Basic Blacksmithing

What a woodworker needs to forge tools

by Ray Larsen

Author files weld on shell auger.

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

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

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

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

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

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Equipment

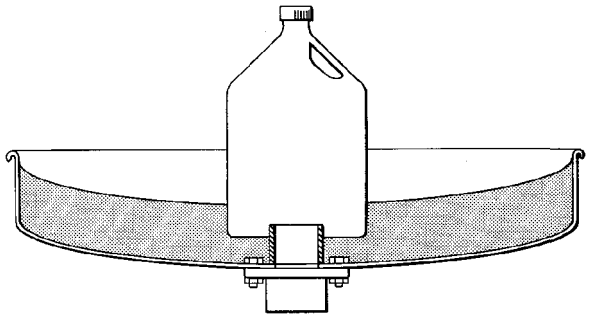
I began blacksmithing with a homemade forge, two borrowed pairs of tongs, a $35 anvil and a beat-up grindstone. Most serious woodworkers already have several pieces of equipment essential to toolmaking, including a good grinding wheel or other sharpening system, high-quality bench honing equipment and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

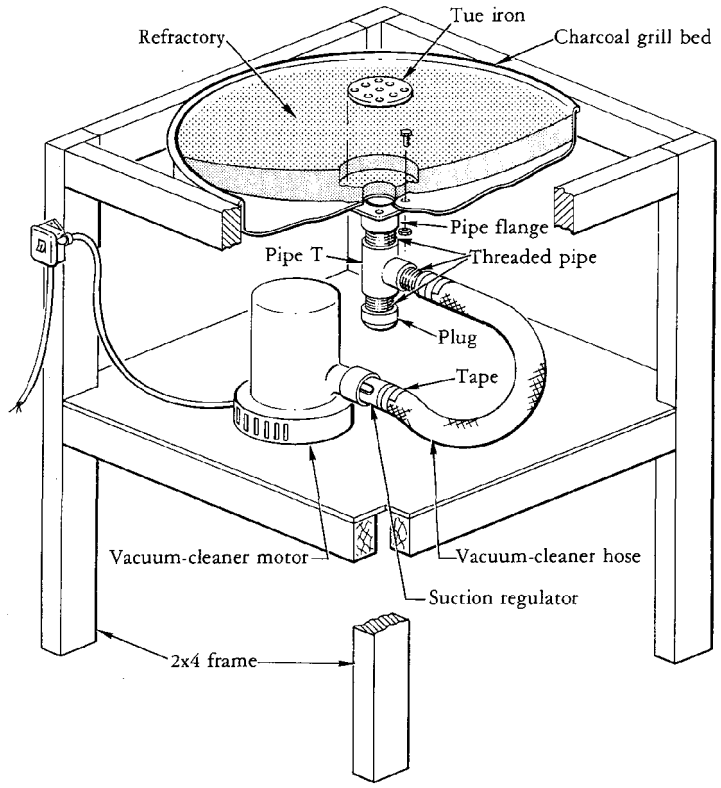
The heart of the blacksmith shop is the forge, in which a blast of air applied to a coal, coke or charcoal fire heats steel to the elevated temperatures required for forging. There are many sizes and styles, from big, permanent types costing well over $1,200 to small, portable types found in junkyards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

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

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

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





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

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

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

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

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

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

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

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

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

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

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

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

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

Fuel

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

Steel

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

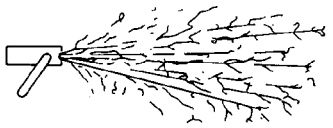
Carbon steel is the single largest type of steel produced in this country and comes in many grades. There are two good reasons for using carbon steel: It costs considerably less than specialty steel, and it comes in many toolmaking shapes not readily available in specialty steels. Prices of carbon steels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

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

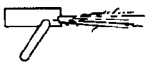
Author at work. Note rack of tongs by the forge and hardies mounted in slips around base of anvil, a 350-lb. Hay Sudden.

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

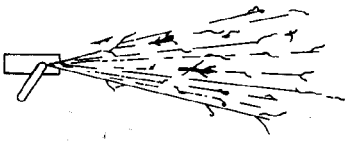
Spark patterns identify steels



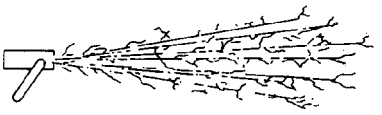
High-carbon steel: Considerable bursting; sparking around wheel. Gold/white color.



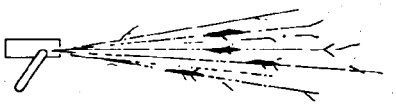
Cast iron (not forgeable): Short, thin, brick-red streamers. Very slight sparking.



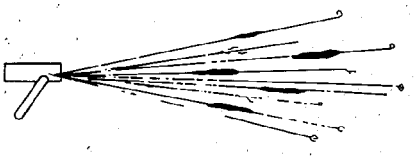
Medium-carbon steel: Some exploding or bursting sparks. Some sparking around periphery of wheel.



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



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



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

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

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

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

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

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

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

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

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

AISI 44OC Stainless is a high-carbon steel favored by most blade makers where exposure to the elements is a major consideration. It relies on high chromium content for its corrosion resistance. It will not hold as fine an edge as W2.

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

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

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

Technique

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

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

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

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

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

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

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

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

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