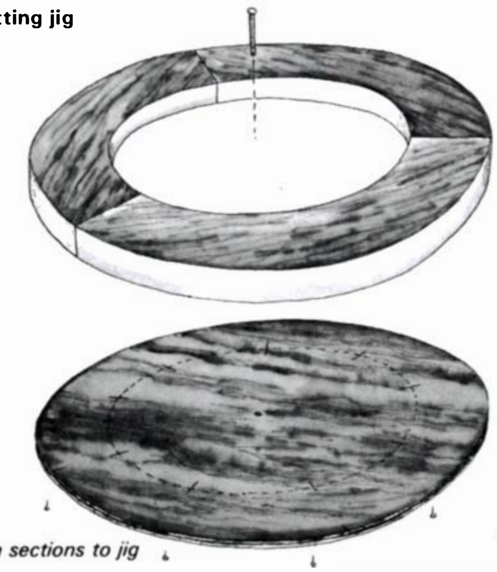
Lathe legs are joined with dowel pins glued in one leg and mated to the other. Bed pins, which hold the ways to the frame, are mortised on back ends. Tapered tusk tenons are wedged in for a tight fit.

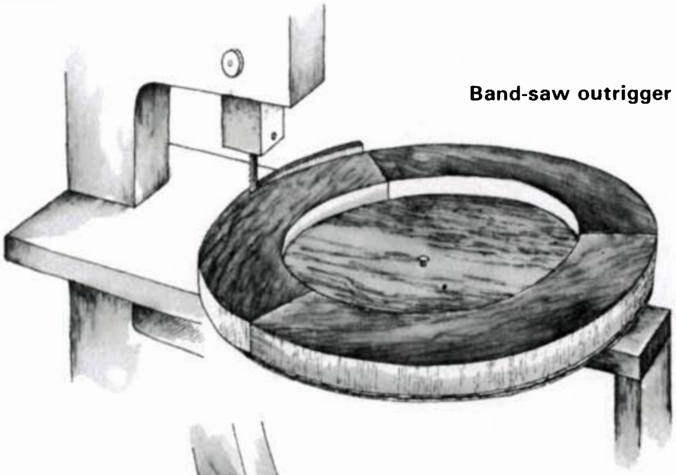
Turn the bed pins for a slip fit in the 1-in. pin holes. Leave a shoulder (or cap) on the front of each pin and about 1½ in. of extra length on the back. Mark and cut the ¼-in. tusk mortises on the back end of the three pins and fit a tapered tusk tenon (wedge) to each. With the pins home and the tusk tenons tapped tight, the frame should be solid and wobble-free.

Flywheel — The flywheel is the most challenging aspect of the lathe. The goal is to end up with a perfectly round, true-running wheel of sufficient size and weight to operate the lathe easily. Knight departed from tradition here in both design and construction. He used three rim sections (not the traditional four) and nine spokes (rather than an even number). He says "an odd number of spokes is more interesting, balanced and pleasing to the eye." He also used dowel joints, driven through the rim into the outboard end of each spoke, to fasten the spokes to the rim, replacing the usual dowel-tenoned spoke end. This allows the rim and the spoke-hub units to be glued up separately and fitted at final assembly.

The first step of flywheel construction is jointing and rough-cutting the three rim sections. For a 24-in. wheel you'll need three ash planks 1¾ in. by 8 in. by 24 in. Make and use a template of a rim section to get the angles right. Joint the three sections to a perfect fit where they meet, but leave the outside and inside curves about ½ in. wide. Knight recommends a simple jig (next page), basically a circle of plywood with a pivot hole at its center, for cutting both the outside and inside of the rim. Tack the three sections in place on the jig. The jig is center-pivoted on an extension to the band-saw table (band-saw outrigger). Then the jig with attached rim sections is rotated against the blade, cutting a perfect circle on the outside of the wheel.

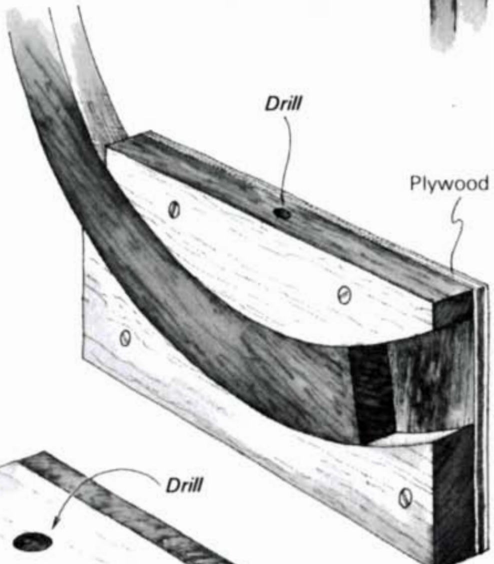
Before cutting the inside curve (which destroys the jig), Rim-cutting jig



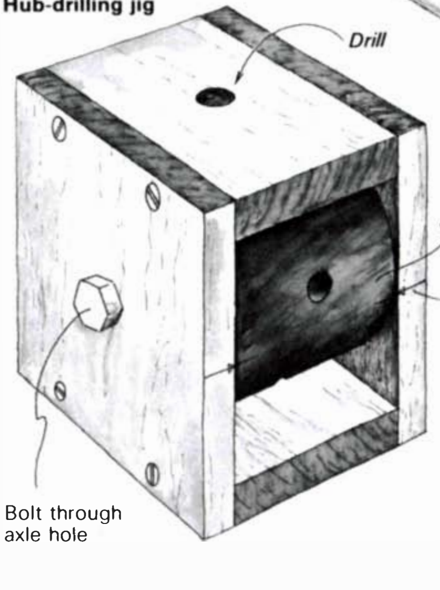


Band-saw outrigger

Rim-drilling jig



Hub-drilling jig



mark the nine spoke locations on the rim using a protractor for the 40° spacing. Cut the inside circumference by moving the pivot point toward the blade. Temporarily remove one rim section to enter the blade and rotate the jig against the blade as before. After that's done, remove the rim sections and drill ⅜-in. dowel holes where marked. It's a good idea to construct and use a drilling jig, as shown in the diagram, so that the holes are at the correct angle. Drill these holes all the way through the rim. To complete the rim, cut and fit splines at the joints of the three rim sections. Glue up the rim on a flat surface using a strap clamp to tighten the sections.

Hub and spokes — For the hub, select a good chunk of 3½-in. square ash about 4 in. long. Predrill the shaft hole before the hub is turned. Drive a dowel through the shaft hole, trim the dowel flush with the block, and pin the hub to the dowel at one end to prevent the hub from slipping. Mount the block on the lathe with the spindles dead center on the dowel, so the shaft hole is true with the hub. Turn the hub to a 3¼-in. diameter. Score the centerline of the hub for easier spoke-hole drilling later. Hub length depends on the spread of the legs and the thickness of wood to be used in the yet-to-be-constructed flywheel cradle: Knight's hub is 2¼ in. long. Turn the hub a little short in length so it won't rub the cradle. You can later add fiber or leather spacers to center the wheel in the cradle. Remember not to part the hub through to the shaft until all turning and sanding is completed.

Next, remove the hub, mark and drill the nine ½-in. spoke holes on the centerline. Again, make and use a drilling jig so the holes will be at the correct angle and the same depth. Turn the nine spokes using 1¼-in. ash. Allow a little extra length on the outboard end to be trimmed later. Knight left the last couple of inches of the outboard end of the spokes square. This puts more weight on the rim of the wheel and leaves more wood for the dowel joint. Drill the outboard end of each spoke to accept a ⅜-in. dowel.

Finish-sand the hub and spokes, then glue the spokes in the hub carefully, maintaining a flat plane perpendicular to the hub. After the glue is dry, trim the spoke ends with the same band-saw table outrigger setup used to cut the rim. Pivot the hub at its shaft and rotate the spokes into the blade, trimming each one to length. Be careful not to cut the spokes short. If everything goes right, the spokes should be trimmed to length with their ends rounded to match the inside curvature of the rim.

Before final assembly, finish-sand the rim, especially the inside circumference where the installed spokes will frustrate further sanding. The last step is to drive home a ⅜-in. dowel through the rim into each spoke end. Taper the dowel ends, cut a *V*-groove and apply glue to the dowel (not the hole). Trim the dowels flush with the rim. The result of all this careful cutting and drilling should be a round, true flywheel.

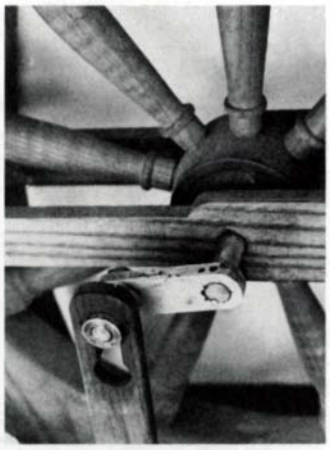
Knight successfully used a flat rim, but he suggests that a slightly crowned rim would help keep the drive belt centered. Crowning could be done on the outboard end of a power lathe or with a router setup.

Shaft, crank and flywheel — The next step is fitting a shaft to the flywheel. The flywheel exerts a lot of torque on the shaft, and it is important to lock the shaft and hub into a solid unit. Knight used a ⁹⁄₁₆ drill-rod shaft keyed to the hub. This approach is difficult to duplicate without metal-working equipment, but there are alternatives. The most direct is the approach used by early builders—a square shaft (with rounded ends) fitted to a snug, square hole in the hub. A wedge driven into the hub contacting a flat spot on the shaft is another alternative. Yet another approach, based on a flanged shaft, is described in the article on spinning wheels in *Fine Woodworking*, Summer '78. This article also describes an alternate approach to wheel construction that would work well with a treadle lathe.

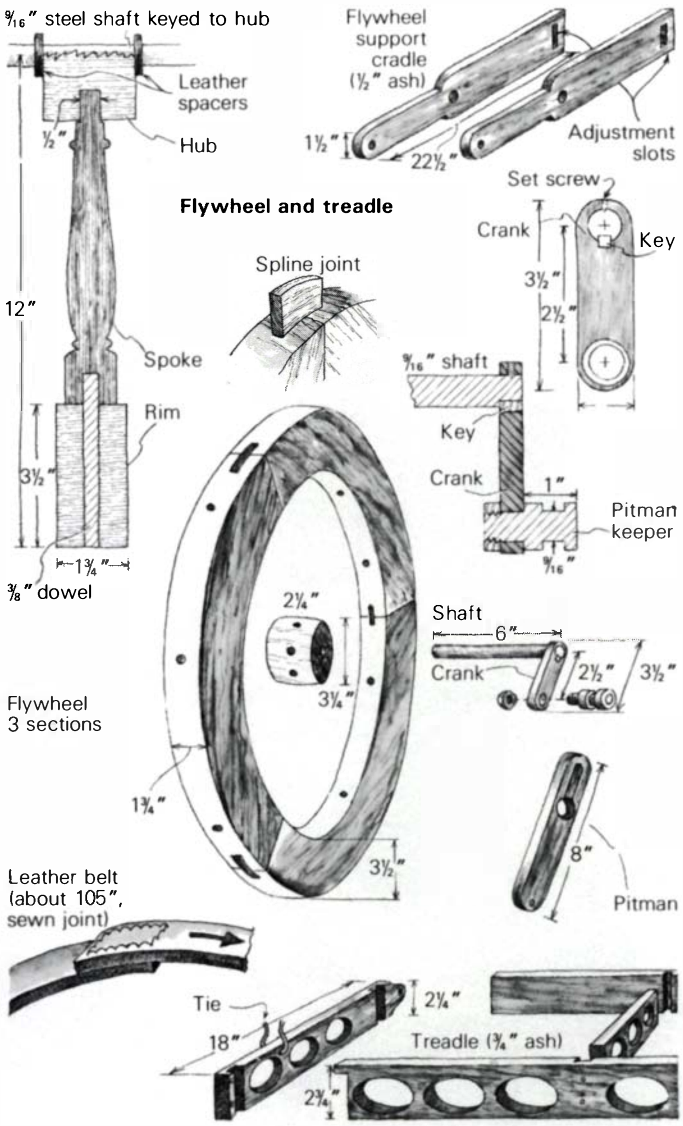
On the outboard side, the shaft should extend slightly more than the thickness of the support cradle. On the inboard side the shaft should extend beyond the cradle so the crank arm can be attached. If the crank is to be bent right from the shaft (as suggested by Knight) an extra 4 in. or 5 in. of shaft extension is needed.

Knight made a separate crank arm from aluminum, keyed it to the inboard shaft end and locked it in place with a set screw. As an alternate, he suggests bending the crank directly from the shaft material. This is direct, requires no metalworking tools and is as effective, if not as elegant. Knight's crank arm is about 2½ in. from the center of the shaft to the center of the pitman keeper.

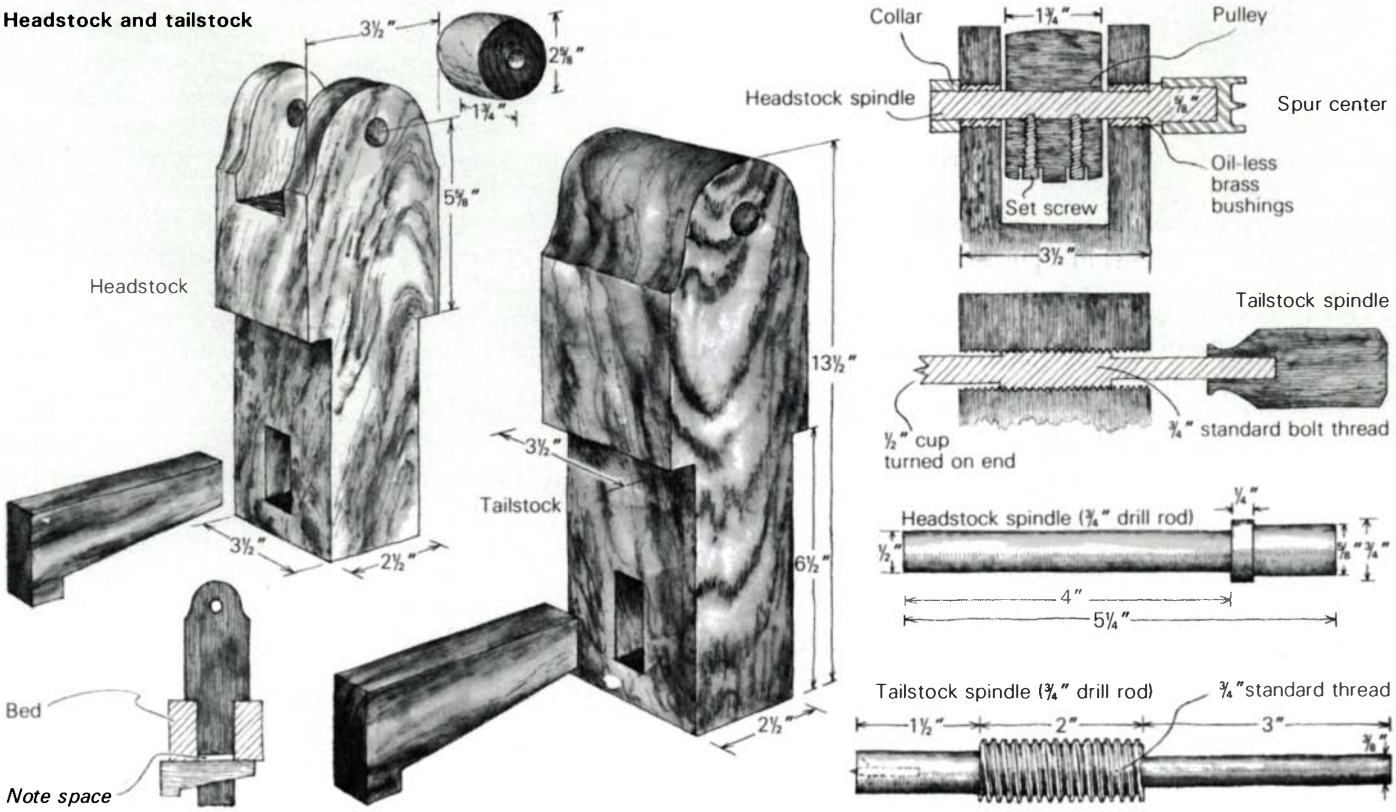
The wooden pitman transfers power from the treadle to the crank. The pitman is fitted to the crank by a keyhole slot and is tied to the treadle with a leather thong. You'll have to experiment a bit to find the right pitman length and tie point on the



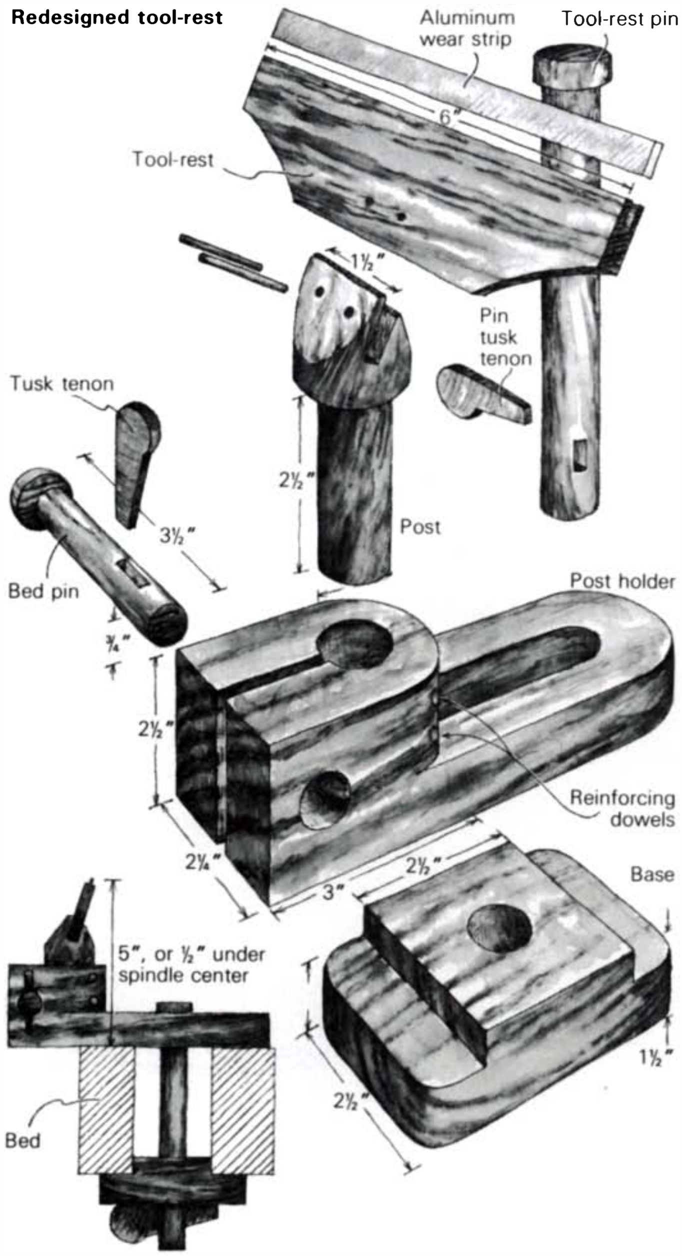
Shaft, crank and pitman assembly connect to hub through flywheel support cradle.



Headstock and tailstock



Redesigned tool-rest



treadle side—both of these can be varied to give the treadle different actions. As the tie point is moved to the back, the treadle throw increases. Knight used an 8-in. pitman tied about a third of the way back from the treadle's front edge. Combined with a 2½-in. crank, this gives about a 6-in. throw to the front of the treadle. To position the pitman, Knight turned and threaded an aluminum keeper that screws to the crank. The middle ⅜ in. of the button was turned to a smaller diameter. If a bent crank is used, machine or grind the pitman keeper groove near the shaft end before the crank is bent. Grinding could be done by rotating the shaft against a cut-off wheel mounted in a table saw. A simple jig should be constructed so the grind will be consistent.

Knight first tried a "floating" flywheel cradle pivoted on wooden pins at the front and left free at the rear. He found it difficult to get the necessary stiffness in the *U*-shaped cradle: His solution was to cut slots in the cradle arms where they cross the back legs. He installed screws through the slots into the legs to allow adjustment of the cradle sides for proper belt tension and flywheel axis alignment.

The treadle is simply a box frame pivoted on wooden pins set into the legs at the rear. The treadle should fit comfortably between the legs, with the front edge just inside the legs at the front. Knight used a template-guided router to cut elliptical holes in the treadle frame. Although the holes aren't necessary, they reduce weight and add a nice design touch.

Headstock and tailstock — The headstock and tailstock (diagram on previous page), or puppets (as they were called on early lathes), are bandsawn from solid 3½-in.square stock. The bottom of each is cut thinner (to 2½ in.) so that the lower parts fit snugly between the ways. Cut a tapered mortise in the bottom of each puppet so that a wedge can be driven in, locking the unit in position. The wedge should exert equal pressure on both front and back bed ways and should extend slightly at the back so it can be loosened easily.

Knight machined the headstock spindle from drill rod. Dimensions are given in the drawings. The inboard end was turned to ⅝ in. to accept an inexpensive spur center available through the Sears tool catalog. The original lathe used oil-less brass bushings for the spindle bearings. These were later replaced by small ball bearings let into the headstock and capped by wood. Knight feels the slight reduction in friction (because of the ball bearings) makes a difference.

Drill the headstock for the bushings or bearings and cut the notch on the headstock top for the spindle pulley. Select a turning block for the pulley and predrill the pulley shaft hole (as before in the wheel hub). Turn the pulley with a crowned rim profile. Install the shaft in the headstock through the pulley. Lock the pulley to the shaft with long hex-head set screws threaded through the pulley and mated with drill-point dimples in the shaft. To save set-up time at craft shows, Knight uses a threaded headstock spindle and predrilled turning blanks that screw right on the spindle, eliminating use of the tailstock.

Knight machined the tailstock spindle from drill rod. To adjust the spindle, he threaded the middle portion of the rod and tapped the wooden spindle hole with a standard metal tap. Metal taps don't cut particularly clean threads in wood but this seems to have worked well. Knight turned the cup center right on the inboard end of the spindle, but an inexpensive cup center is available from Sears. He fitted a wood handle to the other end. For those lacking access to a metal lathe, a large bolt or lag bolt could be effectively adapted for use as a tailstock spindle. The power drive is provided by a 1¾-in. wide leather (latigo) belt stitched together at its ends. The belt on Knight's lathe is about 105 in. long.

The tool-rest requires some nifty engineering. It must move from side to side on the bed, in and out, and ideally, up and down for different cutting angles. Knight's original tool-rest is excellent in most respects, but he is not satisfied because of two small design flaws: The rest is set vertically (it should have been canted slightly toward the work) and the height is not adjustable. The drawings show a slightly redesigned tool-rest that eliminates these drawbacks.

Knight used a router with a ⅜-in. rounding-over bit to shape the legs and outside bed way edges. Since the lathe is a throw-it-in-the-trunk tool, he kept the finish-sanding to a minimum. He used a synthetic oil finish (Minwax) with a light stain base to seal the wood and bring out the grain. □

Jim Richey, of Houston, Tex., is a correspondent for Fine Woodworking *magazine.*

Freewheel Lathe Drive

Bicycle parts convert muscle power

by Richard Starr

A foot-powered lathe must somehow convert the downward motion of the turner's foot to rotary motion of the workpiece. The crank and flywheel (page 60) have been used to do this at least since Leonardo's time. The problem with this system is that power transmission is not linear. The treadle turns the flywheel farther in midstroke than it does at the top and bottom of the stroke—as the treadle descends, it becomes easier, and then more difficult to push. Thus the system can accept a strong power impulse only in midstroke, while our legs can efficiently apply a heavy, constant push throughout the motion of the treadle.

A freewheel lathe drive can more efficiently harness muscle energy since it can use all the power we can supply during the treadle stroke. It can be built from bicycle parts and inexpensive hardware. Two lathes based on this drive system have been in use for several years in our shop at the Richmond Middle School, Hanover, N.H. (*Fine Woodworking*, Winter '77), and have proven to be sturdy and reliable in a very demanding situation. Freewheel lathe drive has other advantages over the crank and flywheel. The lathe starts in the right direction as soon as the treadle is pressed, with no need to nudge the flywheel into motion by hand. The turner is free to stop pumping without fear of being thrown over backwards by a treadle that keeps moving while the lathe coasts. It is easy to learn to use, because the turner needn't develop the rhythmic pumping skill required by the crank and flywheel. Most important, the freewheel lathe is simpler and easier to build than other continuously rotating foot-powered lathes.

The freewheel lathe is a direct descendant of the springpole lathe. On these ancient lathes, the treadle is attached by a rope or thong to a flexible pole or bow hung from the ceiling of the shop. The midsection of the rope is wrapped several times around the turning stock, which is set between dead centers on the lathe. As the treadle is pressed, the work spins toward the turner; when it is released, the bent pole tugs the treadle upwards, spinning the work backwards. Turning on such a lathe is a series of interrupted cuts.

The freewheel system substitutes a bicycle chain for the rope and a long spring for the pole or bow. The idea came from Berny Butcher, of Alstead, N.H., who converted a springpole lathe to continuous rotation by adding a ratchet mechanism. I replaced his clever homemade ratchet with an ordinary bicycle sprocket commonly known as a freewheel, mounted on a shaft. The chain runs on this sprocket. As the treadle is depressed, the chain rotates the sprocket and shaft toward the turner. But as the spring pulls the treadle and chain back to the starting point, the ratchet in the freewheel disengages, allowing the shaft to continue turning in the same direction. A flywheel on the shaft keeps the work moving between power strokes. The bicycle freewheel is a rugged, though inexpensive, piece of 20th-century machinery. I found I needed one with the smallest high gear available: 13 teeth. Five-speed clusters with this sprocket are available at good bike shops and can be equipped with low gears of 21, 24 or more teeth. The larger sprockets offer lower lathe speeds and a higher mechanical advantage, useful for large work and for powering a drill bit in the lathe.

Richard Starr, 35, is a frequent contributor to this magazine. He lives in Thetford Center, Vt.

Photos: Richard Starr

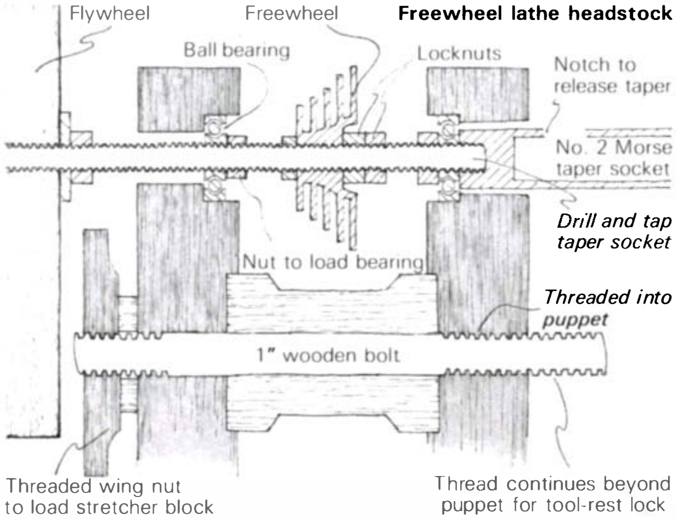
Seventh-grader Mike Kelly turns a bongo-board roller on freewheel lathe. The lathe, which is about 5 ft. long and can swing 12 in., is the second Starr has built. He says, 'The first was kind of crude, but it allowed me to work most of the bugs out of the drive mechanism. The newer one is solid and easy to use but not a thing of beauty. I consider it a prototype subject to modification and improvement. If I were to build a third lathe, I would retain the same basic structure but I would make it much heavier and more rigid than this one.'

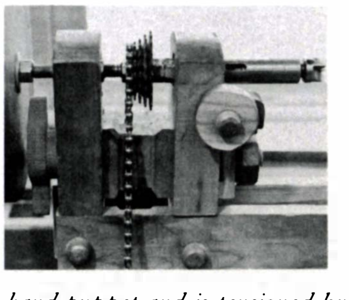
The freewheel is fixed to a ⅝-in. threaded shaft by locking a couple of nuts against it from either side. The shaft rides in ball bearings, which are set into wooden puppets and held in place by nuts pressing outwards against them. The threaded shaft is slightly undersized for standard ⅝-in. I.D. ball bearings and must be fitted with shims to make up the difference.

The speed of the lathe is affected by the size of the sprocket and by the point at which the chain is joined to the treadle. Mounting the chain farther from the treadle pivot magnifies the motion of the foot—the longer the extension, the faster the lathe will run for a given pumping speed. On our more recent lathe the chain is fixed 23 in. from the pivot, while the front edge of the footrest is 15 in. from the pivot. With the chain on the 13-tooth sprocket the lathe makes about 450 revolutions per minute at a relaxed pumping speed. It can be pushed to about 600 rpm by rapid treadling. Extremely low speeds are easy to maintain.

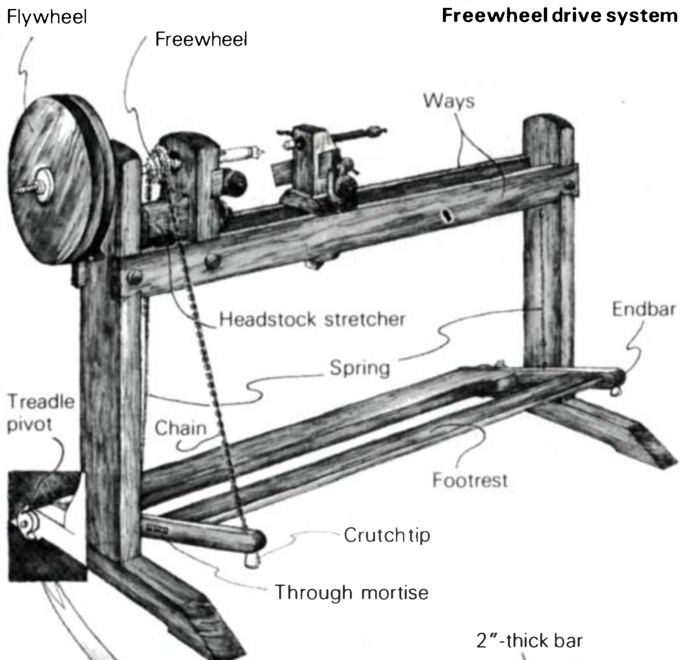
The treadle must be lightweight because part of the turner's effort is used to tension the spring for returning the treadle to its upper position. To keep lifted weight to a minimum, I used a ½-in. cherry plank for a footrest, mortised into

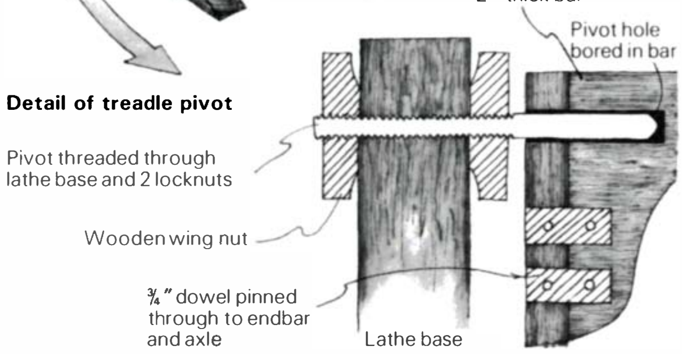
Illustrations: Christopher Clapp





Freewheel lathe headstock. The socket accepts standard No. 2 Morse taper centers and chucks. Below the spindle shaft is a stretcher that locks the headstock puppets tightly together. The stretcher is mortised into both puppets, which are pulled against it by a wooden bolt passing through the center of the stretcher. The bolt is threaded into the right-hand puppet and is tensioned by a wing nut located between the flywheel and the left-hand puppet. The compression on the stretcher resists the outward pressure of the loaded bearings on the puppets. The right end of the wooden bolt extends beyond the right-hand puppet and serves as a threaded stud for the tool-rest extension lock.





¾-in. endbars. The endbars are locked together by a heavy 2-in. square axle that adds no lifted weight because it is located along the axis of the pivot. The treadle is returned by the drive-system spring and by a second spring on the right end of the lathe. Without the helper spring, all the work of lifting the treadle would be transmitted through the drive chain, straining the lathe shaft and bearings and resulting in a sluggish return. My springs resemble those sold as screen-door closers but are limper. They are about 18 in. long and ¾ in. in diameter, from the local hardware store. The impact of the treadle hitting the floor is softened by mounting rubber crutch tips on wooden studs under the endbars.

Because the flywheel on a freewheel lathe runs at full spindle speed, it can be much smaller than one on a crank-and-flywheel lathe, but due to its speed it must be well balanced or the lathe will shake. I've found that wooden discs are seldom uniform in density and make poorly balanced flywheels. I solved the problem by cutting two discs from the same knot-free board and rotating them 180° to each other on the shaft, i.e., 12 o'clock to 6 o'clock. Discs cut from the same board tend to have similar distribution of density (if knot-free) and the opposed orientation cancels out most of the imbalance. The flywheel on our new lathe is 11 in. in diameter and almost 4 in. thick. Our older lathe runs with a 17-in. diameter wheel that is about 1½ in. thick and stores up more momentum. A much bigger flywheel, possibly a bicycle wheel, would not strain the mechanism and would make it easier to maintain high speeds and a longer coasting time. But I prefer lighter flywheels because they accumulate less power, making them safer for kids to use.

The headstock socket is made from a No. 2 Morse taper extension (available from hardware specialty houses), with the male end sawn off. The end is drilled and tapped to screw to the end of the shaft of the lathe. If the socket does not run true, the high point is marked and whacked with a wooden mallet until centered. Though the business end of the spur center in this socket extends more than 5 in. from its bearing, the structure is rigid and stays true.

I've used threaded wood fittings (*Fine Woodworking*, Spring '77 and Fall '77) to hold the lathe together and for all the tailstock and tool-rest adjustments. The tailstock quill is a hornbeam screw that has been drilled to accept a center made from a threaded rod. With the metal center removed, a hollow conical fixture can be screwed on for boring lamps and musical instruments. A ½-in. shell auger will pass through the bore of the quill.

The drawback of freewheel drive is that it's a little noisy. While the treadle is coming up the ball bearings in the freewheel clatter and the ratchet pawls click. I found that the noise was reduced considerably by packing the bearing races with axle grease.

One could think of other applications for this efficient footpowered drive system. It could be adapted to grinders, sanders, jigsaws and band saws. Woodworkers who prefer to rely on their own muscle power rather than on the electric company might put it to good use. □

AUTHOR'S NOTE: A "chain and freewheel" lathe was manufactured in Norfolk, England, in 1922 by Hobbies, Inc. There is a reference to their instruction book in *A Bibliography of the Art of Turning*, published by the Society of Ornamental Turners, 2 Parry Dr., Rustington, Littlehampton, Sussex, England BN16 2QY. It goes to show that good and simple ideas are seldom really new.

Milk Paint

Colonial finish is cheap, charming

by Jon W. Arno

In reading books on early American and Shaker furniture I occasionally run across references to a paint used in Colonial times that was made of milk. I first thought it must have been a foul-smelling, short-lived, inferior finish, but a few months ago I mixed up a batch for use on a not-too-precious pine knickknack and found that milk paint has many advantages. It can be made as transparent or opaque as desired, and it dries overnight. Brushes clean up in water, and a batch can be mixed up in minutes for less than $2.00 a quart, including the pigment. It does have a strong odor, but this can be buried under a sealer coat of shellac or varnish.

The problem with making milk paint is the lack of literature covering it in detail. In furniture-refinishing books it is referred to, in passing, as that stuff on the bottom that defies paint removers. In the Colonial history books it is described as a paint made out of milk or buttermilk and colored with berry juice, blood or pigments made of burnt clay. Further coverage deals only with the coloring agents, assuming that any amateur can mix the base. When anything remotely like a formula is offered, it is usually a list of ingredients, often without proportions or explanation of the chemistry.

So that you need not cover the same ground I have, here is what works best for me. Reconstitute instant nonfat dry milk, using just enough hot water to dissolve the milk into a thick, smooth syrup. Add the pigment in small increments and mix thoroughly. Vary the opacity and color by adding either more hot water or pigment, testing the mixture from time to time on a piece of scrap. Apply to raw wood with a brush or rag while the paint is still warm. When dry, it will have an almost dead flat finish much like latex wall paint, but with a certain translucence all its own. For an antique look, use full-strength milk paint and rub it with a damp cloth as it dries: The opacity of the paint in the corners and crevices will contrast with the lighter finish of the rubbed surface.

Some books suggest limestone or quicklime was used but don't say whether it was a pigment, a thickener or a drying agent. With lime the paint seems to be a little more resistant to moisture, but it becomes grainy and dries more opaque and muddy. Vivid colors are harder to achieve.

You could probably use fresh whole milk, boiling it to a paint-like consistency, but I have experimented with neither fresh milk nor the canned condensed variety. I have, however, experimented with a host of possible coloring agents. The pigments that produce colors like those seen in books and museums are the earth colors: burnt sienna, Venetian red and Indian red. The latter is best, but hard to find. Acrylic paints also work, and the choice of colors there is mind-boggling. I have even tried bloodmeal as a pigment, but it remained grainy and failed to go into solution. Prepared mustard produces a creamy yellow color, but the quantity needed for a vivid hue seems to affect the drying properties of the paint. Concentrated grape juice produces a blue-purple color depending upon how much water is added.

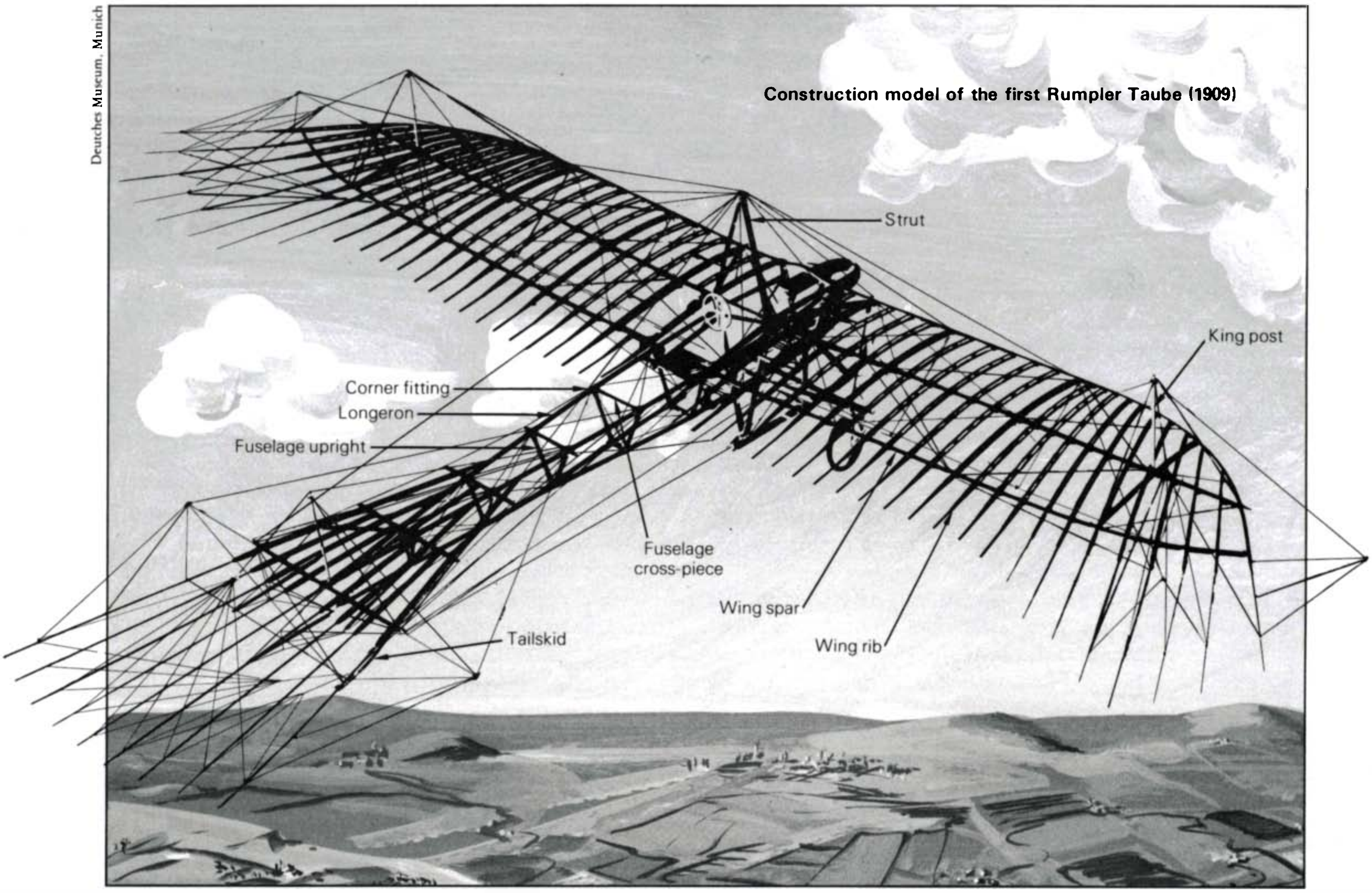
Only time will tell me of the resistance of milk paint to fading and its reaction to humidity. I have sealed the paint on the projects I have completed with shellac or varnish rubbed down to a satin finish. Orange shellac adds warmth and enhances the color of burnt sienna and Venetian red. ☐

Jon Arno, 37, of Wayzata, Minn., is a business consultant and amateur furniture-maker. He spends most of his spare time tinkering in his basement shop.

Photos: Richard Levine

Full-strength milk paint on pine stool hides most grain features.

Dilute milk paint on pine recipe chest is almost translucent.



Deutches Museum, Munich

Flying Woodwork

Light, strong wood got first aviators aloft

by Leonard E. Opdycke

Icarus, the first flyer on record, built his machine from wax and feathers—a disastrous construction. Since his attempt, builders of flying machines have relied on stronger stuff. The materials may vary, but all airplanes have certain features in common. All have wings, commonly one (monoplane), two (biplane) or three (triplane). Almost no biplanes and triplanes are being built today, except as reproductions. Most airplanes have one to three hulls, called fuselages, although no multifuselage design is currently being built. Only the so-called "flying wings" have no fuselages, and none of these are being built today. All except the flying wings have some sort of tail surface, commonly a fixed horizontal surface or stabilizer, combined with one or two moving horizontal surfaces or elevators, and a fixed vertical surface, or fin, combined with a moving vertical surface, or rudder. Landing gear is also common to all planes, consisting of some combination of wheels, or wheels and skids. The airframe has to be braced internally and externally against stresses in all directions. In general, the airplane is suspended from its wings and dragged by its propeller. As a result, all parts must be braced against the direction of the drag.

Initially, bamboo and wood were used for airframes, with steel or aluminum fittings at the connections. Bamboo could serve as spars or struts only, so it was accompanied from the beginning by wood planks, beams or sheets. Bamboo worked fairly well for small spars if it was braced with struts and wire. The joints in the cane were weak, and were often bound with tape and glue; sometimes the partitions were reamed out and wood dowels inserted to stiffen the cane. Metal fittings had to be used for joining bamboo to wood struts or to other bamboo, and for anchoring the wire bracing; these fittings were often cast aluminum. Struts, usually upright in the airstream,

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Leonard Opdycke is editor of the journal World War I Aeroplanes *(15 Crescent Rd., Poughkeepsie, N.Y. 12601). He is currently building a reproduction of a 1914 Bristol Scout.*

were soon made of wood, usually spruce, instead of bamboo, because the wood could be carved to a streamlined shape. After a while the spars, growing thicker and requiring more complex sections, were also made of wood.

By 1912 or so, aircraft structure had pretty much stabilized, although even then there were experiments in all-steel and plywood monocoque structures. But the average airframe used wood primarily in compression, in rectangular bays diagonally braced with piano wire or cable, sometimes with tie-rods. The corner fittings were made of stamped steel plates, and the whole bay was tightened with turnbuckles. Wings were made with two main spars divided in the horizontal plane into the same cross-braced rectangular bays and separated in the two vertical planes with pairs of struts and more diagonal cross-bracing. The whole airframe, then, was a series of more-or-less parallel wooden girders (spars and longerons—the main fuselage beams) separated by wooden cross-members in compression (fuselage uprights and cross-pieces, wing struts and ribs), the whole thing held in compression with miles of wire and wire-tighteners and dozens of steel fittings everywhere. Monoplanes with thin wing sections required one or more king posts both above and below for the many anchoring wires and, sometimes, the wing-warping wires as well. Only when the wings became thick enough to allow internal vertical diagonal bracing did the outside wires finally disappear.

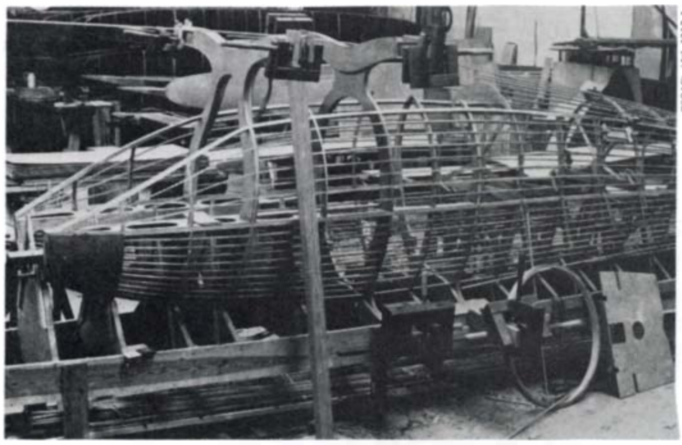
Early efforts attempted to lighten the wood in the airframe in several ways. The first was to vary the type of wood used, depending on stress and location. A frequent solution was to use ash for the forward longerons on the fuselage where the engine would be mounted on steel plates or bulkheads, where the weight was generally needed to overcome tail-heaviness, and where the landing gear and wing attachments were located, along with their bracing wire attachments. Both the longerons and cross-pieces in the rear were spruce. Ash was also used for packing-blocks and small beams requiring special strength, like the tailskid or the seat mountings.

Tapering spars and longerons where possible was another method used to lighten wood in small airplanes. The longerons began in front at about 1$\frac{3}{16}$ in. square and tapered to only $\frac{3}{4}$ in. square at the tail. Since the uprights were all in compression, simple stress analysis showed that the point of greatest strain was in the middle, so the uprights could frequently be tapered down at each end where they fitted into the corner-plates.

Another method was to rout out the faces or sometimes the corners of the wood spars or struts. Such routing became sculpturesque, leaving rectangular or flat sections for the attachment of fittings, and scooping deep into the faces of spars or longerons. As the routing became more elaborate and the wood pieces became larger, it was easier to build up special sections through lamination or other forms of assembly. Toward the end of World War I it became increasingly common to combine lamination and special fabrication processes with bending and molding, especially of plywood, resulting in some handsome streamlined outer forms. One of the continuing problems with this process was the inadequacy, or rather the irregularity, of the gluing. Hide glues were generally used, and they were not dependably water-resistant. There are, however, reports of glued joints being as solid today as they were in 1918.

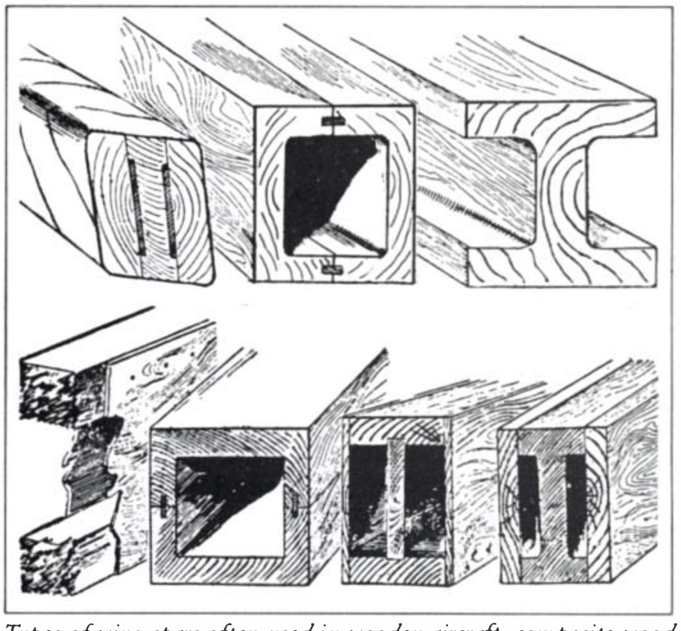
The last generally used lightening method was to cut out holes where design analysis allowed, usually in steel fittings and sections of plywood, the latter appearing in wing ribs and fuselage bulkheads. The cutouts in the steel engine-mounting plates could be reinforced with flanges either pressed out or welded on, and the webbed ribs were strengthened with varying forms of spruce capstripping.

Attempts to strengthen this standard wire-braced structure with panels of plywood nailed and glued across the fuselage bays were unsuccessful, because the wood and the metal expanded and contracted unevenly, and such multimedia frames could pull themselves apart. Airframe design then went in several directions. The first was a combination of welded or bolted steel tube, usually in the front of the fuselage, bolted to a standard wood and wire rear end. The second was the development of modern all-steel welded tube structures. The third was an all-wood frame, often in the form of a Warren truss with diagonal wood struts for bracing. The corners were held together with plywood gussets that were nailed and glued on. Sometimes the wood frame was covered with planking. Fuselages could be planked with thin strips riveted together like a clinker-built boat, or with long tapered strips edge-butted and screwed and glued to the



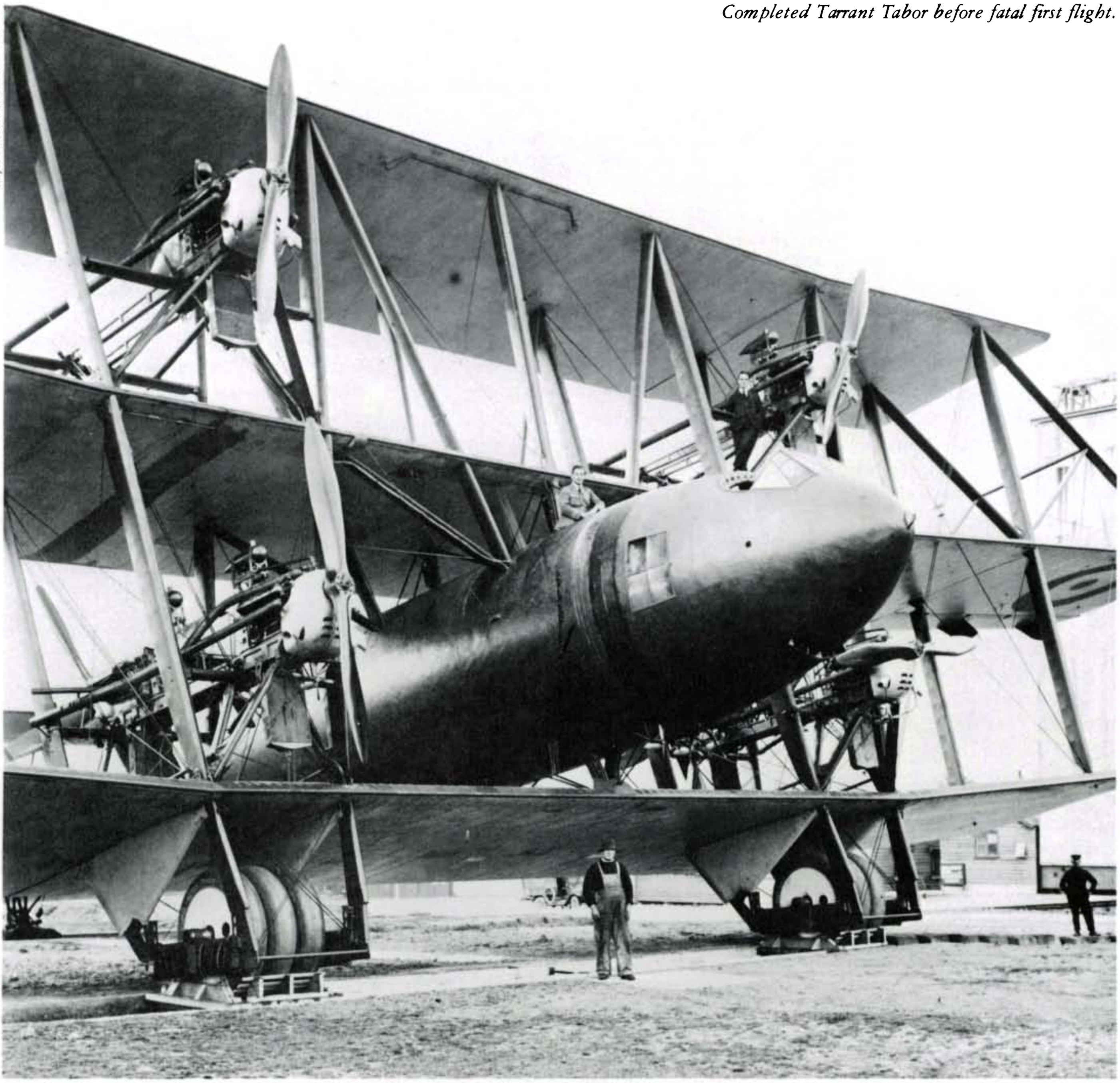
Peter M. Grosz

Wooden fuselage of late World War I Rumpler 7D1 fighter plane under construction.

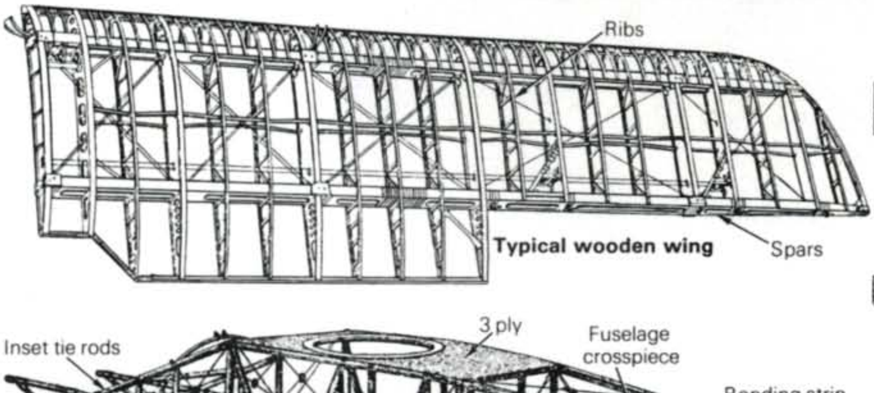


Types of wing spars often used in wooden aircraft: composite wood and steel, wrapped with tape (top left), box spar (top center) and I-beam (top right). Spars in the bottom row are of built-up wood, commonly used with European aircraft.

Royal Aeronautical Establishment

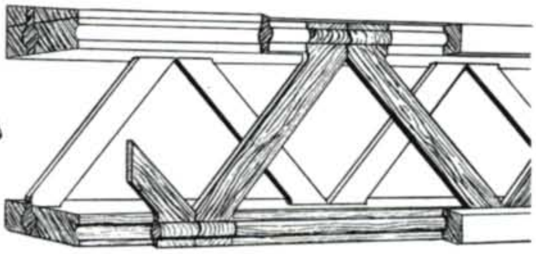


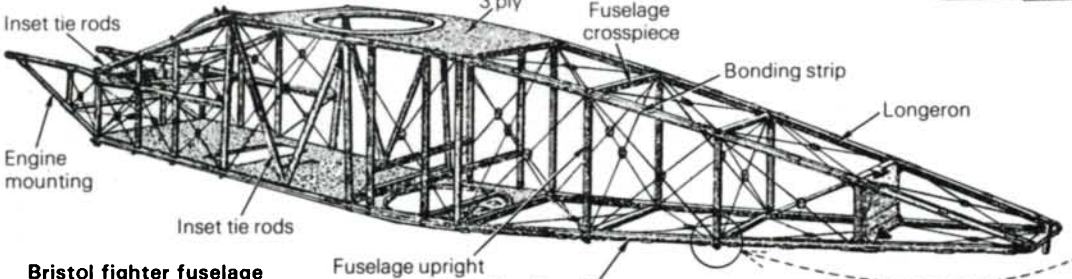
Completed Tarrant Tabor before fatal first flight.



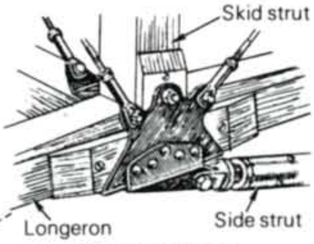
Typical wooden wing

Double-truss spar construction of Tarrant Tabor had routed diagonal pieces that fit into correspondingly routed spanwise sections.





Bristol fighter fuselage



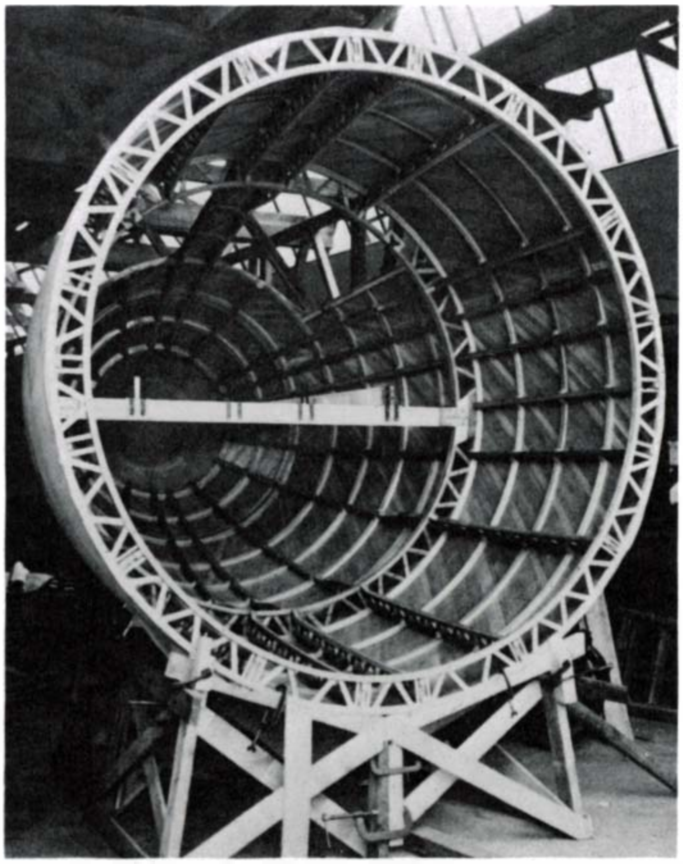
Fuselage fitting

frame. They could also be planked with small rectangular sections of plywood edge-butted or scarfed and screwed and glued to the frame, or with long tapered sheets of thin plywood wrapped diagonally in several layers and glued to each other, or with big concave panels of plywood layers that had been molded and glued under pressure.

Wood plays very little part in aircraft structure today, except for home and reproduction builders, who usually use one or more of the methods listed above. There is one current general-aviation aircraft builder, Bellanca, that still uses wooden wings: These are now made with plastic-impregnated molded plywood, which results in smooth, strong and virtually weatherproof rivet-free surfaces. The most famous wooden aircraft of modern time, Howard Hughes' great Hercules (the "Spruce Goose") lies in perfect condition in its temperature and humidity-controlled hangar in Long Beach, Calif. It was designed to avoid the use of critically short materials and to make use of factories and craftsmen not already in the aircraft business. It flew once. At one point it was to be scrapped, and several museums had plans to exhibit sawn-off sections of the huge 320-ft. one-piece wooden wing.

Long before the Hercules was thought of, aircraft engineers were beginning to struggle with the problems of larger sizes and weights. One of the most remarkable attempts was begun in April 1918, at the Royal Aircraft Establishment at Farnborough, England, where the Air Board had granted permission and support to W.G. Tarrant, a building contractor, to design and construct two enormous wooden six-engined triplanes, using his method for constructing wing spars and fuselage bulkheads. Most of the first aircraft was built in his own works, and then assembled in the great shed at Farnborough. One of the features of the design was the enormous monocoque streamlined wooden fuselage, free of all diagonal bracing and cross-wires, suited both for bombing and military transport work, and also post-war airline work. Another feature was the girder design that appeared everywhere in the structure. This design required only small lengths of wood, more easily obtained, dried and inspected than the longer lengths commonly used.

The wings, spanning 131 ft. 3 in., required some special design work. The normal spar construction of the period for small aircraft was a single length of spruce, tapered at the tip and sometimes routed between the ribs. Frequently, due to the difficulty in getting long lengths of aircraft-grade spruce, the spar would be laminated of two or three thinner pieces, which could themselves be made of shorter lengths scarf-jointed. Larger or heavier machines used box spars with two span-length beams, often themselves laminated. The two beams were joined vertically with two sheets of ply, sometimes cut with the grain at 45° to the span. Such box beams had to be carefully varnished inside, leaving clean sections for gluing; they could not later be inspected for water damage, and sometimes became unsafe. It was such a beam in the wooden wing of a Fokker Trimotor that failed, killing Knute Rockne, and brought about the end of wooden wings in American transport aircraft. But in the big Tarrant Tabor, the box spars were so big that vertical ply webbing would have buckled, or would have been too heavy. So Tarrant designed the elaborate double-truss shown in the diagram at left, using the specially routed small diagonal pieces laid into the correspondingly routed spanwise sections. The enormous wing struts were built up as long hollow boxes of Oregon pine,



Royal Aeronautical Establishment

Rear end of Tabor fuselage under construction.

square in section, and streamlined with long thin sheets of molded plywood fairing on each side.

The fuselage, measuring 73 ft. 3 in. long, was built on a series of wooden girders made in ring form, similar to the wing spars. The rings were held together with full-length longitudinal fuselage spars; neither the rings nor the spars had to be cut away where they intersected. The fuselage was covered in four molded quarters, each quarter being assembled on its own separate mold first, and then scarfed and glued to its neighbor on the Tabor frame. The four skins were made of two diagonally wrapped layers of 1½-in. wide wooden strips, each from 1 mm to 3 mm thick, depending on their location.

The weight of the three wings, together with their struts, was 8,900 lb.; the fuselage frame without the landing gear weighed 4,050 lb. The completed aircraft ready to fly weighed 44,672 pounds, certainly the largest and heaviest aircraft of its time.

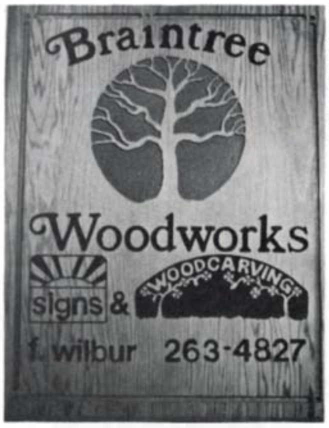
The rest of the Tabor's story is very sad. On the day of its first flight the two pilots in the nose taxied out onto the field, ran the engines, did a straight tail-up run, then opened up the top two engines fully and the giant triplane went over on its nose, crushing the front end of the fuselage. Both pilots were killed. The project was abandoned and the second Tabor was not completed. The Tabor, perhaps like the Hughes Hercules, was an attempt to carry woodworking beyond what was practical at the time. The growing expense of aircraft-grade woods, the fabrication time and the difficulties with weatherproofing, even with modern glues and finishes, make it less and less likely that the wooden airplane will ever return in quantity. But for the individual craftsman or restorer, wood is still the exciting and living material that it was for the Wright brothers in 1903. □

Routed Signs

Overhead projector transfers layout to prepared wood

by Frederick Wilbur

No one can deny the need for signs, yet billboards and neon have become synonymous with a cluttered, hypermobile society. Signs routed in wood look better and also advertise effectively. They can even work well for traffic control, although this use is limited. One might argue that wooden signs weather badly and are therefore not as economical as metal or neon signs, but I beg to differ. If the correct woods are used, wooden signs become more attractive as they age. Painted signs fade, blister and become an eyesore, and neon signs get the mean jitters, then die. And there is nothing worse than a sign that is crooked, missing letters or in need of repair.



Photos: Rich Wilbur

Sample routed sign displays various raised and inset lettering, carving and border designs.

Redwood, white cedar and cypress are most commonly used for exterior signs because they weather well and resist cupping, checking and mildew staining. I prefer redwood, endangered as it is, because it routs and carves well and is readily available. All three woods are soft and will split easily, but redwood is more often denser and is clear of knots. An interior sign can be of any hardwood, provided it is treated like a piece of furniture to allow for the inherent movement of wood. Though these woods are expensive, one must overbuild exterior signs, especially those which intend to be authoritative. Three years of making ski-resort signs have taught me that such signs are abused and need to be replaced periodically. An attractive sign may even be stolen by some appreciative soul. Consequently I make nearly all my exterior signs from 2-in. stock.

The letters and logos of wooden signs can either be routed out or raised by routing out the background. The edges of the sign can be beveled, molded or enclosed in a frame. Letters or logos can also be applied to signs—they are bandsawn from marine plywood, sealed and painted, and applied to a variety of backgrounds, such as textured plywood or cedar siding. I use plastic pipe cut into ½-in. lengths for spacers.

I countersink a screw through the letter, through the spacer and into the background, and use plastic wood to hide the screws. The letters have to be repainted from time to time, and raw plywood edges, including the backing for applied siding, must be covered by a frame or (less desirable) flashing. Remember also that a large sign is subject to a lot of wind pressure. Brace it as necessary and use stout uprights.

For esthetic and practical reasons, I design my signs with wide margins. If clients want 4-in. high letters, I warn them that the sign will be bigger than they think. On the other hand, I discourage 1-in. letters because they aren't easily read and are harder to rout. When I don't use a frame, I often rout a simple border around the sign to set the letters off from the background of telephone poles or other clutter.

Sign joinery is relatively basic: edge joining, mitering and mortise and tenon framing. Design embellishments can produce complicated moldings and peculiar outlines, but more often than not, the beginner's apprehensions concern the layout and the "time-honored secrets" of calligraphy, not the woodworking. Basic skill in design and some knowledge of typefaces are necessary, but laborious hours with pen and ink are not. Architectural stick-on letters are available (Letraset, Artype and Formatt are common brands at art supply houses) in dozens of styles and sizes. Using these letters, my own designs and a few parallel lines, I mock-up my sign on a small piece of plastic film. Then I transfer my layout onto the prepared wood with an overhead projector. For economy I sometimes use letters of the same size to lay out an entire sign, even though some lines will end up smaller. I simply readjust the position of the projector for each line. With this method, one does not have to draw letters by hand on a gigantic piece of paper or manipulate small sheets of carbon paper numerous times (and what happens when four of the same sign are to be produced?). Another advantage of this technique is that the entire design can be made in miniature in minutes, easily revised and then projected to any size. Even small logos or artwork from letterheads or other printed matter can be traced directly onto the plastic film, then blown up to size. The versatility of this technique is amazing.

I move the projector backward or forward to get an idea of how big the letters can be while still leaving appropriate margins. When I have the projection about where I want it, I draw a line on the wood parallel to the top edge and touching most of the bottoms of the letters in the top line, to make sure the line of letters is straight on the board. When everything is ready, I trace the image onto the wood. If the sign is large or the wood is dark, I use tape, which is more readily seen, instead of a pencil line. Make sure the vertical members

Architectural letters, left, available in a wide variety of typefaces and sizes, are easily transferred to transparent plastic sheets, right.

Left, Wilbur traces image cast by overhead projector directly onto the wood, then routs out sample letters, above. The heels of the hands rest firmly on the wood to guide the router through each letter. Some of his finished signs are shown at right.

Courtesy Wintergreen, Inc.

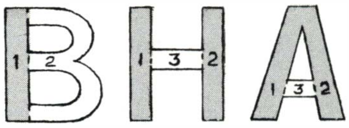
are perpendicular to the baseline by using a try square. The remaining parts of letters are drawn freehand.

Up to now the process has been mechanical, but the freehand routing that follows is the critical step because unlike the projecting, tracing and aligning, it is indelible. Patience and practice make letter-perfect signs. You may ask, why not use commercially available templates? I began on a $1,200 machine using different-sized templates and could produce a number of the same sign rapidly, but they were inferior signs. The letters were poorly spaced, stilted and, because there was little room for innovation, boring. For what I want to produce, template routing is out of the question.

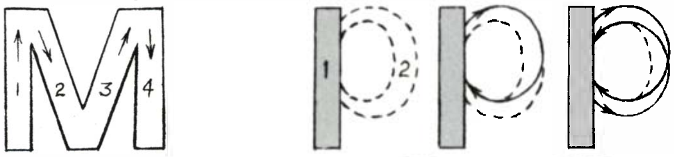
One soon devises a system to rout each letter that takes into consideration the properties of the piece of wood. The most difficult letters to rout are *e* and *o*. The lower curve of the *e* has to be balanced with the rest of the letter, and making the *o* symmetrical can be tricky. The letter *s* is comparatively easy. It is best to do the verticals first, then the curves. Once a letter is begun, rout from the open space into the wood. Working the other way, breaking into the open space from the wood, will chip the points off the letter. Make several passes to get the width of the letter or to straighten a line before proceeding to the remaining parts of the letter. I usually don't outline the entire letter, except on large (4-in.) letters. I use a ⅛-in. straight bit for letters less than 3½ in. high and a ¼-in. straight bit for anything larger, because the smaller the bit the squarer the letter appears (which is desirable for a squarish typeface). I rout to a depth of ¼ in. in a single pass, which allows for sanding and ease in painting. I have found that the best router for this kind of work is the 1½-hp Black and Decker Cyclone 1 because it is compact and has an on-off switch instead of a trigger switch. Its pear-shaped handles mounted low on the cylinder allow the heels of my hands to rest on the work. I start the router, then lower it into the letter, lifting it only to go to another letter.

Sand and assemble the sign and it's ready to be stained or painted. Because redwood turns a silvery-grey, I usually use Cabot's Bleaching Oil 0241 for the entire sign, and flat black enamel for the letters. Contact Cabot's at 1 Union St., Boston, Mass. 02108 for a local distributor; the cost of the oil varies from region to region. I pay about $15 a gallon. I also use either solid or semi-transparent stains for logos and artwork. Though there are occasional instances when bright enamel colors are needed to highlight a design, I don't like to use them. I have not yet experienced flaking or peeling when

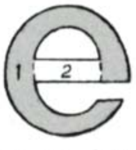
1 *Tips on routing letters: Rout the vertical members first, then the horizontals.*

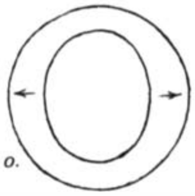


2 *To rout an acute angle, do one leg completely, then rout head-on into the angle.*



3 *Outline the curved parts of the e then do the horizontal section.*





4 *First outline the inner part of the o. Then work outwards.*

Illustration: Marilde Anderson

several coats of enamel have been used. To preserve the beautiful grain of the wood, I have also used a thin coat of sanding sealer instead of the bleaching oil. I don't use varnish at all. For directional signs I use either black or white reflective liquid, available from 3M (3M Center, St. Paul, Minn. 55101) through local distributors at nearly $50 for a 5-lb. can.

Frames and moldings should not be put on the sign until tracing, routing and sanding of the flat part are completed. The signmaker should instruct the client to mount or install the sign with galvanized or aluminum fasteners, because regular nails and bolts bleed. If lag bolts are used, the hole through the sign should be somewhat overlarge to allow for wood movement.

The endless possibilities in calligraphy, design and also technique are most satisfying. Though the majority of the routing is two-dimensional, sculptural effects can also be achieved by routing a design in different levels, rounding with gouge and sandpaper. This is not authentic woodcarving, but for signs it is practical and legible. I enjoy doing this "public" woodworking—it is informative, pleasing and serves as an advertisement for itself. □

Fred Wilbur, an ex-teacher and freelance writer, owns Braintree Woodworks in Shipman, Va., and specializes in wood-routed signs and woodcarving.

Staved Containers

Coopers relied on hand tools and a good eye

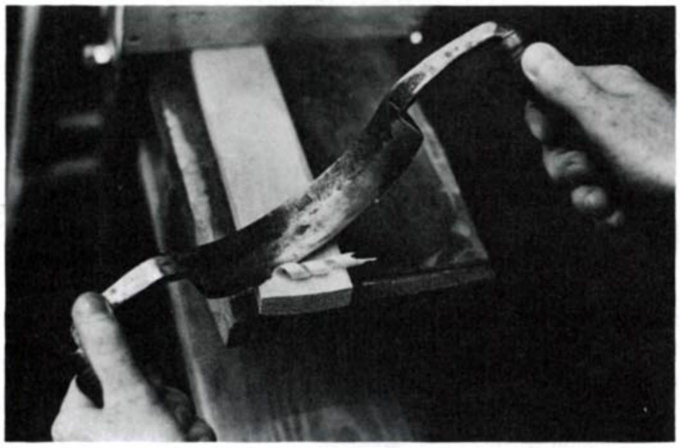
by Daniel Levy

Some of the historic methods used by coopers for constructing wooden staved containers can provide alternatives to techniques requiring power machinery (*Fine Woodworking*, Spring '78). Coopering techniques may be used either to construct entire containers, or to set up staves for turning. They may also be useful to woodworkers using stave construction in other applications, such as curved doors for cabinets.

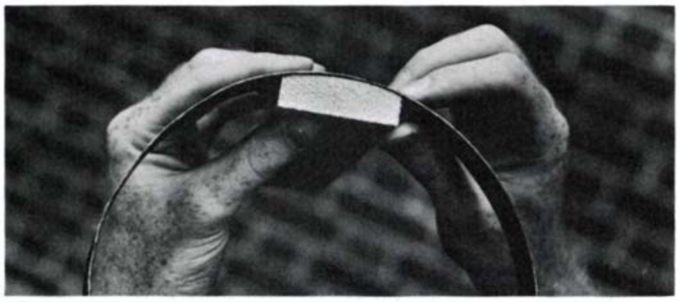
Daniel Levy, 27, teaches courses in woodworking at the University of Maryland, College Park.

Photos: Mark Sanders

A drawknife rounds the outer surface of the stave. If working the stave in both directions chips the grain, hold the stave between a notch in the shaving horse and your stomach.



A hollow knife cuts the concave surface on the inside of the stave.



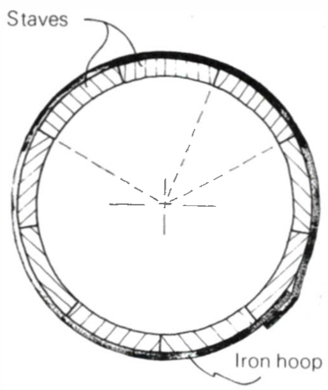
The staves are checked against a hoop for proper curvature.

Traditionally, the containers made by coopers ranged from casks of all sizes to a variety of straight-sided items. For tight casks, like those used for the maturation of spirits, white oak was generally selected. For less exacting cooperage, various hardwoods and softwoods were used, depending on the type of product to be stored or shipped, the length of time the container would be used and available timber. Both turners and coopers would generally select clear stock that was quartersawn for resistance to warping, reduced shrinkage across the width of the staves and dimensional stability.

Coopers use drawknives to round the outer surface of the staves, which is known as backing. Hollow knives, similar to drawknives but with blades curved for concave cuts, are used to contour the inside of the staves. A shaving horse holds the work. If working the stave in both directions causes the grain to chip, the stave is held between a notch in the shaving horse and the cooper's stomach to complete the cut. These steps are not necessary for turning, but backing makes it easier to check the beveled edges and determine the wall thickness when joining staves of varying widths, and also makes turning safer because the setup is close to a true circle before turning is begun. A hoop can be used to check the curvature—wide steel hoops are best, but a circle made from a wire hanger will do. Check each stave against the same part of the hoop in case it is not a true circle.

A cooper's jointer plane is used to bevel and taper the stave edges. It's 5 ft. to 6 ft. long and is raised at one end on legs. The staves are hand-held at the proper angle, which is judged by eye, and pushed across the blade. To avoid wasting stock, random-width staves are used. Because staves of varying width require different bevels, a fence is not used. For stave turning, a 2-ft. long jointer plane clamped upside-down in a vise serves the same purpose. In either case, be sure to set the plane for a light cut and keep your fingers curled away from the blade. If the container is short, joint the staves two or more times longer than needed and then cut them to length.

Coopers judge the bevels by eye, but the hoop can be used to check the angles. Joint the first stave so that the bevel angle is on an imaginary radius line to the center of the hoop, or determine the angle mathematically. Both stave edges should be cut at the same angle. Use this stave as a template by clamping it to the hoop and checking both edges of all the other staves against it. If the bevels are cut carefully, the staves can be assembled in any order to form a tight circle. If the



Joint the edges of the staves on an imaginary radius line, so the staves will fit tightly in any order.

hoop is not a true circle or the template stave is not cut accurately, the diameter may not be what you expected.

Coopers taper their containers either from one end to the other for straight-sided containers, or from the center to both ends for casks. The taper lets the hoops be driven towards the wider part of the container, drawing the staves tightly together. Begin cutting the taper by placing part of the stave past the blade of the jointer plane, like cutting tapers on a power jointer. This procedure can be duplicated for stave turnings. The number of passes determines the extent of the taper, but be consistent on all of the staves for any one container. Full-length passes then clean up the entire edge to the proper bevel.

The staves can easily be assembled in the hoop by leaving the template stave clamped in place. Add the other staves by pressing each one back towards the template. You'll need to hold only the last stave, because the outsides of the staves are wider than the insides, preventing the others from falling in. On a tapered container, you may need to move the hoop up or down to fit the last stave, or perhaps you'll have to replace a stave with a wider or narrower one. When assembling a straight cylinder, a helper can attach a band clamp to draw the staves together, or a wooden wedge can be driven between two staves to hold the assembly temporarily.

A cooper uses scorps and inshaves to smooth the inside of the container, important for a tight leakproof fit of the head (bottom). The outside can be smoothed with spokeshaves or scrapers. The head is set into a groove called a croze, cut with a tool also called a croze, which is composed of a cutter suspended below a board. The board is held against the end of the container and swung around it to cut the groove. The cutter has either saw teeth for small containers, or an iron with two spurs for large ones.

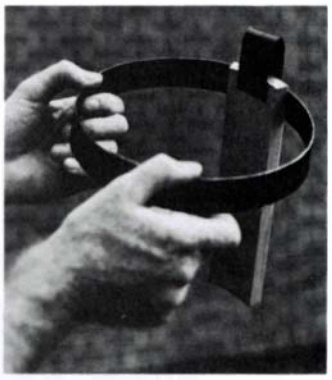
The radius of the head is determined by stepping dividers around the groove. The dividers will be set to the proper radius when six steps around brings you exactly back to the starting point. The head, either one board, or two or more butted or joined with dowel pins, is then scribed and cut. Coopers taper the head from both sides with a heading knife, which is similar to a drawknife, but you may prefer to do this by machine. The tapered edge wedges tightly into the groove. Insert the head by loosening the hoop until the head can be snapped in. Then tighten the hoop.

If you're setting up staves for turning, the cooper's method of setting the head doesn't apply because the staves have to be glued, but you can use the hoops to clamp the staves for gluing. Draw the staves together by driving two or more appropriately sized hoops towards the wider part of the assembly. Coopers hold a driver against the hoop and strike it with a hammer. A hard block of wood will also work. To avoid starved glue joints, do not apply too much pressure. When the adhesive has cured, drive the hoops off the narrow end.

To turn, glue scrap stock to the top end of the staves and attach to a faceplate. Cut a rabbet into the other end of the staves for the base. The head is turned on another faceplate and glued into the rabbet. The scrap stock that was attached to the open end is then cut away, and the container can be turned to a smooth finish inside and out. □

AUTHOR'S NOTE: An interesting gauge for checking the bevels on staves is described in the chapter "Butter Churns," in *Foxfire 3*, edited by Eliot Wigginton (Anchor Press/Doubleday, Garden City, N.Y. 11530).

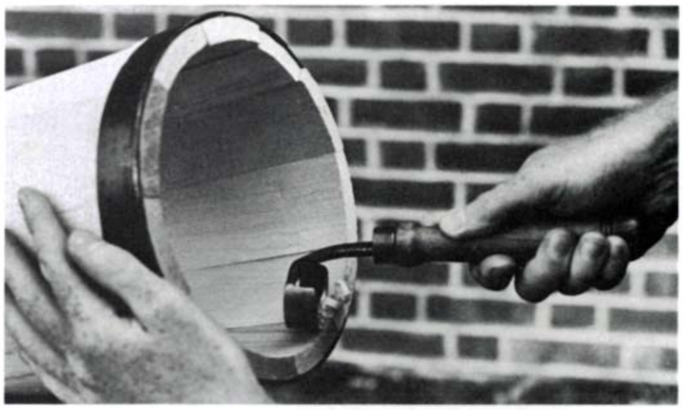
When jointing stave edges, determine the bevel by eye.



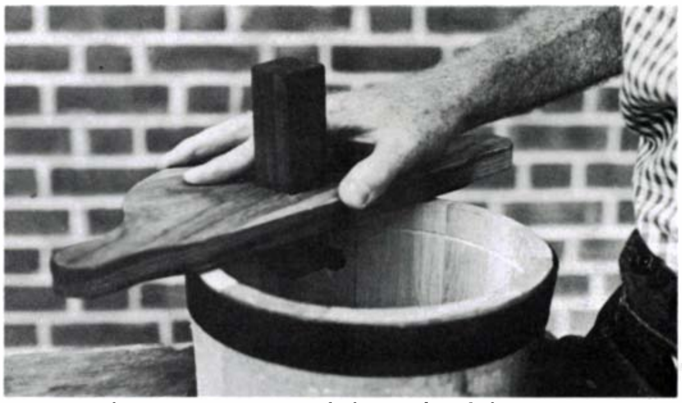
The first stave clipped to the hoop with a scrap of hoop is a template for the other staves.

Each added stave is pushed towards the clip. Because the outsides of the staves are wider than the insides, they won't fall in.

A hoop driver and hand adze are used to tighten the hoops and clamp the staves.



A scorp smooths the inside of the container.

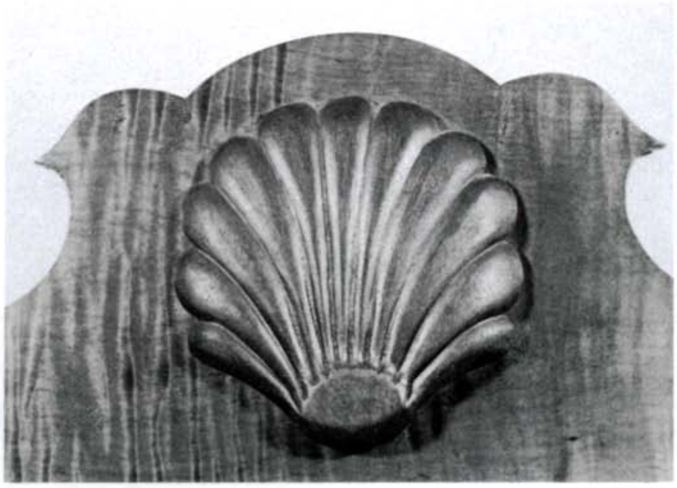


A sawtooth croze swung around the inside of the container cuts a groove for the barrel bottom.

Courtesy: Old Sturbridge Village

Photos: Donald Eaton

The convex Goddard shell, with alternately concave and convex rays, is found on block-front desks, secretaries and bureaus.



This shell with convex rays, the simplest example of the form, is from a large Chippendale mirror, c. 1770.

Carved Shells

Undulating motif enhances Chippendale reproductions

by R. E. Bushnell

A beginning carver is often intimidated by the apparent complexity of shell carvings on heirloom furniture. But the layout and carving are quite straightforward, and proceed easily from carving the simple fan (Summer '77, pp. 60-61). Shells require a few more tools as well as a little more time and effort.

Whether the rays of a fan are all convex, or alternately concave and convex, the carving remains basically flat. Carved shells, on the other hand, represent natural seashells and the carving must take on depth to follow shapes and forms one might find at the shore.

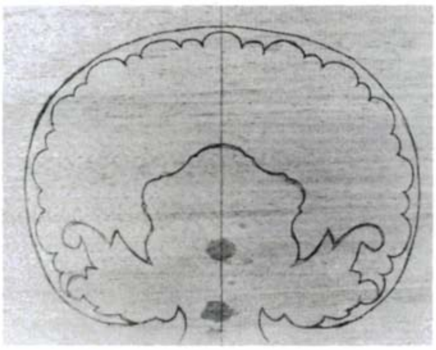
The concave form represents the inner side of a shell, while the convex portrays the outer part. It follows that shells are carved on a convex or a concave surface, with the ray delineations generally following those found on the fans. Convex forms are usually carved on a separate piece of wood, which is then glued to the furniture. Concave forms, and combinations of concave and convex, are nearly always carved into the furniture itself.

You will find as you progress in carving that having a "good eye" to visualize various shapes and forms is essential. As skill and experience develop, so does that "good eye."

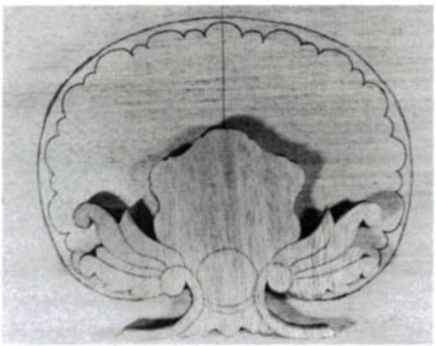
Carved fans are absolutely geometrical and designing them requires only a good pair of dividers and a ruler. But shells are nongeometrical, with flowing lines that require freehand drawing. It becomes necessary to visualize the form of the finished product before actual carving starts. When designing a shell form, I have found the easiest method is first to make a rough sketch. From that I make a full-sized layout, first drawing in the left-hand side, then matching on the right with dividers or a carbon-paper tracing.

A complex shell of the Philadelphia Chippendale school, although it looks ornate and difficult, is really quite simple to carve. The design is started by drawing a bulbous or elongated circle on a center line. Within this outline draw the small inner shell, which is convex and has both concave and convex rays. At the base, delineate a circle within which the drawer knob will eventually go. Surround this with several simple leaf forms. If you choose to carve vines around the entire shell, the base of the vines will also begin here.

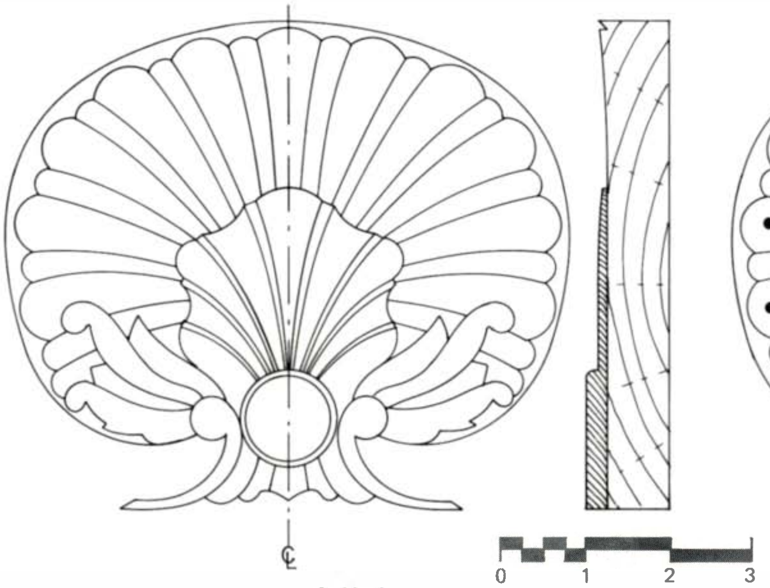
The convex inner shell and leaf forms are raised ¼ in. above the remainder of the drawer front. This can be done by lowering the groundwork with a router or carving chisels, or by the easier method of appying this entire area to the drawer front. Since the Colonial carvers usually glued on the extra thickness, I've used this method in our example, although the crossed grain adds the risk of delamination with humidity



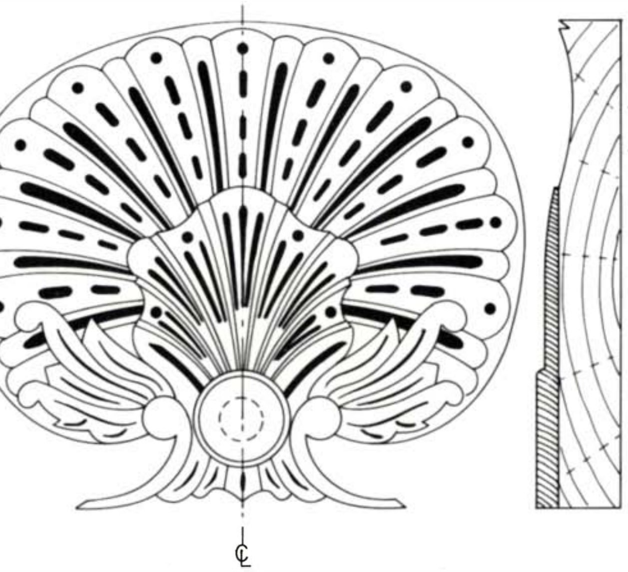
Chippendale shell layout: Design outline is traced onto drawer front with carbon paper; center line orients pattern.



Raised portion—inner shell, leaf and vine motifs—is jigsawn from ¼-in. stock and glued in place.



Full-sized shell layout: Above, half of shell is drawn free-hand, then duplicated on the other side with dividers or carbon-paper tracing.



Side views show depth of cuts. Completed drawing locates drawer knob; dark markings indicate holes and hollows.

Illustrations: Joe Esposito

changes. A good finish is the answer.

With carbon paper, trace the design onto the drawer front. By the same method, trace the area of the convex shell, leaf designs and vine appendages on 1/4-in. stock. Jigsaw to shape, file and sand all edges smooth. Now glue the raised portion onto the drawer front.

Start the carving at the base of the inner shell by lowering the surface approximately 1/16 in. with 6-mm parting and firmer chisels. The entire inner shell is then made convex using a firmer chisel, leaving the outer edges 1/16 in. above the surrounding surface.

Delineate the base circle and lower the inner portion about 3/32 in. Again use the parting and firmer chisels to carve the leaf forms, which slope toward the base.

The scalloped edges are delineated by using a 26-mm #7 gouge for the large rays, and a 10-mm #7 gouge for the small rays. Hold the gouge vertical and press downward. Cut down the extreme outer portion with a 12-mm #5 gouge, taking care that you follow exactly the shell outline, which is taken down 1/8 in. at the scalloped edges.

Now, use a 20-mm #5 gouge to make the outer shell concave. The outside edge is left at its original height, the inner portion taken down 1/8 in.

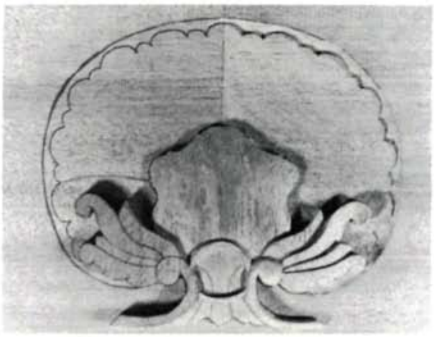
Next, draw in the ray lines from the design. With a parting chisel or a jackknife, follow each line outward to delineate the convex rays. About three passes should do. Then round the rays with a small firmer chisel. Grain direction is not a problem on the nearly perpendicular rays at the center of the shell, but it will affect the direction of the cut on the rays on either side. Smoothing is done with a 1/2-in. or 10-mm chisel, or with rifflers. The small rays in the outer shell are flattened with a firmer chisel and their outer ends should finish 1/16 in. high.

The inner shell rays are alternately concave and convex. Delineate them with the jackknife or parting chisel, round the convex rays with a small firmer, flatten the concave rays and work them hollow with a small veiner and gouges. Leave a shoulder about 1/32 in. wide on each side of the concave rays. The inner shell is carved so that both the convex and concave rays end up 1/16 in. above the outer surface. Scrape and sand all surfaces, then mark the location of the details that will complete the fan. These are the dark portions of the drawing above right.

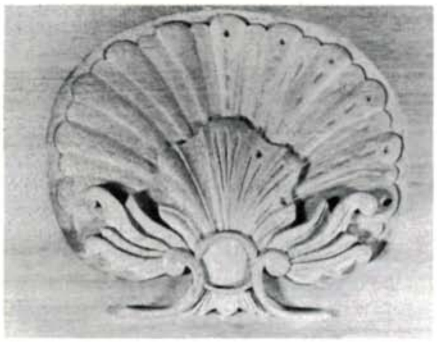
The small holes at the extremities of the rays are made with a 3-mm veiner and located about 1/4 in. from the outside edges. Hold the veiner upright and simply turn it around to release a little circle of wood. Holes on the inner shell are located on the concave rays, those on the outer shell on the convex rays.

The 3-mm veiner is also used to cut the three spaced dash-type hollows on all the convex outer rays, as well as the concave hollows in the narrow flattened rays. A 2-mm veiner is best for detailing the rays of the inner shell and the veins of the leaf forms. □

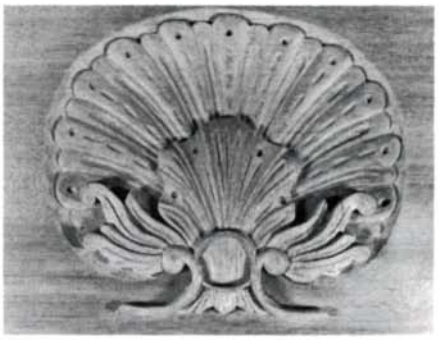
Reg Bushnell, now retired, was formerly in charge of furniture restoration at Old Sturbridge (Mass.) Village.



Inner shell is made convex, then base circle is lowered and leaf forms are carved. Gouge delineates scalloped shell edges.



Outer shell is made concave, then rays are outlined and carved. After the piece has been scraped and sanded, a veiner cuts holes and hollows on rays.



The completed shell, simple yet highly decorative, will do justice to the finest Chippendale highboy or lowboy reproduction.

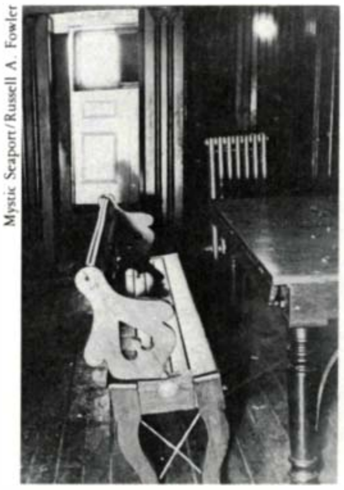
Tage Frid

Restoration calls for all the tricks in the book

The Benjamin F. Packard was a 244-ft. sailing ship built in Maine in 1883. In 1930 it was destroyed, but some of the paneling and furniture from the cabins was removed and stored at the Mystic (Conn.) Seaport Museum. I got involved with the Packard as a consultant in 1972, and was asked to figure out what was missing from the paneling and if it could be saved. That was a job, but finally I got the puzzle together, and the board of trustees decided to go ahead with the project. It was difficult to find somebody to do the restoration, which included, among other things, veneering concave moldings with bird's-eye elm, so it was done in my own shop and installed by Mystic Seaport's own staff.

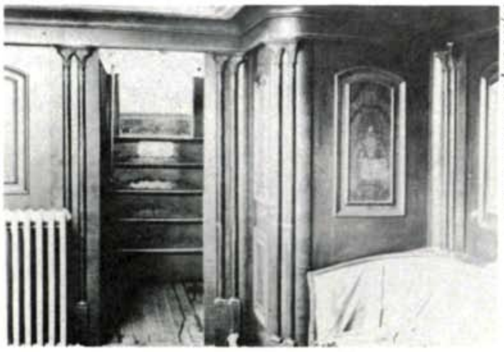
At first glance, the finished cabin is breathtaking with its exotic veneer and elaborate gold leaf designs. But looking closer you see that all the tricks in the book were used to jazz it up. All the molding is nailed on. The frames and panels are pine and veneered on only one side. Back sides are painted, except for the doors, which are veneered on both sides. Between each panel are three rosewood veneered moldings with two pieces of half-round covering the joints, that I first thought were solid rosewood. Looking on the back I discovered that it was mahogany made to look like rosewood.

Mystic Seaport/Russell A. Fowler



Photos: Roger Birn

The crew's front cabin, before and after restoration. Most of the wood is solid ash with walnut trim and black painted floral decoration. The back of this unusual bench pivots on a dowel; in the position shown it was used for dining. With the back flipped to the other side, the bench was a convenient place to sit. The Packard's benches must have been broken many times, because they had been repaired with wire, large nails and more than a dozen exotic woods—apparently, whatever was available in port. Frid repaired the joints by cutting off the broken tenons and inserting splines. Splits were sawn open and filled with matching slats of new wood.



Mystic Seaport/Russell A. Fowler

The captain's cabin of the sailing ship Benjamin F. Packard, before and after restoration. The finished job looks very elegant, but all the tricks in the book were used to jazz it up. Throughout the job, Frid used as much of the original material as possible. Where parts had to be replaced, he used what the original builders had used, even if that required faking mahogany so it would look like rosewood. The wall paneling is made of pine, veneered with Honduras mahogany on one side and painted on the back. The recessed panels are veneered in bird's-eye elm and the raised panels with burled walnut, with mahogany moldings. The concave molding near the ceiling is also bird's-eye elm veneer. The wide, horizontal-grain molding between the panels is rosewood veneer, with mahogany half-round columns painted to look like rosewood covering the joints. All the molding is nailed on. The finials are carved wood covered in gold leaf and the floral borders above the finials are also gold leaf. Merlin Szosz describes the technique of applying gold leaf on page 80. The line work is bronze paint.

Mystic Seaport/Mary Anne Stets

Identifying the wood was difficult because there were several coats of finish on top of the original finish, and each time a little stain had been added to cover up wear and tear. For example, some of the panels in the front cabin were ash with a natural finish, but they were so dirty it was impossible to recognize the wood until the top layers of finish were removed. The shellac finish came off easily with ammonia, which doesn't harm varnish, lacquer or any other finish. For sanding the round or concave pieces, I used a blackboard eraser as a sanding block. These erasers are made out of flexible strips of felt and conform easily to a shape.

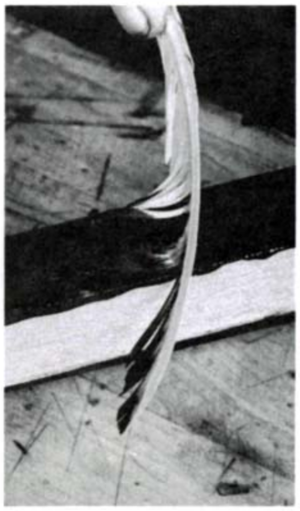
To make the mahogany half-round look like rosewood, I used a rosewood-colored, oil-based stain. The best brush to use is a wing feather from a goose. I didn't have one when these pictures were taken, so I had to use a feather from one of our own chickens, which my wife chased all over and caught so I could clip one feather off.

Making the imitation rosewood reminded me of one of my first refinishing jobs. I was still an apprentice, so to make a little extra money I took a job refinishing a cabinet I thought was curly maple. But when I started removing the finish, I found it was straight maple. You can imagine how I felt. Luckily, I knew an old painter who taught me how to fake it. Here's how: Use a water-based stain for imitation curly maple or birch. Apply it so the color is fairly even, then take a damp cloth or chamois, and twist it. For curly birch don't twist too hard, for curly maple twist more. Roll the cloth over the stain when still wet—the high part of the cloth will absorb some of the stain, but the lower part will not, so the stain will stay dark and appear as curls in those places. For a bird's-eye effect, dab the end of the damp cloth onto the surface, or use a damp sponge. If the viewer is not a professional, he will find it hard to tell if the finished product is real or not.

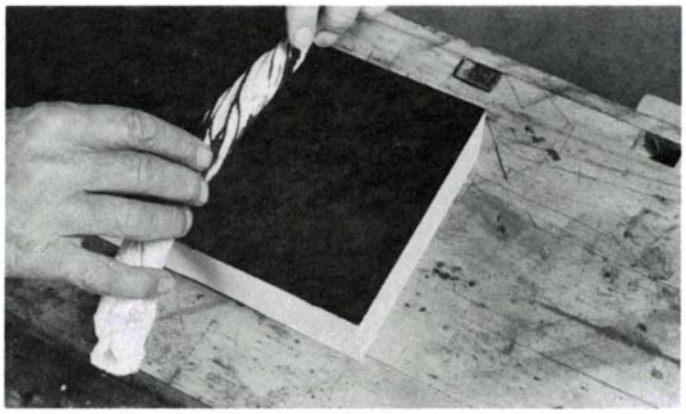
The concave molding near the ceiling of the Packard cabin was veneered with bird's-eye elm, brittle and wrinkled stuff that is harder to handle, cut and join than regular veneers. The veneer can be flattened by soaking it in water and pressing it between two flat boards with two or three sheets of newsprint on each side of the veneer. The problem with using water is that the veneer expands and the minute it is removed from the two flat boards, it starts drying—and wrinkling—again. For small pieces, though, where the veneer can be glued on before it starts to wrinkle, this method is fine.

A better way to treat burled veneer is to use this mixture: 2 parts cascamite powder (from the hardware store), 1 part flour, 3 parts water, 1½ parts glycerin (from the drugstore), and 1 part isopropyl alcohol. First mix the cascamite powder and flour together, then add the water slowly so it doesn't lump. Slowly add the alcohol and glycerine. Apply this mixture generously to both sides of the veneer, or immerse the veneer in it. Then stand the veneer on end until it is dry to the touch. Place the veneer between two flat boards with three or four sheets of newsprint between, and weight it to hold the veneer flat. After two hours, open it up and replace the damp newsprint with dry; if left longer, the paper will stick or the veneer might mold. Then put the veneer and paper back between the boards. Press it down. After three or four hours, remove the newsprint and put the veneer back between the boards without paper, applying light pressure. The veneer will dry in a day. It will shrink some, but will still be flexible—ready to use.

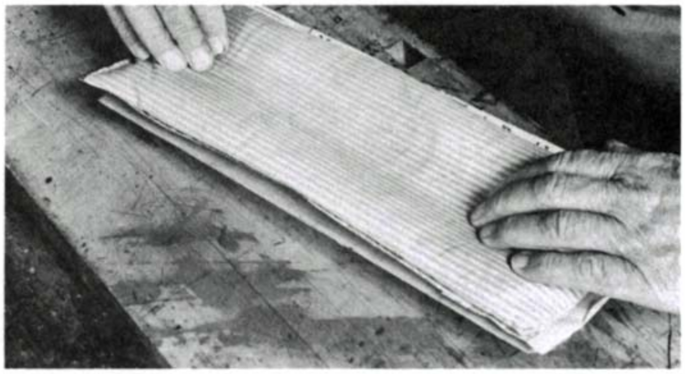
Keep the veneer between the boards until you use it. If



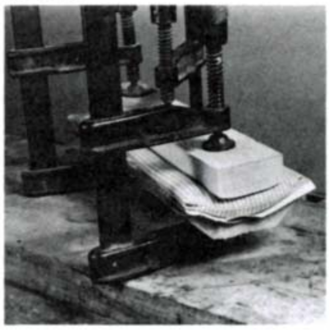
Mahogany half-rounds, sanded with an old eraser block, above, are made to look like rosewood by flooding with an oil-based rosewood stain, then painting in the figure with a chicken feather, right.



Curly figure can be imitated by rolling a twisted cloth over evenly applied stain. High spots on the cloth absorb stain but low spots don't. The stain can also be dabbed with the twisted end of the cloth, to imitate bird's-eyes. A water stain works better than an oil stain, and for best results start with straight-grained wood.



Crinkled bird's-eye elm veneer (left) can be flattened by following the recipe given in this article. Then use a heated sandbag (above) and a caul to apply even gluing pressure against a curved molding (below).



more than one sheet of veneer from the same flitch has to be flattened, put them on top of each other and double the layer of newsprint in between.

For veneering the concave pieces, I used a long sandbag half-filled with fine sand, and a piece of wood (caul) to clamp on. The cauls don't have to fit the concavity exactly, because with pressure the sand will distribute itself evenly over the veneer. Sandbags can also be used on convex surfaces. When using sandbags for veneering, I use hot glue. It is the oldest known glue and the strongest, but is not suited for moist and hot climates. It sets fast and because the veneer is clamped down before the glue starts melting, it cannot expand when it absorbs the moisture. Never put glue directly on veneer, because the sides with the glue will expand and scroll up. Put the glue on the piece to be veneered only. Let the glue cool, then apply the veneer with a piece of paper on the top so the sandbag won't stick to the veneer if any glue comes through. Heat the sandbag to about 200° F in a frying pan or in the kitchen oven. Then place the sandbag on the veneer, pushing the sand so it is evenly spread. Lay the clamping caul on the bag and clamp it down tight. When the sand gets cold, take the clamps off. The veneer will be stuck, but leave it to dry for 24 hours before sanding. Here again, I would use a blackboard eraser for a sanding block. □

GILDING

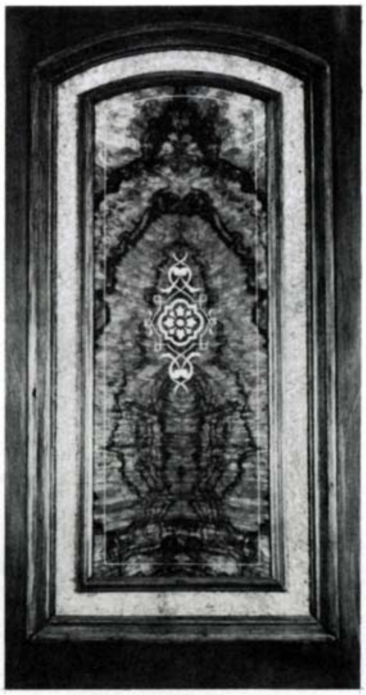
by Merlin Szosz

The discreet use of gold as an embellishment is complimentary to almost any material, but one of the most handsome partnerships is gold leaf on wood. There are several techniques for its application—those explained here were used to reproduce the original gold decorations on the Benjamin F. Packard paneling and are basic to the gilding process. In gilding, gold leaf is applied to a prepared adhesive surface, then stroked down with a soft brush. Excess gold is removed by light rubbing with a cotton ball dampened with water. Although the leaf is delicate, it can be burnished, giving a lustre that cannot be produced by cheap imitations.

Leaf is one of the oldest and most versatile forms in which gold is produced. It shouldn't be confused with gold paints, which are basically metallic powders suspended in a varnish medium. Leaf is literally a thin sheet of gold—in its finest form, the metal is rolled and beaten until it is so thin you can actually see through it. It's available at most art-supply stores and comes in two forms: patent leaf and glass leaf. Patent leaf is bonded to a paper backing for easy handling, but its use is limited to flat applications. Glass leaf is a free sheet of gold supported between the leaves of a paper booklet. It is as delicate as gossamer—the slightest breeze or exhaled breath while handling can ruin it—but it has an almost unlimited range of application.

Shades of leaf vary from the deep gold of 23 karat to 13 karat white gold. Variations are produced by alloying other metals, such as silver, with the gold. I used two shades to restore the Packard's paneling—a deep gold patent leaf and a lemon gold glass leaf. Both are produced in 3-in. squares, in books of 25 sheets. Silver and bronze leaf are also available, but require a transparent finish to prevent tarnishing.

For the leaf to bond, the surface of the design must first be painted with an adhesive ground, called size. Sizes have either a water/glue base or an oil/varnish base. I am more familiar with oil/varnish size and will concentrate on its use here. Oil size is generally available in 12-hour or 24-hour mixtures. The hour refers to the relative time the size takes to mature before leaf can be applied. I say "relative" because the time varies with temperature and humidity, as well as with the effects of turpentine, which may be introduced as a thinning agent. The slower the size, the more time it has to flow into a smooth consistent surface. I recommend 24-hour size fresh from the container.



The restored gold-leaf design on panel in the captain's cabin of the Benjamin F. Packard.

Oil sizes are available in both clear and yellow. Yellow is best for seeing the design as it's being painted on and helps disguise any small defects in the leaf application. Clear size is primarily for application on glass and may be tinted with oil pigments if yellow is unavailable.

Before applying oil size, wood surfaces should be sealed and filled with shellac, varnish or lacquer. A smooth, hard surface will prevent absorption of the size and promote the metallic character of the gold leaf, which otherwise would reproduce and magnify surface defects and grains. The surface should also be free from dirt, oil and grease. Leaf, however, tends to bond with the squeaky-clean sealed surface, as well as with the size. A light dusting of talcum powder before painting on the design doesn't affect the size and is necessary for a non-adhesive background. The talcum also makes the penciled design more visible when working on darker woods such as walnut or mahogany.

Most good brushes are suitable for applying size. The shape, width and length of the brush should relate to the marks required in your design. For work on the Packard, I used a #1 sign-writer's quill, and cut away the outer hairs at the quill's base for a finer line. Once the design is painted with size, it should be kept dust-free until the size is hard but still tacky, and the leaf is applied. If leaf is applied while the size is gummy, the size may penetrate the leaf and result in a crinkled dull finish.

I suggest using a stencil to lay out your design. This is especially important if you are repeating a design, but also re-

Merlin Szosz is a sculptor/designer who lives in Foster, R.I.

duces the anxiety that tends to occur with freehand efforts. If there is the need to coordinate more than one pattern, or if orientation with natural features in the wood is important, cut your template or stencil in clear plastic sheet for easy alignment. Be careful not to press too hard when penciling, because any indentations on the surface will be magnified by the sheen of the gold leaf.

Steadying the brush hand is important in creating fine lines and patterns. I am right-handed, and I get the best support by resting the butt of my right palm on the back or fist of my left hand. I support my left forearm on a movable wooden bridge that is also useful as a guide for straight-line patterns. The left hand offers a flexible pivot point when making radial movements, and the straight edge of the bridge is useful as a guide for straight-line patterns.

To apply patent leaf to the sized surface, hold the backing by its edges and lay it gold side down onto the design. Rub the paper backing lightly with your finger to ensure that the gold is making full contact, then lift off the backing. You will find that the gold readily separates from the paper. If there are areas of gold still attached to the paper, use them to cover any exposed areas of the sized design. Applying glass leaf is more delicate. It requires patience and a flat 3-in. wide gilder's static brush, used to pick up the leaf from the book and move it to the prepared surface. You cannot handle leaf with your fingers. A gilder fans the brush through his hair to generate static, then brings it to the outer edge of a leaf. The leaf clings to the edge of the brush, and is then gently slid from the book and floated onto the prepared surface.

When a full leaf is not needed, you can remove a smaller section by scribing the leaf with a dull pocketknife (a sharp one may snag and tear the leaf), completing the separation with a small brush. This is done while the main section of leaf is held in place under a folded page of the book.

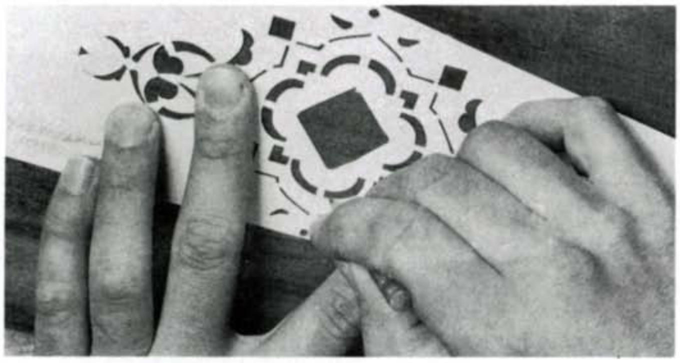
Once the design is completely covered by either the glass or patent leaf, stroke it down with a soft brush, covering any imperfections with scraps of leaf. At this point you have a gilded pattern with gold debris on the surface. Wet a cotton ball with cold water and lightly rub down the gilded area. The water helps pick up loose gold. After the initial rubdown, a fresh dry cotton ball may be used to lightly burnish the design. Too much pressure will wear through the fine layer of leaf. Make certain that no water beads remain because they may spot both the gold and the background finish.

Although gold is durable, it usually needs protection from the abrasion of handling, cleaning and polishing. A good-quality clear varnish is generally applied for this purpose. It will also add fire and brilliance to the burnished design.

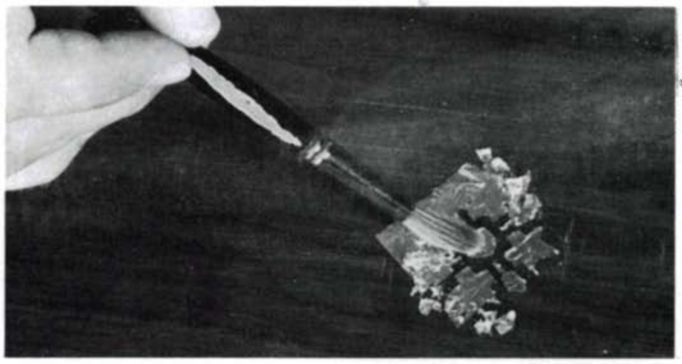
As work progressed in the restoration of the paneling, I became intrigued with the drawing-room character of the captain's cabin, which seemed more appropriate to a social yachting atmosphere than to the practical roughness of a working freighter. I discovered in my browsing of the Mystic Seaport Museum's exhibits several photographs of captains' families aboard working schooners. Two or three of the pictures were taken inside the captain's quarters and show paneling almost identical to that of the Benjamin Packard.

The discovery brought the realization that we were not restoring a unique, custom-designed interior, but semi-production paneling components that were probably offered as an option or a sales promotion to prospective captain/owners. I was not disappointed, however, to realize that the Packard was not as special as I had originally thought. Instead, I was more impresssed with the abilities of craftsmen from an earlier generation who made less of a distinction between quality and production. □

EDITOR'S NOTE: Gilding supplies are generally available from sign-writers' supply houses. One large company is M. Swift & Sons, 10 Love Lane, Hartford, Conn. 06101.

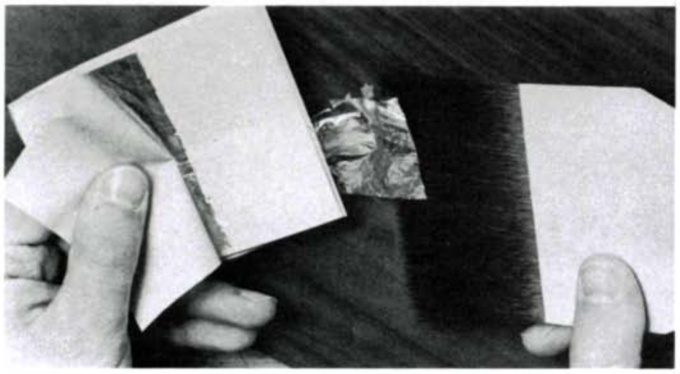


Design is stenciled onto surface to be gilded.

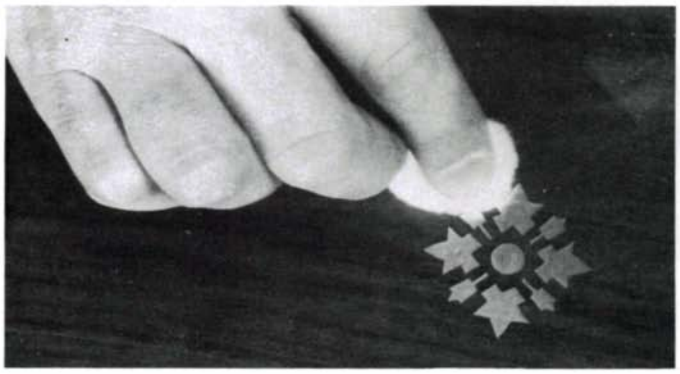


Photos: Roger Birn

Gold is stroked down lightly with a soft brush.



A gilder's static brush lifts glass leaf gold from book.



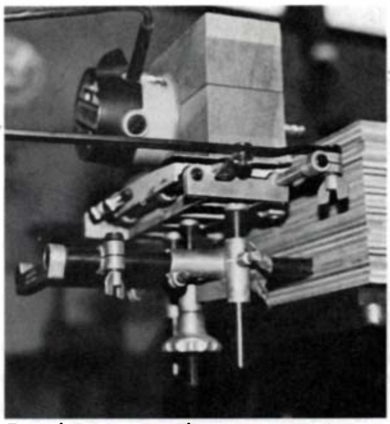
The gilt design is lightly burnished with a dry cotton ball.

EDITOR'S NOTEBOOK

Of mortising machines, tree surgeons and carving duplicators

by John Kelsey

In the shops of several cabinetmakers I've seen metalworking milling machines being used to cut mortises and make tenons. I started asking where this idea came from, and several people referred me to Bob Sperber of Caldwell, N.J., a woodworker and machine addict who manufactures and sells a chain-saw rig for converting logs to lumber *(Fine Woodworking,* Fall '77). Sperber explained that the best style of machine for conversion to woodworking is the horizontal mill, and one excellent make common on the used-machinery market is the hand-mill, made by U.S. Machine Tool Co., now part of Powermatic.



Deatherage uses the Inca mortising attachment to move the router into stationary work.

Jim Richey

The machine is basically a cast-iron column with a horizontally mounted belt-driven spindle. Its precision table moves back and forth and in and out in relation to the spindle; the spindle itself moves up and down. Sperber's advice is to look for rack-and-pinion feeds on the table and spindle, since they will be faster for mortising than the more usual screw feeds. Most makes of horizontal mills use a screw for the in-out axis, but Sperber finds that the hand-mill's screw can easily be removed and replaced with a lever. It doesn't seem to matter whether the machine's head has roller bearings or bronze bushings.

A good used machine will cost between $200 and $500, and you'll have to spend a couple of days cleaning, repairing and adjusting. But fitted with an industrial end-mill cutter, it will make as fine, quick and clean a mortise and tenon as the fanciest Italian slot mortisers—and they cost $2,000 or more.

Jim Richey, our Texas correspondent, reports another variation on the theme, from the Houston shop of cabinetmaker Roger Deatherage, who noticed that an Inca table-saw attachment for mortising provides controlled motion in all three directions. Inca intends the device to be mounted outboard on their table saw, with the saw spindle driving the cutter. Writes Richey, "Deatherage turned the whole arrangement around. He mounted a 1½-hp router with a ½-in. chuck on the mortiser table, and built up a stationary work table from stacked plywood. He uses the Inca device to move the router against the stationary workpiece, clamping fences and hold-downs to the work table as necessary for each job. The fluted end-mill cutters make an incredibly smooth mortise." Inca makes two attachments, for their 7-in. and 10-in. saws, costing about $155 and $170 respectively. The smaller has a slightly shorter stroke, but comes with bolt holes for mounting, while the more expensive version is fitted with mounting rods that match holes in the table saw itself. Both are sold by Garrett Wade, 302 5th Ave., New York, N.Y. 10001.

While these methods produce a square tenon, they leave the mortise round at the ends. Some workers square up the mortise with a chisel, others round off the tenon. One way is to sever the fibers at the tenon shoulder with a bench chisel, split off most of the waste, then shape round with a rasp and strip of sandpaper.

* * *

Tree surgeon Sam Willard seems to be the first businessman to connect the demand for fine hardwoods with the ancient trees he had been chopping up and burying in the landfill. Willard therefore installed a 52-in. circular rip saw, a couple of 50-in. chain-saw mills and a dehumidification dry kiln. Now he turns the city trees that must fall into boards and slabs. His inventory includes air and kiln-dried planks from all the usual city species, much of it tree-wide, some including crotch, stump and burl figure. Write Willard for a price list at 300 Basin Rd., Trenton, N.J. 08619. His prices seem high to me, but he does have wood that other dealers only dream about, and he'll ship anywhere. If you have something special in mind, send him a drawing and he'll return Polaroid photos of planks that might do.

* * *

Don Laskowski (2436 Fisher Ave., Indianapolis, Ind. 46224) has invented and patented a duplicating carving machine he sells for less than $600. It looks like a drafting table with a framework of sliding rods on top, which carries a router motor coupled to a stylus. Whatever the stylus does, the router copies. It handles objects up to 14 in. in diameter and 23 in. high, and has an attachment for spindles up to 65 in. long—plenty for gunstocks. The sample carvings I saw were proportionally correct although pretty ragged, requiring a fair amount of hand-carving and detailing to produce an acceptable surface. This seemed partly due to the flat-end router bits Laskowski uses, with matching flat-end styluses. Many industrial carving machines use a rounded stylus with a ball-mill type of bit, which follow detail more closely.

* * *

Difficulties of organization and site which have beset the group of craftsmen who planned to hold a woodworking conference this spring (see this column, Nov. '78), have now been resolved. The State University of New York at Purchase has offered its facilities, and the American Crafts Council has added its prestige as well as its public relations assistance. "Wood Conference '79: The State of the Art" will now be held Oct. 5, 6 and 7 at SUNY-Purchase. The fee will be $50, and enrollment will be limited to the first 200. The program is aimed at professional woodworkers and includes marketing, health and safety, tools and techniques and design. For more information write Ken Strickland, Visual Arts Department, State University of New York, Purchase, N.Y. 10577.

SOURCES OF SUPPLY Summer Woodworking Courses

Many woodworkers find summer vacation a convenient time to go back to school and hone their skills, either at short sessions that can be part of a family vacation or at full-time courses. To survey this summer's offerings, we sent a questionnaire to 279 woodworking schools and compiled the information below from their replies. The list is not complete, as many schools won't settle their schedules until later in the spring. We hope readers will tell us about other schools so we can keep the listings up to date.

The schools are listed alphabetically by state. Tuition does not include materials, and it sometimes depends on whether college credit is sought. Courses offered by schools with dorms sometimes can accommodate the vacationing families of students; this is indicated by the phrase, "lodging for families." Otherwise, "lodging," where listed, means for students only. Woodworkers should check with the schools for full details, and it's best to apply early. Woodworking courses are in great demand and enrollment is often limited.

California—Baulines Craftsman's Guild, Box 305, Bolinas, CA 94924. *Wood Seminars*, 10 consecutive Saturdays. Tuition: $135, includes materials, use of tools. 12 students. Dates to be determined.

California—Calif. College of Arts and Crafts, Wood Program, 5212 Broadway, Oakland, CA 94618. *Woodworking*, May 14-June 14, June 18-July 19, July 23-Aug. 23, 4 classes/wk., 4 hrs./class. Tuition: $360. College cr. Lodging. 15 students. Apply before first class to E.E. Benson.

California—Calif. State University, Industrial Studies Dept., 5151 State University Dr., Los Angeles, CA 90032. *Wood Construction Technology II (Cabinetmaking), Wood Manufacturing Technology II, Introduction to Wood Technology*, all June 18-Sept. 1, 2 classes/wk., 2½ hrs./class. Tuition: resident $112.50, nonresident $35/cr. Prerequisite: College-level woodworking or permission of instructor. College cr. 18 students. Apply before May 25 to S. Cappiello.

California—Evolution Art Institute, 6030 Roblar Rd., Petaluma, CA 94952. *Basic Woodworking—Hand and Machine Tools*, June 21-Aug. 30. 3 hrs./class, 1 class/wk., evenings. Tuition: $60. 8 students. *Basic Woodworking: An Introductory Weekend*, July 7-8, 8 hrs. daily. Tuition: $35. 6 students. Apply by date of first class.

Colorado—Anderson Ranch Arts Center, P.O. Box 2406, Aspen, Col. 81611. *Dollhouse Making*, June 11-15; *Wood Sculpture*, June 18-July 6; *Fine Furniture Making*, July 9-27; *Furniture Design*, July 30-Aug. 17; *Guitar-Making Clinic*, Aug. 20-24. Contact D. Garwood.

Connecticut—Eastern Connecticut State College, Extension Division, Windham St., Willimantic, CT 06226. *Sculpturing*, June 25-July 7, 5 classes/wk., 8:30 A.M.-10:00 P.M. Tuition: $105 noncr., $120 undergrad. cr. Lodging for families. 15 students. Apply to Shirley Wood.

Illinois—Chicago Academy of Fine Woodworking, 744 W. Fullerton, Chicago, IL 60614. 15-wk. courses in *Basic, Intermediate*, and *Advanced Woodworking, Advanced Design, Boat Carpentry*. 12-wk. courses in *Wood Turning, Carving* and *Sculpting*. Tuition: $175, includes materials, tools, text. Contact Ron Phillips for specific dates.

Kentucky—Eastern Kentucky University, Dept. of Ind. Ed. and Tech., Richmond, KY 40475. *Workshop in Industrial Education and Technology—Musical Instrument Construction*, June 11-22, 5 classes/wk., 6 hrs./class. Tuition: resident $62, nonresident $156 (grad. cr.). *Advanced Technical Problems in Woodworking and Wood Technology*, June 25-Aug. 3, 5 classes/wk. 3 hrs./class. Tuition: resident $93, nonresident $234 (grad. cr.). Prerequisite for both: 3 college courses in woodworking or equivalent practical experience. Lodging. 15 students. Apply to Albert G. Spencer before May 11 for Workshop and June 25 for Advanced Technical Problems.

Maine—Maine School of Cabinetry, Box 12, Cobb's Bridge Rd., New Gloucester, ME 04260. *Introductory Woodworking*, June 4-16, *Advanced Woodworking*, Aug. 6-18, both 56 hours. Tuition: $395. 14-16 students. Apply May 15-July 15 to Bill Huston.

Massachusetts—Boston Center for Adult Education, Crafts Dept., 5 Commonwealth Ave., Boston, MA 02116. *Woodworking, Fine Furniture*, both June 14-Aug. 23, 1 class/wk., evenings. Tuition: $44. 12 students. Apply before June 21 to registration office.

Massachusetts—Boston University Program in Artisanry, 620 Commonwealth Ave., Boston, MA 02215. *Wood Furniture Design I*, May 22-June 30. *Wood Furniture Design II*, July 5-Aug. 10, both 5 classes/wk., 6 hrs./class. College cr. Lodging for families, about $42/wk./adult. 20 students. Apply May 1-16 for Design I, June 5-27 for Design II, to Elmer Taylor.

Massachusetts—Cambridge Center for Adult Education, 42 Brattle St., Cambridge, MA 02138. *Woodwork and Carpentry*, June 15-Aug. 8, 1 class/wk., 2 hrs./class. Tuition: approx. $36. 11 students. Apply to Richard Siegel and Willie Hulls, instructors.

Massachusetts—Hoosuck Design and Woodworking, Windsor Mill, 121 Union St., North Adams, MA 01247. *Woodworking Skills*, June 4-9, June 18-23, July 9-13, *Woodworking Techniques*, June 11-16, July 16-21, *Design for Woodworkers*, July 23-28. All 7 hrs./class, 6 classes/wk. Tuition: $375, includes materials. Lodging for families, $35 1 adult, $100 family. Apply at least 2 weeks before class to Continuing Education, North Adams State College, N. Adams, MA 01247.

Massachusetts—New England Craftsmanship Center, PO Box 47, 5 Bridge St., Watertown, MA 02172. *Woodworking/Furniture Making*, June 1-Sept. 15. Continuous. Tuition: $4/hr. 4-6 students. Apply to Shirley Norton.

Massachusetts—Stringfellow Instruments, Windsor Mill, 121 Union St., North Adams, MA 01247. *Beginning Guitarmaking*, June 4 ($750), *Advanced Guitarmaking*, July 23 ($1000), both 6 wks., 6 classes/wk., 8 hrs. daily. Materials and tool use included. Col. cr. through North Adams State College or S. Vermont College. 9 beginning students, 6 advanced. Apply to William Cumpiano.

Massachusetts—Truro Center for the Arts/Castle Hill Inc., Castle Rd., Truro, MA 02666. *Wood Carving and Wood Technology*, Aug. 6-17, 5 classes/wk., 3 hrs/class. Tuition: $105, incl. materials, but students should bring tools. Col. cr. through Mass. College of Art and Lesley College. Lodging, $70/wk. 10 students. Apply to registrar.

Massachusetts—Worcester Craft Center, 25 Sagamore Rd., Worcester, MA 01605. *Woodworking*, July 9-27, 5 classes/wk., 6 hrs./class. Tuition: $180. College cr. Lodging for families, $50 wk./adult, $60 wk./2 adults, $5 wk./child. 12 students. Apply before June 15 to registrar.

Mississippi—Delta State University, Art Dept., Box D-2, Cleveland MS 38733. *3-Dimensional Design*, July 9-Aug. 10, 5 classes/wk., 2 hrs./class. Tuition: $25/semester hr. College cr. Lodging, $168/term. 15 students. Apply before July 9 to Malcolm Norwood, chairman.

Montana—Western Montana College, Ind. Arts Dept., Dillon, MT 59725. *Working with Wood*, July 27-Aug. 4, 4/classes, 8 hrs./class, *Finishing Materials—Wood*, July 20-22, 7 hrs./class. Tuition: resident $49, nonresident $79. College cr. Lodging, $5/wk. 8-15 students. Apply to Clayborn J. Anders.

New Hampshire—University of New Hampshire, Continuing Education, 6 Garrison Ave., Durham, NH 03824. *Stringed Instrument Making*, June 15-Sept. 1, 2 classes/wk., 4 hrs/class. Tuition: $75-$100. Woodworking helpful. 5 students. Apply to Thomas E. Knatt, 83 Riverside Ave., W. Concord, Mass. 01742.

New Jersey—American Carving School, Box 1123, Wayne, NJ 07470. *Basic Carving* ($200), *Advanced Carving* ($250), 1-wk. sessions (40 hrs.), materials included. 8 students. Apply before June 15 to M. DeNike.

New Jersey—Peters Valley Craftsmen, Star Route, Layton, NJ 07851. *Basic Furniture*, July 5-7; *Lumbering*, July 9-13; *Musical Instruments*, July 16-27; *Sculptural Woodworking*, Aug. 2-4; *Basic Joinery*, Aug. 6-17; *Furniture*, Aug. 20-30. Lodging. 7-10 students. Contact Summer Workshops for details.

New York—Art Life Craft Studios, 1384 3rd Ave., New York, NY 10021. *Sculptural Wood Carving* and *Wood Construction and Carving*, continuous June-Sept. Tuition $95. 10 students. Contact Ron Mineo before June 30.

New York—John Harra Woodworking Studio, 39 W. 19th St., New York, NY 10011. *Cabinetmaking*, 4 hrs./class, 10 classes. Tuition: $190. College cr. can be arranged. 7 students.

New York—School of Visual Arts, Fine Arts Dept., 209 E. 23 St., New York, NY 10010. *Beginning to intermediate woodworking* offered in sculpture courses, 1 class/wk., 12 wks., for 3 hrs. Tuition: $135. Contact Division of Continuing Education in April.

New York—Thousand Islands Museum Craft School, 314 John St., Clayton, NY 13624. *Bird Carving*, July 30-Aug. 10, Aug. 13-24, 5 classes/wk., 60 hrs. Tuition: $115. College cr. 10 students. Apply to Keith Walker at least 2 weeks before course.

New York—The Woodsmith's Studio, 142 E. 32nd St., New York, NY 10016. 2-wk. mini-courses in *Woodturning* ($155), *Picture Frame Making* ($155), *Woodcarving* ($145), *Furniture Finishing* ($145), and *Cabinetmaking* ($195). 5 classes/wk., 2½ hrs./class, except Cabinetmaking (4 hrs./class). 10-wk. courses in same areas begin June 25, 1 class/wk., 2½ hrs./class. 3-10 students. Apply to Jerry Gerber, president.

North Carolina—Appalachian State University, Industrial Arts Dept., Boone, N.C. 28608. *Wood Tech., Adv. Wood Tech., Indus. Finishing*, and *Furniture Design & Construction*, June 4-Aug. 10. Contact B. Hanner.

North Carolina—Central Piedmont Community College, Art Dept., Box 4009, Charlotte, NC 28204. *Basic Woodworking, Furniture Restoration*, both July 12-Sept. 13, 2 classes/wk., 3 hrs./class. Tuition: resident $9.25, nonresident $39.50. College cr. 15 students. Apply before June 11 to Don Chapman.

North Carolina—Country Workshops, Inc., Route 3, Box 221, Marshall, NC 28753. *Country Woodcraft*, July 2-6; *Make a Chair From a Tree*, Aug. 14-18; *Log Building*, dates not set. All 5 classes/wk. Tuition: $165, includes materials, campsite and meals. Send self-addressed, stamped envelope for info. Apply to Drew Langsner.

North Carolina—Guilford Technical Institute, Adult Ed. Dept., Box 309, Jamestown, NC 27282. *Furniture Construction*, 2 classes/wk., 3 hrs./class, and *Wood Sculpture*, 1 class/wk., 3 hrs./class, both June-Sept. Fee: $5. 20-25 students. Apply before June to W.C. Eller.

North Carolina—Penland School of Crafts, Penland, NC 28765. *Courses in furniture design and construction*, June 4, 18, July 2, 23, Aug. 13, Sept. 3. Tuition: $75. College cr. through East Tenn. State University. Lodging. 10 students. Apply to registrar.

Ohio—Agricultural Technical Institute, Wood Science Dept., Wooster, OH 44691. *Internship in Forest Products Industry*, June 18-Aug. 24. Tuition, $310. College cr. Apply before June 1 to Dr. Peter R. Mount.

Ohio—Kent State University, School of Tech., Kent, OH 44242. *Woods I*, June 18-July 20, 5 classes/wk., 2 hrs./class. Tuition: resident, $65, nonresident, $133. College cr. Lodging for families, $9 wk./ adult, children half price. 24 students. Apply to W. Heasley.

Oklahoma—East Central State College, Woodworking Dept., Ada, OK 74820. *Fundamentals of Woodworking*, June 2-July 29, 4 classes/wk., 2 hrs./class. Tuition: resident $11.95/semester hr., nonresident $18.75/semester hr. College cr. Lodging for families. 15 students. Apply before June 5 to Charles R. Barrick.

Oklahoma—Northeastern Oklahoma State University, Ind. Ed. Dept., Tahlequah, OK 74464. *General Wood, Machine Wood, Finishing of Materials*, all June 4-July 31, 5 classes/wk. Tuition: resident $38.85, nonresident $101.10, except Finishing (resident $41.85, nonresident $110.10). Col. cr. Lodging for families, 15-20 students. Apply before June 6 to V. Isom.

Oklahoma—Northwestern Oklahoma State University, Ind, Ed. Dept., Alva, OK 73717. *Bench Woodworking, Furniture and Cabinetmaking*, both July 2-Aug. 3, 5 classes/wk., 1½ hrs./class. Tuition: Bench Woodworking, resident $12.45, nonresident, $32.45. For Cabinetmaking, resident $13.45, nonresident, $34.45. College cr. Lodging for families, $20 wk./adult. 10 students. Apply before July 2 to Jerry Brownrigg, chairman.

Oklahoma—Oklahoma State Univ., Ind. Arts Ed., 104 Industrial Bldg., Stillwater, OK 74074. *Production Shopwork*, 4 classes/wk. *Industrial Crafts*, 2 classes/wk. Both May 31-July 27. Tuition: $15.50/cr. hr. Lodging for families. 20 students. Apply before June 4 to Dr. J.B. Tate.

Pennsylvania—Edinboro State College, Art Dept., Doucette Hall, Edinboro, PA 16444. *Wood Furniture I, Turning, Basic Furniture*, June 4-22, 5 classes/wk., 6 hrs./class. Tuition: resident, $117, nonresident, $213. College cr. Lodging for families, $27 wk./adult, $54 wk./2 adults. 15 students, total. Apply before June 4 to R. Laing.

Pennsylvania—Indiana University of Pennsylvania, School of Fine Arts, Woodworking Dept., Indiana, PA 15701. *Advanced Woodworking*, June 25-Aug. 2, 2 classes/wk., 3 hrs./class. Tuition: resident $120. College cr. 12 students. Apply to Christopher Weiland.

Pennsylvania—Kutztown State College, School of Art, Kutztown, PA 19530. *Wood Design I, Wood Design II, Wood Design Studio*, all Aug. 6-24, 5 classes/wk., 3 hrs./class. Grad. or undergrad. cr. Tuition: resident $39/cr., nonresident $71/cr. *Grad. Wood Design*, Aug. 6-24, 5 classes/wk., 3 hrs./class. Tuition: $153/cr. Some prerequisites. Room and board $33/wk. adult. 25 students. Apply before Aug. 24 to John E. Stolz.

Rhode Island—Rhode Island School of Design, Box E-16, 2 College St., Providence, RI 02903. *Woodworking/Furniture Construction*, June 25-Aug. 3, 3 classes/wk., 7 hrs./class. Tuition: $260. College cr. Lodging. 15 students. Apply before June 25 to John Dunnigan.

Vermont—Goddard College, Plainfield, VT 05669. *Hand Woodworking*, June 2-Aug. 22, 2 classes/wk., 3 hrs./class. Tuition: $2400 for 15 crs., room, board. 8 students. Apply before May 15 to Summer Arts Community.

Vermont—Guitar Research and Design Center, South Strafford, VT 05070. *Guitar Construction and Design*, April 30-June 8, June 18-July 27, Aug. 6-Sept. 14, 6 classes/wk., 8-12 hrs./class. Tuition: $1000, incl. materials, tools, lodging. 8 students. Apply to C. Fox.

Vermont—Russ Zimmerman, RFD 3, Box 57A, Putney, VT 05346. *Woodturning Workshop*, continuous, 16-17 hrs. Tuition: $150, includes meals, lodging, tools. 2 students. Apply to Russ Zimmerman, $.25 for brochure.

Virginia—Woodshed Studio, 5003 W. Leigh St., Richmond, VA 23230. *Woodworking, Cabinet Making, Furniture Making*. Classes offered continuously. Tuition: $100 for 10 classes, 1 3-hr. class weekly. Apply to R.W. Haine.

Washington—Northwest School of Instrument Design, P.O. Box 30698, Seattle, WA 98103. *Intro. to Hand Tool Woodworking*, June 4-15, July 16-27, 5 classes/wk., 5 hrs./class. Tuition: $150. *Dulcimer Makers' Workshop*, June 25-July 6, Aug. 6-17, 5 classes/wk., 5 hrs./class. Tuition: $250, incl. materials, tools. 10 students. *Evening lecture on instrument making*, 10 weeks, 3 classes/wk., 3 hrs./class. Tuition: $250. 20 students. Contact registrar.

Photos: Brian Gulick

Flight of Fancy

Although John Kahn's Flying Machine will never leave the ground—except in Kahn's mind—it captures the fascination with woodworking and flight of its maker, who is also a unicyclist and circus performer. The body of the contraption is a wooden tricycle; the pilot aboard it pedals, turning the back wheels and the chains that roll the cage full of ping-pong balls. The cage turns the center gears with off-center bearings, cranking the connecting rods, and the wings flap. The hand pedals above the wheel open the front propeller, for lift-off.

Kahn used seven different woods for the machine, but ash and mahogany predominate. Both the shaft below the propeller and the wheel spokes are brass. To form parts like the tricycle body and the feathers in the wings, Kahn used a combination of steam-bending and lamination, best, he says, for tight curves. The machine measures 11 ft. tall, has a wingspread of 16 ft. and weighs about 600 lb. It took about 1,000 hours over 7½ months to build, and cost about $2,000 in materials. The Flying Machine will next be shown at the Allen Stone Galleries in New York City in June, as part of their annual "New Talent" exhibition, and Kahn would sell it to the right buyer, just as he's sold each of his other sculptures—without sentimentality. The joy is in the making, he says.

Kahn, 22, of Malverne, N.Y., built the Flying Machine, eggbeater and corkscrew (which also work), in the woodworking shop at the State University of N.Y. (Purchase). For his senior show last year he was asked to haul 25 of his pieces to the college's Neubeurger Museum, a rare honor for student work. Kahn plans to open a woodshop of his own this spring, but right now he's foreman of a team restoring a house in Seacliff, Long Island to its previous Victorian splendor.

Ash, oak and walnut corkscrew is 3 ft. tall.

Eggbeater, 7 ft. tall, is made of ash, cherry, mahogany, Russian birch and brass.