First Fires

a workshop for beginners

FORWARD

This publication has been developed to serve in two parts: 1) as a guide to plan and set up a beginner's workshop, and 2) as a booklet for participants to follow with illustrations of basic techniques.

A pilot workshop started by the Blacksmith's Association of Missouri (BAM) was the beginning of this program, setting the guidelines for a traveling curriculum, complete with mobile equipment that could be used for beginner or advanced classes and demonstrations. the members of BAM who volunteered their time and effort for the first event have set a fine precedent to follow.

A special thanks to Jerry Hoffmann of the ***Blacksmith's Journal,*** who has given permission for the reproduction of his illustrated techniques.

I hope this publication serves as a guide and as the needed element for a successful workshop.

Lou Mueller

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TIPS TO SAVE YOUR ARM & OTHER BODY PARTS

ANVIL HEIGHT

The old rule that the height of the anvil should be set to the knuckles of your hand when standing was used for strikers when delivering heavy blows. Raise the anvil to a height that serves you better. When your hammer makes contact, your wrist should not be over extended. This will take the strain off the tendon in your forearm.

HAMMER

Learn to relax your grip as you strike. Do not use a full over-hand swing until you have developed hammer control. It will come with time and practice. Your grip should be firm, but relaxed when you come in contact with the metal.

At first, use a hammer you are comfortable with and one you can control. As you advance, you will find you may change the style, shape and weight of your hammer.

When you hit, do not try to push the hammer with your wrist for more power.

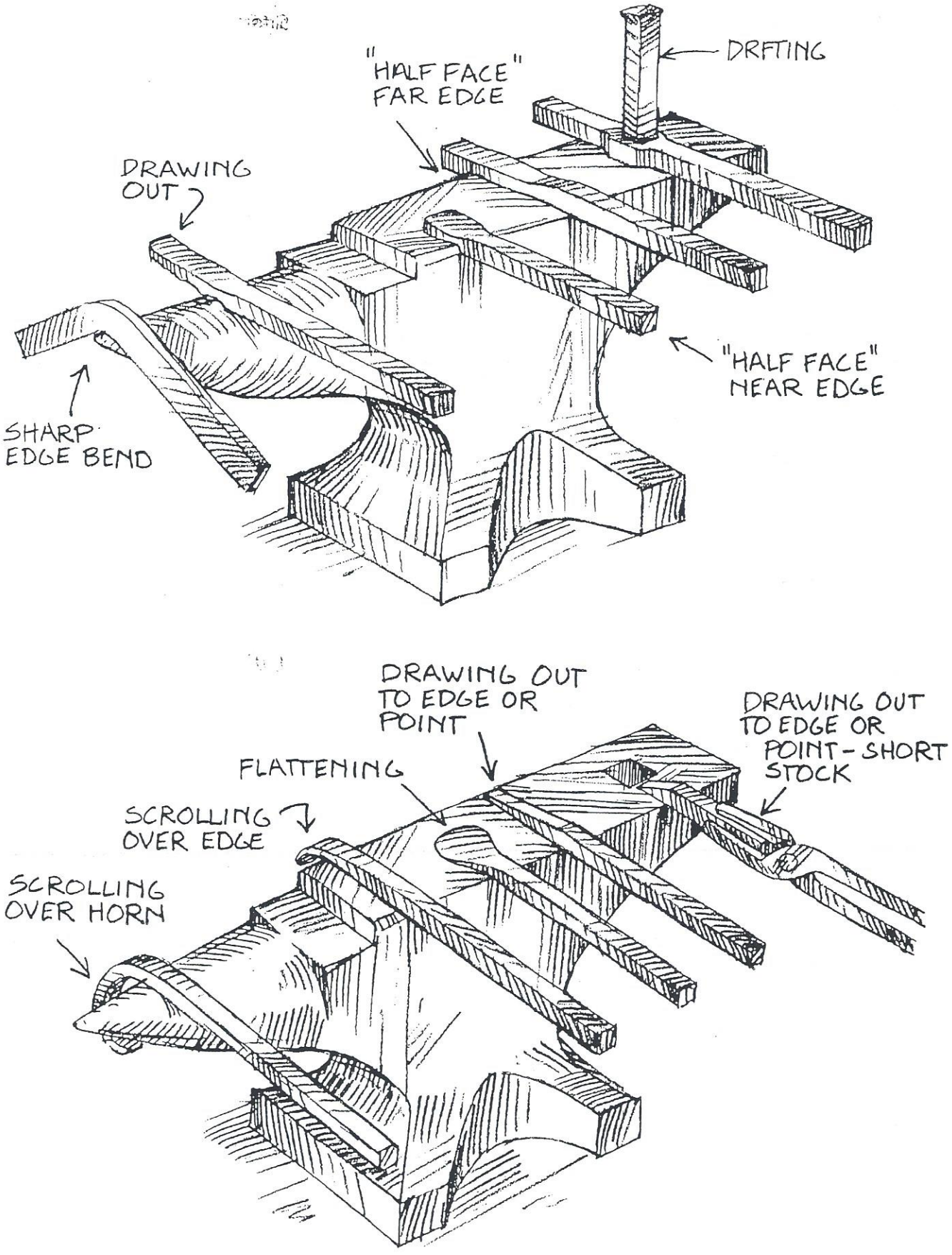
Placing the thumb on top of the hammer handle for control is for finish work. Use a full grip with the thumb on the side of the hammer for heavier blows.

When first starting out, use 5/16" or 3/8" round and/or square stock, and 1/4" x 1/2" flat material. You will be able to see metal movement without a lot of hammering. (Don't forget to use the anvil horn.)

KEEP THESE SAFETY TIPS IN MIND

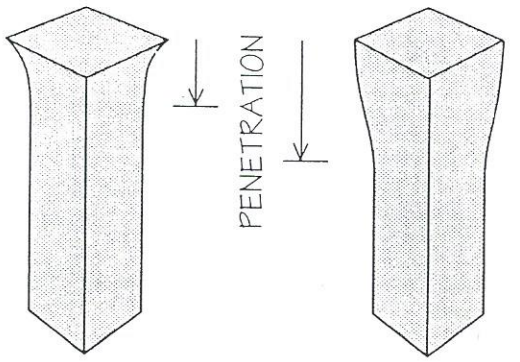
1) Safety glasses are a must!
2) Ear plugs are recommended.
3) Wear cotton gloves, especially for your holding hand.
4) Do not stare directly into a hot fire.
5) When metal is a dull red, it is still at least 1,100 to 1,200 degrees F.
6) If it is on the floor, it is probably hot! Never pick up any metal without checking it first.

HAMMER & ANVIL



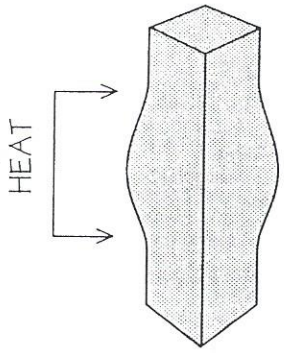
FORGING DYNAMICS

UPSETTING

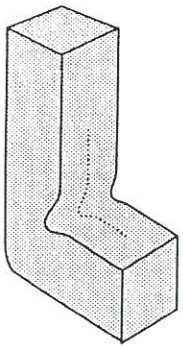


LIGHT BLOWS FORM ENDS INTO A BELL SHAPE.

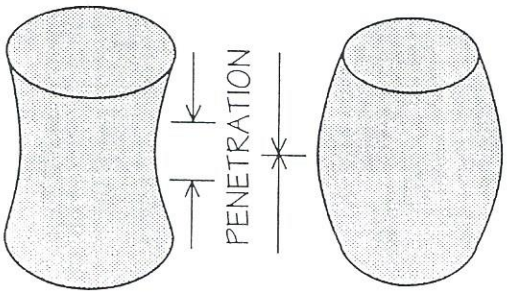
HEAVY BLOWS FORM ENDS DEEPER INTO THE STOCK.



HEATED AREAS AWAY FROM THE END OF A BAR UPSET UNIFORMLY.



UPSET CORNERS TEND TO FOLD IN-WARD ON THE INSIDE.



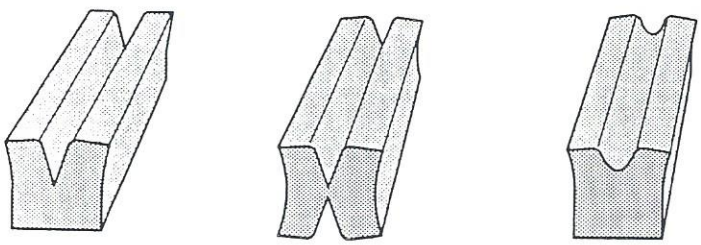
LIGHT BLOWS FORM THE ENDS OF SHORT STOCK INTO A BELL SHAPE; HEAVEY BLOWS UPSET THE CENTER UNIFORMLY.

PUNCHING

PUNCHING DRAWS STOCK DOWN INTO THE HOLE MAKING THE SURFACE CON-CAVE, SPREADING THE STOCK OWTWARD FROM THE HOLE.

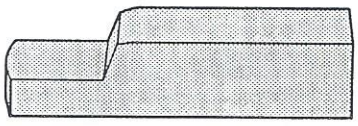
AWARENESS OF FORGING DYNAMICS ENABLES YOU TO USE THEM TO YOUR ADVANTAGE AND PREDICT THEIR OCCURENCE. EFFICIENT APPLICATION OF FORCE AND USE OF EFFECTIVE TOP AND BOTTOM TOOLS SAVES TIME AND EFFORT IN THE LONG RUN.

CUTTING & GROOVING



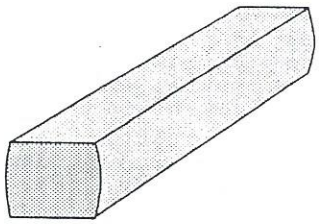
GROOVING AND FULLERING ALONG THE LENGTH OF A BAR MAKES THE EDGES CONVEX AS THEY MOVE AWAY FROM THE SHAPE OF THE IMPRESSION.

SHOULDERS

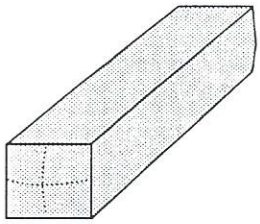


SOULDERS FORM AT AN ANGLE AS THE DRAWING OUT FORCE OF THE END PUSHES MATERIAL AWAY FROM THE TOOL. MATERIAL DRAWS DOWN BETWEEN THE TOOL AND SHOLDER, DEMENISHING STOCK THICKNESS NEAR THE SHOULDER

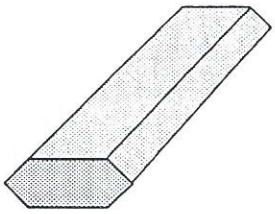
DRAWING OUT (DEEP PENETRATION)



HEAVY, DEEPLY PENETRATING BLOWS ON TWO SIDES MAKE THE EDGES CONVEX.



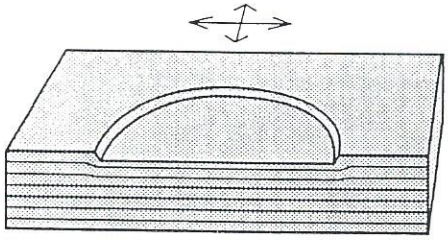
HEAVY, DEEPLY PENETRATING BLOWS ON ALL FOUR SIDES MAKE THE END CONVEX.



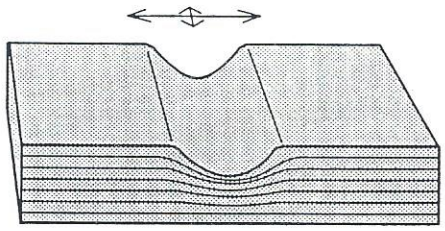
FORGING ON THE DIAMOND OR FORGING ROUNDS PERMITS DEEPER INITIAL PENETRATION.

THE RATIO BETWEEN THE AMOUNT OF FORCE AND PENETRATING ABILITY OF THE TOOL WILL DETERMINE THE WAY IN WHICH SURROUNDING MATERIAL WILL MOVE. DEEP PENETRATION TENDS TO MOVE MATERIAL FROM THE CENTER OF THE STOCK OUTWARD, SHALLOW PENETRATION TENDS TO MOVE MATERIAL NEAR THE SURFACE OF THE STOCK OUTWARD.

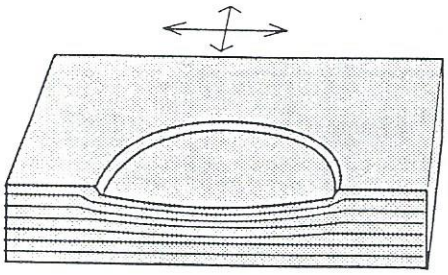
IMPRESSIONS (EQUAL FORCE)



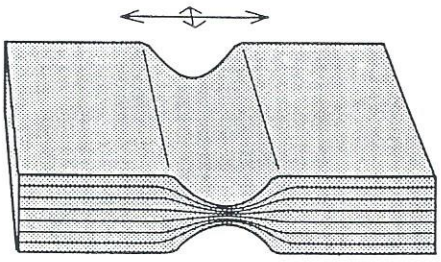
FLAT IMPRESSIONS IN FLAT SURFACES MAKE SHALLOW PENETRATION DISPLACING SMALL AMOUNTS OF STOCK RADIALLY.



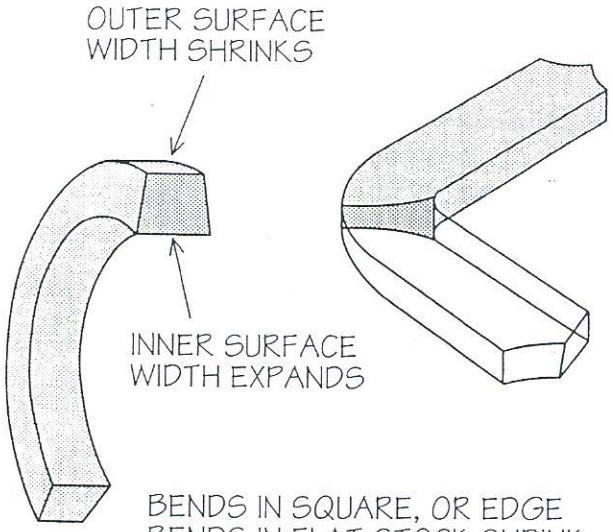
HALF-ROUND IMPRESSIONS IN FLAT SURFACES MAKE DEEP PENETRATION DISPLACING LARGE AMOUNTS OF STOCK IN OPPOSING DIRECTIONS.



CONVEX IMPERESSIONS IN FLAT SURFACES MAKE MODERATE PENETRATION DISPLACING MODERATE AMOUNTS OF STOCK RADIALLY.

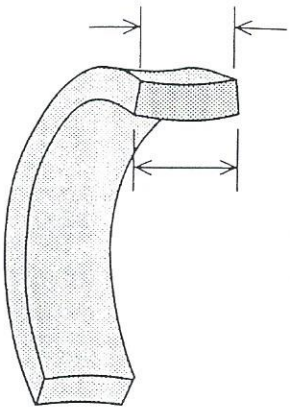


HALF-ROUND IMPRESSIONS, TOP AND BOTTOM, IN FLAT SURFACES MAKE VERY DEEP PENETRATION DISPLACING LARGE AMOUNTS OF STOCK IN OPPOSING DIRECTIONS.



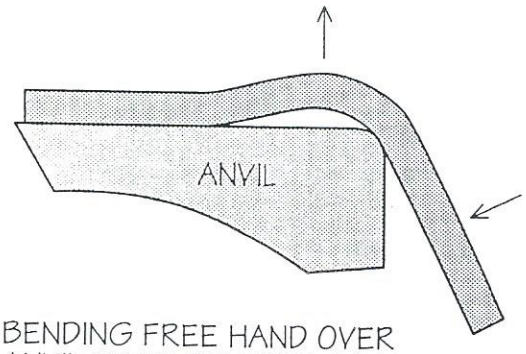
BENDS IN SQUARE, OR EDGE BENDS IN FLAT STOCK SHRINK THE WIDTH OF THE OUTER SURFACE AND EXPAND THE WIDTH OF THE INNER SURFACE.

BENDING

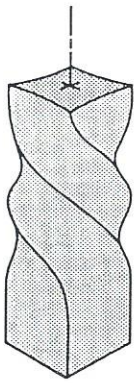


BENDS IN THE FLAT STOCK SHRINK THE OUTER SURFACE MAKING IT CONCAVE, AND EXPAND THE INNER SURFACE MAKING IT CONVEX.

TWISTING



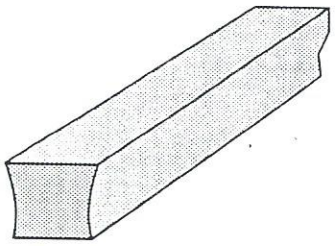
BENDING FREE HAND OVER ANVIL EDGE OR HORN CAUSES HEATED AREAS BEHIND THE BEND TO BUCKLE



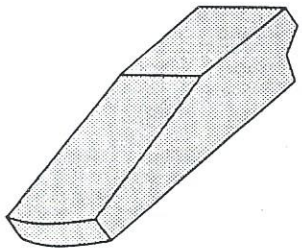
TWISTING MAKES FLAT SURFACES CONCAVE. THE LENGTH OF THE BAR REMAINS THE SAME BECAUSE THE AXIS REMAINS UNDISTURBED.

IMPRESSIONS STRETCH ALONG THE LENGTH & SHRINK ON THE WIDTH OF THE SURFACES.

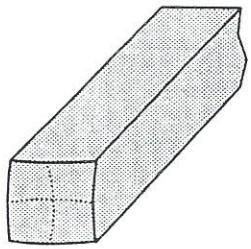
DRAWING OUT
(SHALLOW PENETRATION)



HAMMER TOP, ANVIL BOTTOM BLOWS MAKE THE TOP SURFACE WIDER THAN THE BOTTOM.



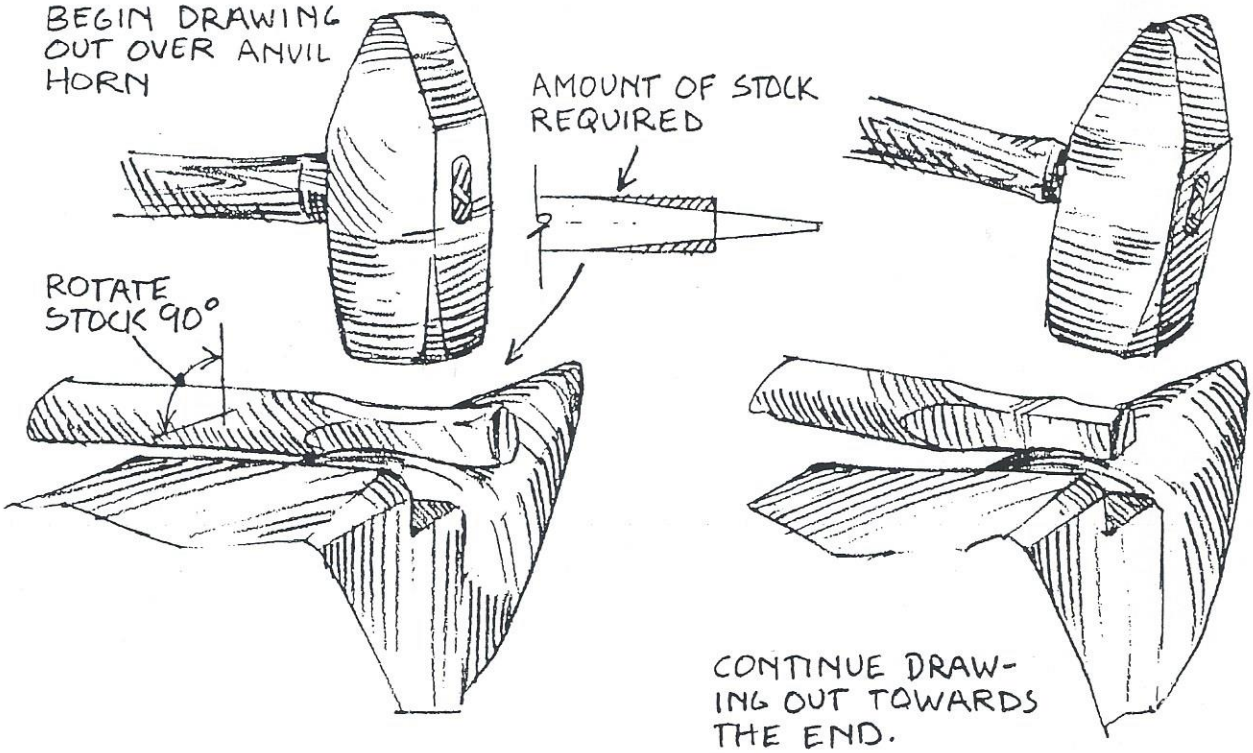
HAMMER TOP, ANVIL BOTTOM BLOWS MAKE THE END TAPER FROM THE TOP TO THE BOTTOM.

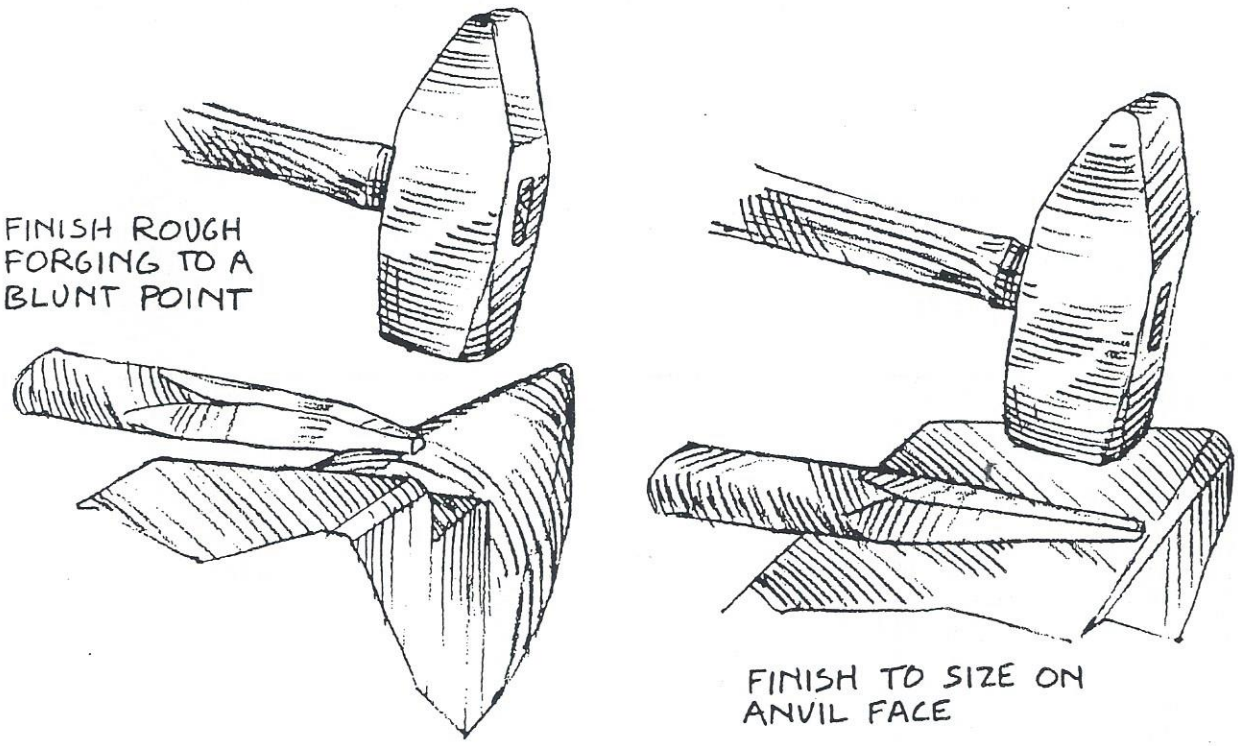


LIGHT TO MEDIUM BLOWS TO ALL FOUR SIDES MAKE THE END CONCAVE.

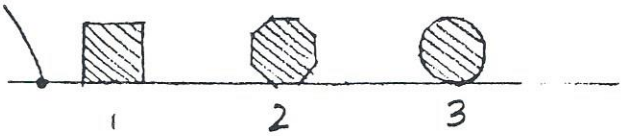
SECOND PERIOD

DRAWING OUT

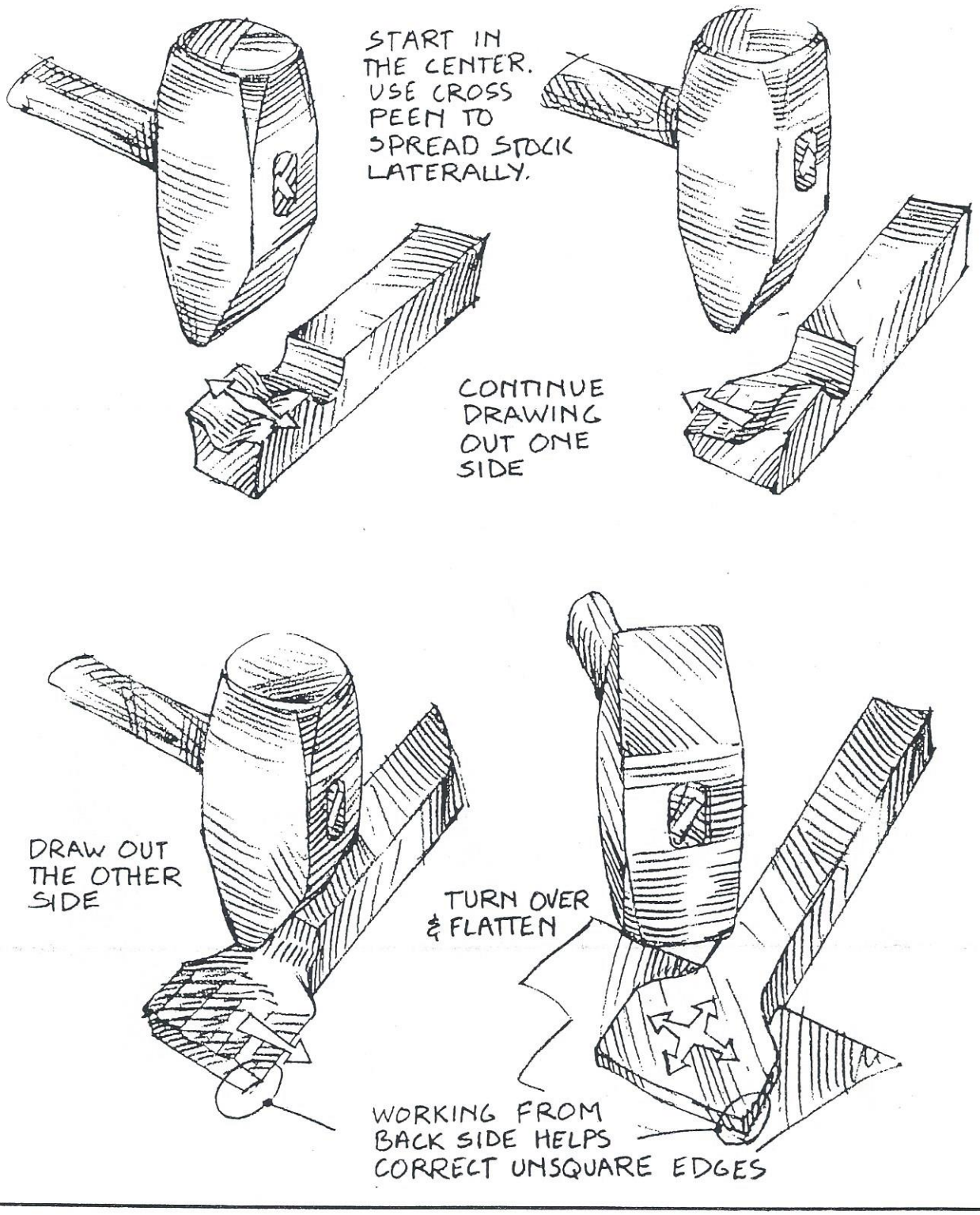




TO MAKE A ϕ TAPER, CONTINUE FORGING INTO AN OCTAGON SHAPE - THEN ROUND



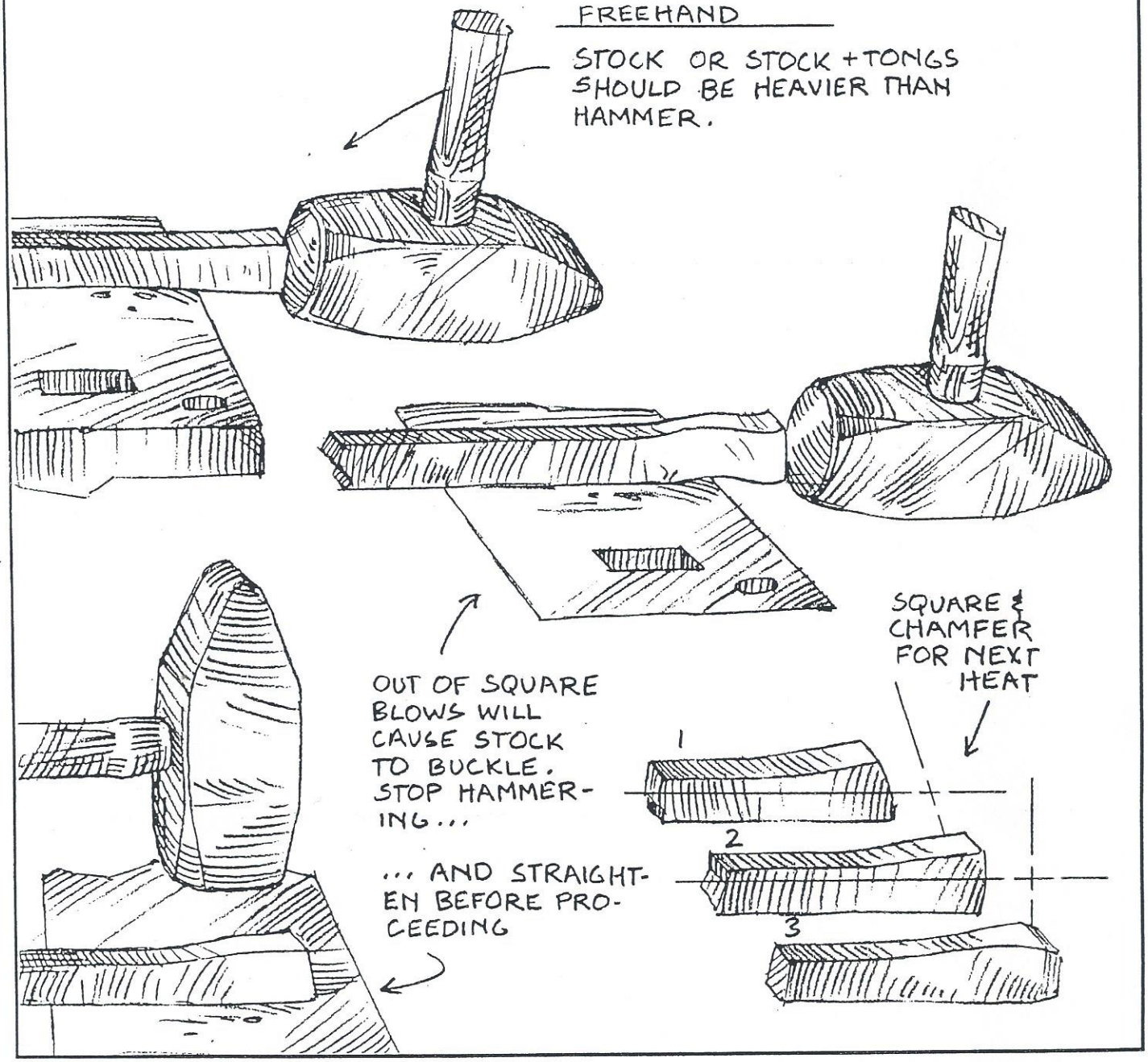
DRAWING OUT


START IN THE CENTER. USE CROSS PEEN TO SPREAD STOCK LATERALLY.
CONTINUE DRAWING OUT ONE SIDE
DRAW OUT THE OTHER SIDE
TURN OVER & FLATTEN
WORKING FROM BACK SIDE HELPS CORRECT UNSQUARE EDGES

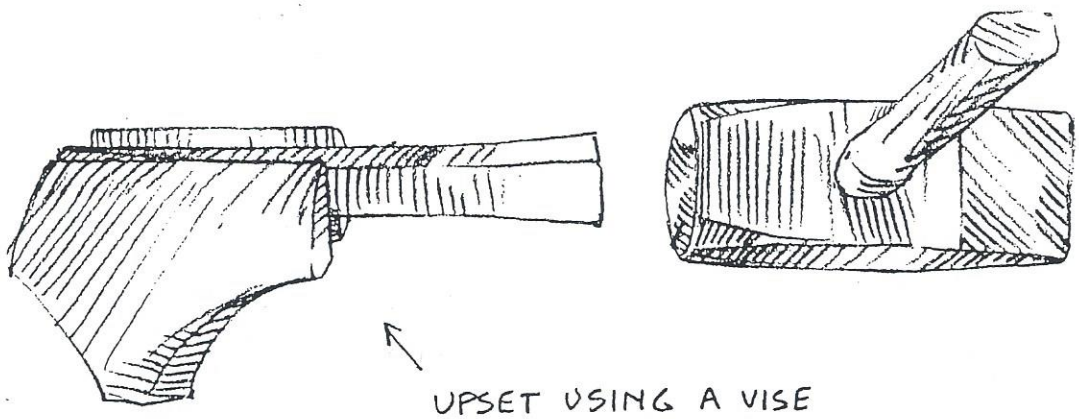
THIRD PERIOD

UPSETTING

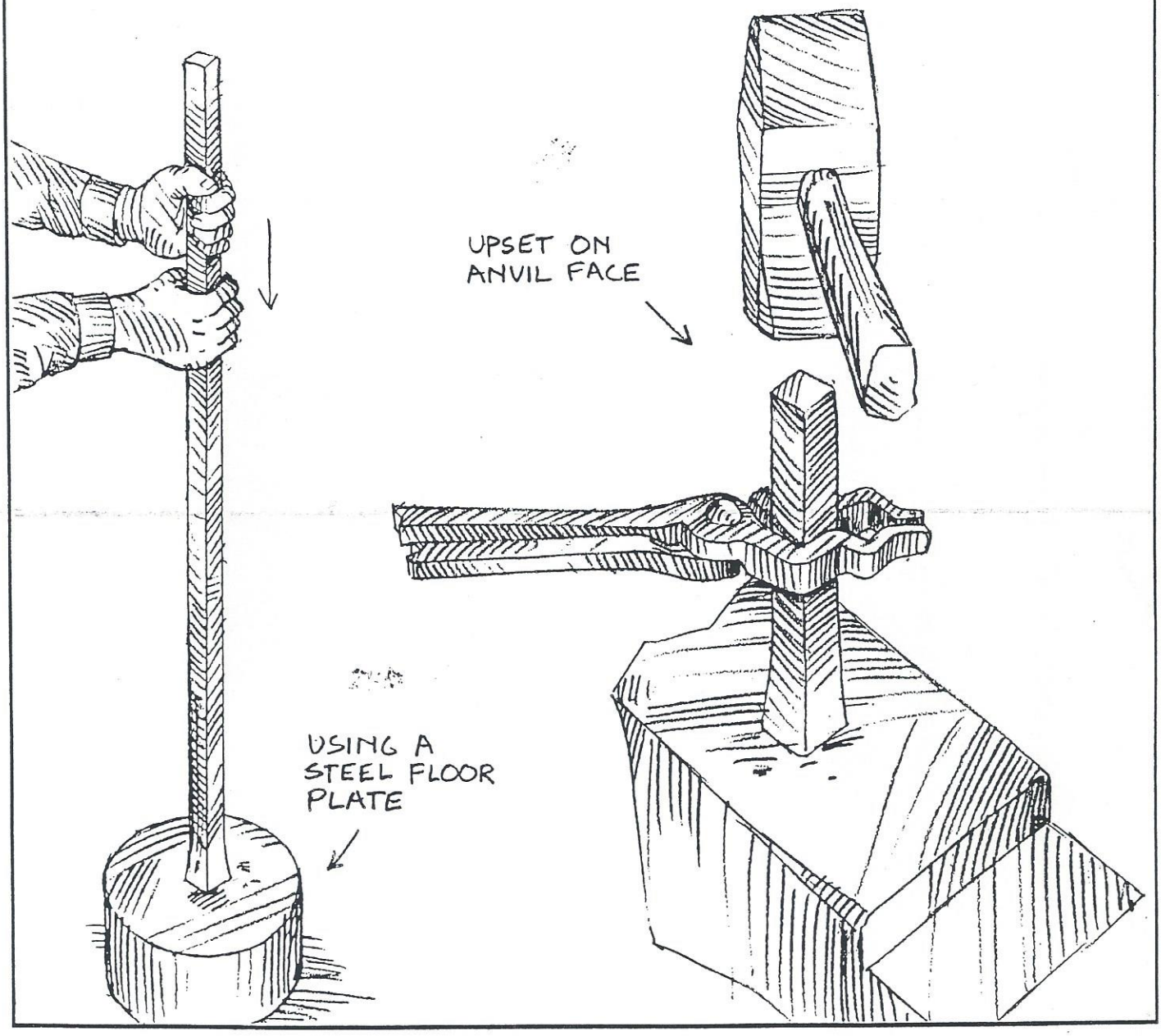
Upsetting is a process in which the stock becomes thicker and shorter as a result of hammering on one end. It is most commonly used for preparing scarfs (111.2-1), forming rivet heads & rosettes and for other applications where extra mass is needed. Upsetting does have it's limitations, and it is sometimes easier to forge weld more material to the piece than it is to upset it.



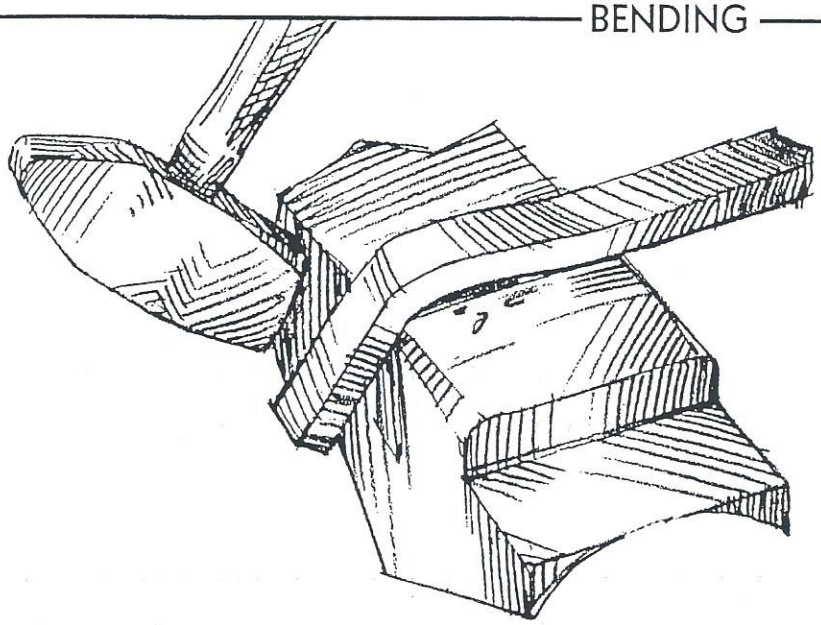
UPSETTING



UPSET USING A VISE

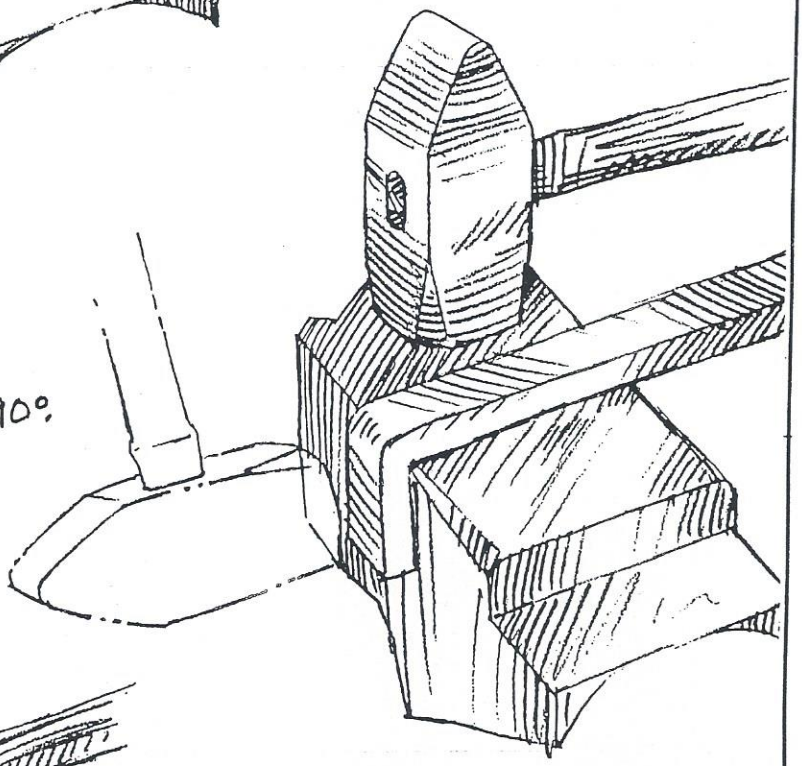


BENDING

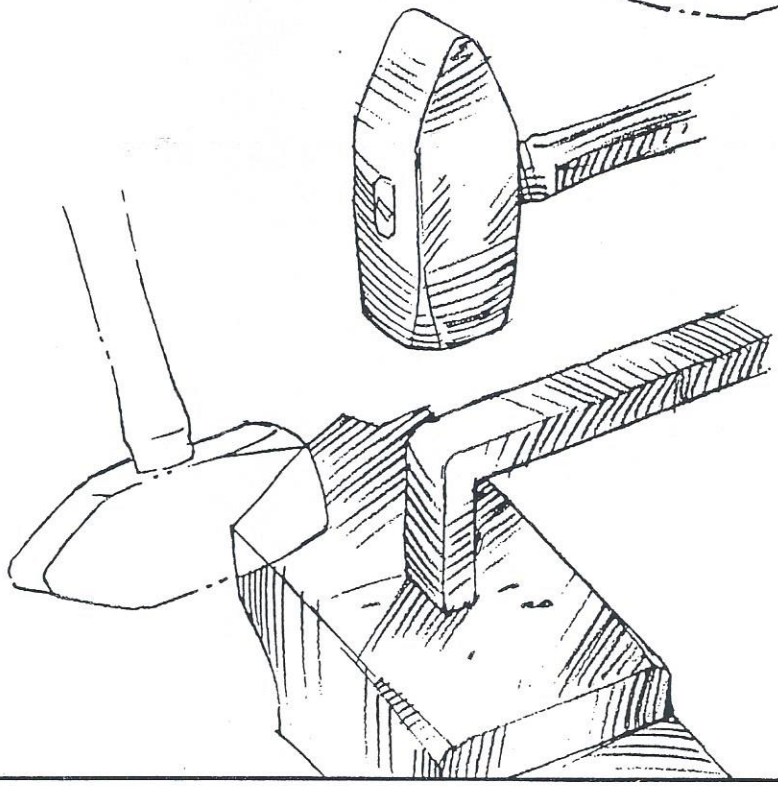


RIGHT ANGLE BEND

START OVER SLIGHTLY ROUND EDGE OF ANVIL. HAMMER JUST BEYOND THE BEND.



STRAIGHTEN THE STOCK BEHIND THE BEND BEFORE FINISHING @ 90°.

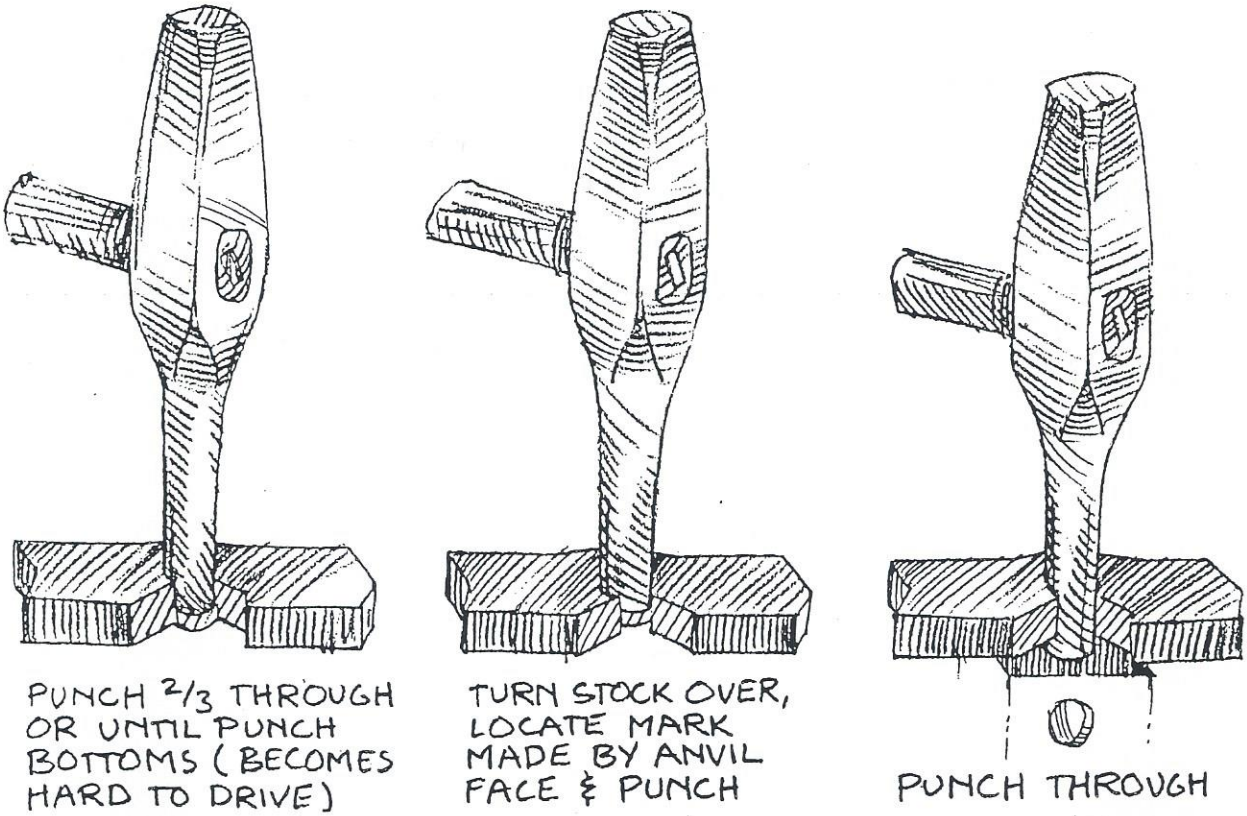


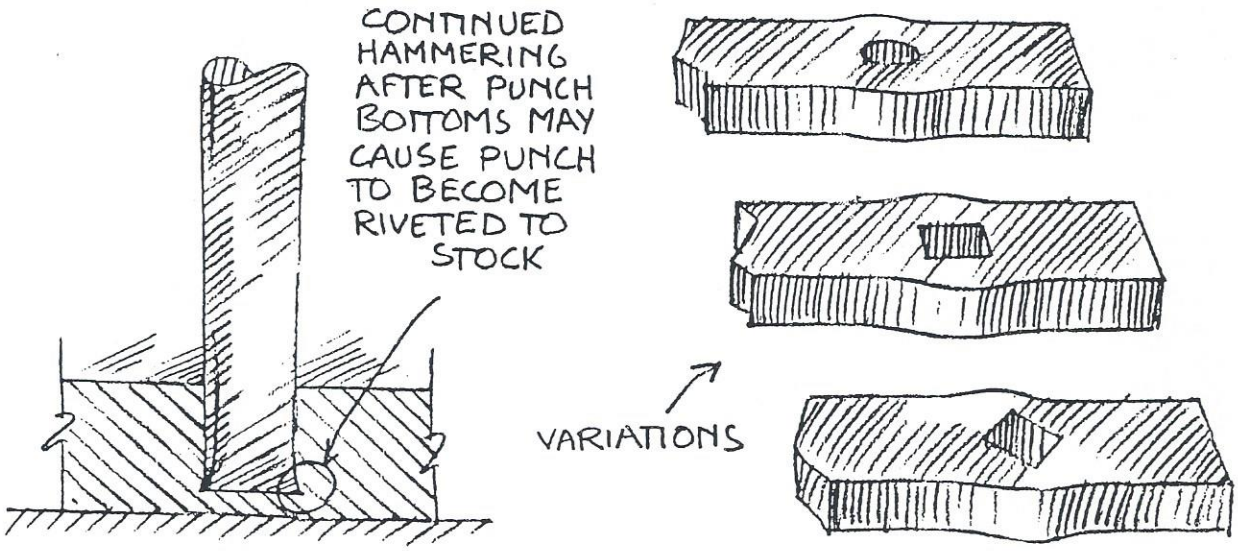
HAMMER AS SHOWN TO TIGHTEN UP THE BEND A LITTLE BIT.

FOURTH PERIOD

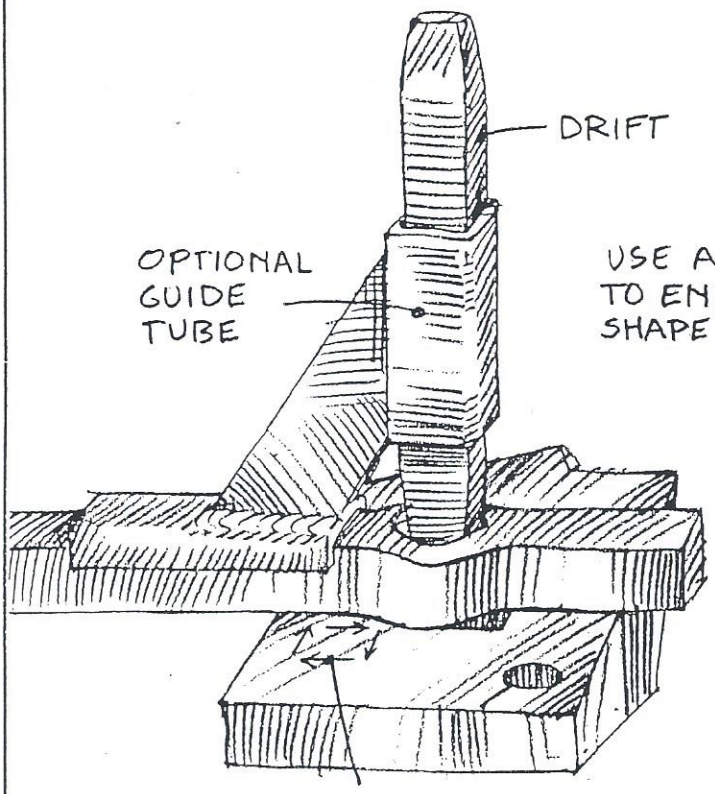
PUNCHING

Hot punching enables you to punch relatively thick stock, using hand held tools, with less material loss than if you were cold punching or drilling. Holes can also be slot punched; this technique combines splitting and drifting to make holes with little or no material loss. Slot punched holes do not weaken the stock as much as holes made by other methods.



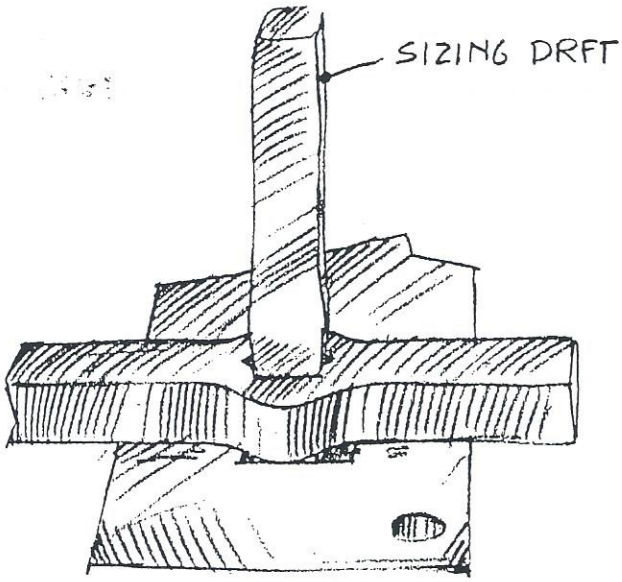


DRIFTING

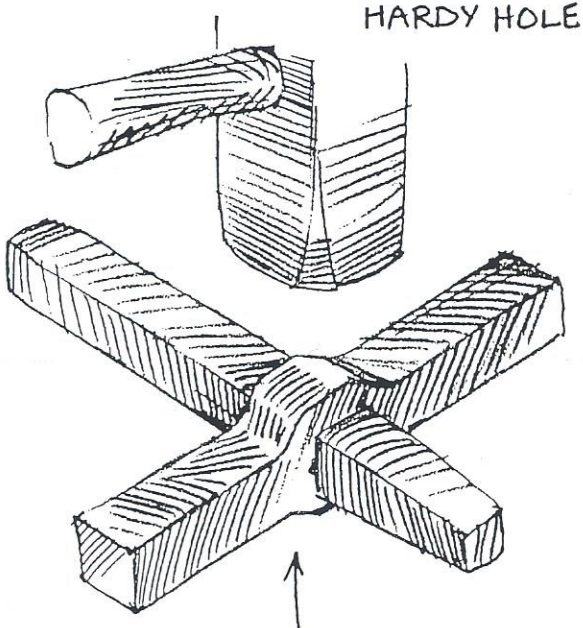


USE A DRIFT TO ENLARGE & SHAPE THE HOLE

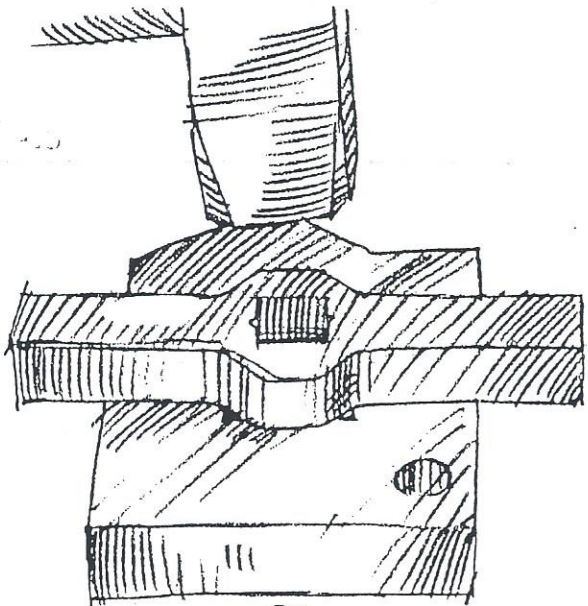
DRIFT TO FINISHED SIZE



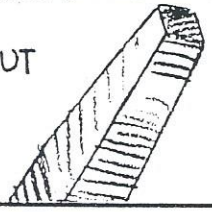
BACK UP IN ALTERNATING CORNERS OF HARDY HOLE



HAMMER "FLATS" BEFORE DRIVING DRIFT ALL THE WAY

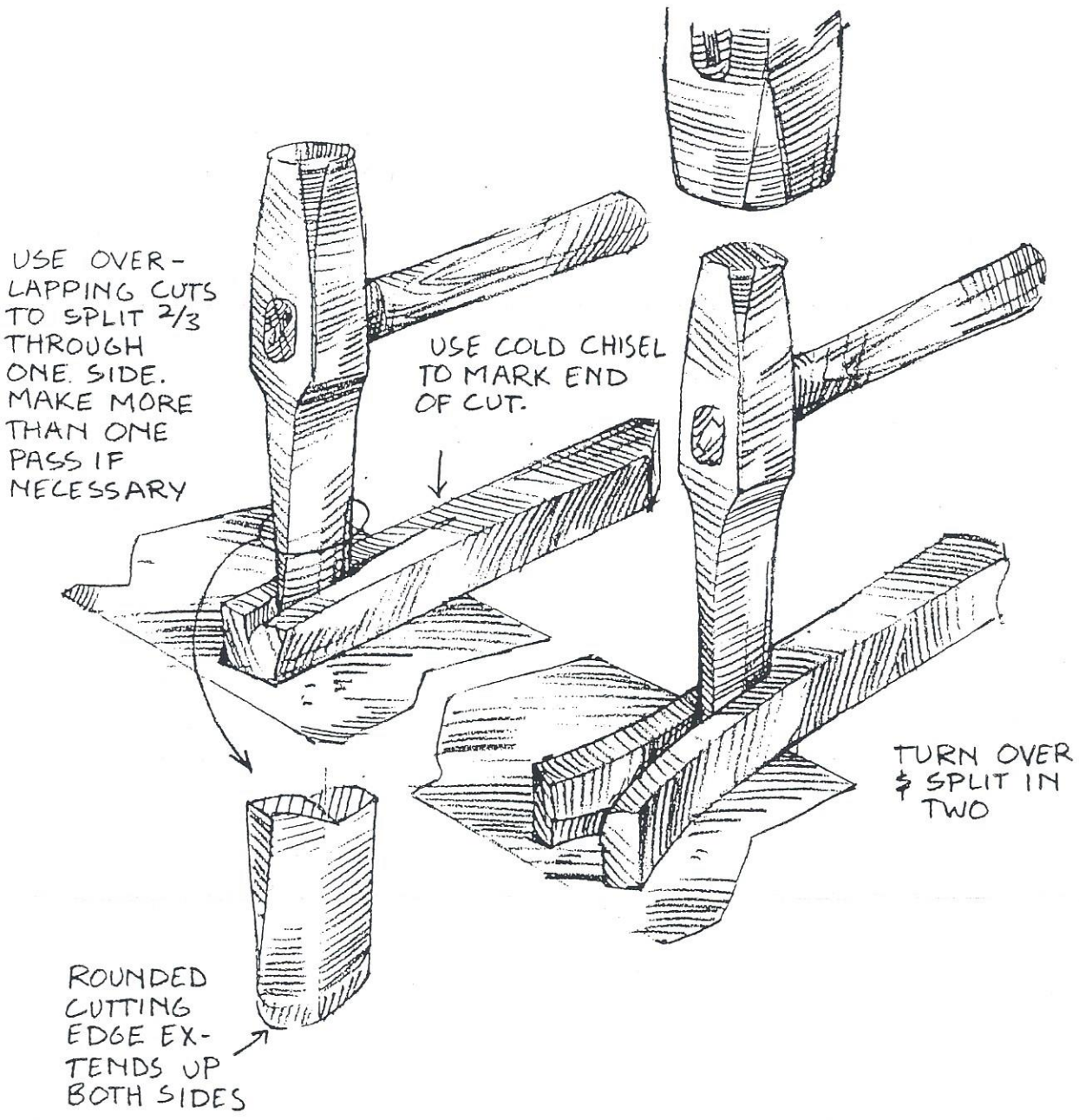


KNOCK OUT DRIFT

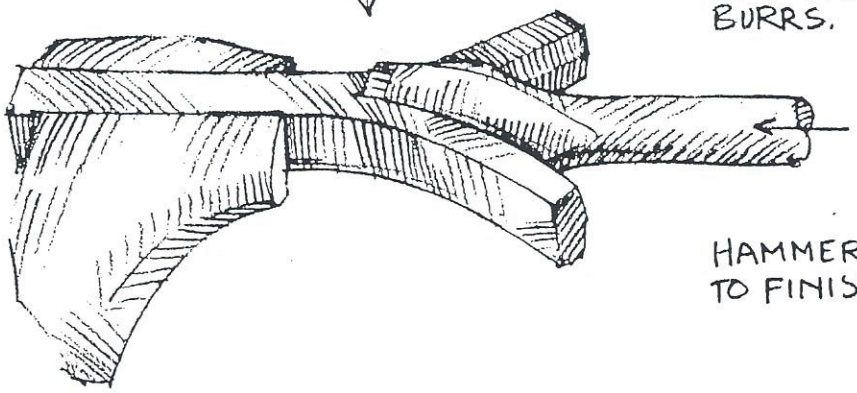


SPLITTING

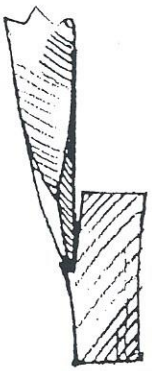
The "hot cut" chisel is one of a blacksmith's most versatile tools. it can be used for splitting the end or middle of a bar, cutting barbs and scroll shapes on edges, and making grooves. It's rounded blade penetrates easily, and enables the user to split any length section using overlapping cuts. A hot cut should not be confused with a cut off chisel used for trimming stock with a straight blade.

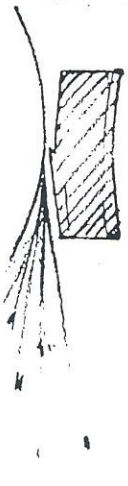


SPLITTING



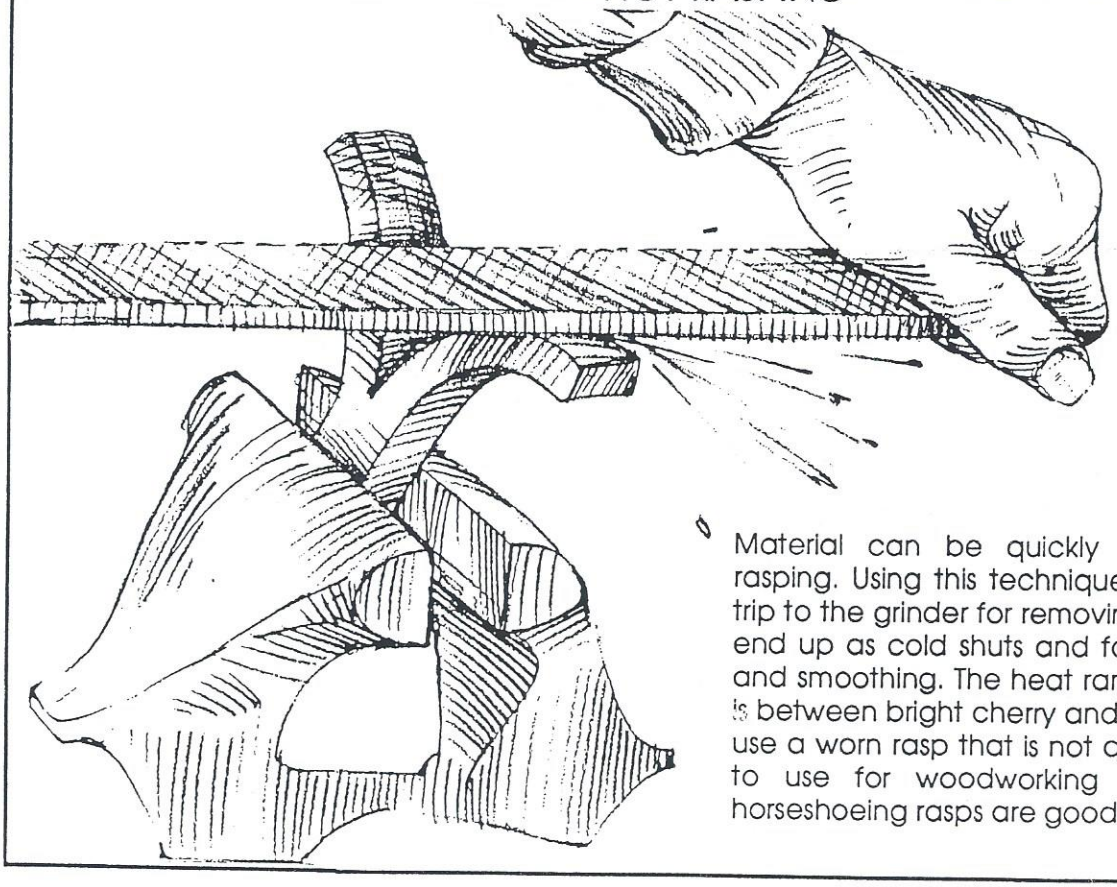
REMOVE ANY BURRS WITH A CHISEL OR GRINDER. (KEEPING THE HOT CUT CHISEL SHARP WILL HELP PREVENT BURRS.





HAMMER FLAT TO FINISH.

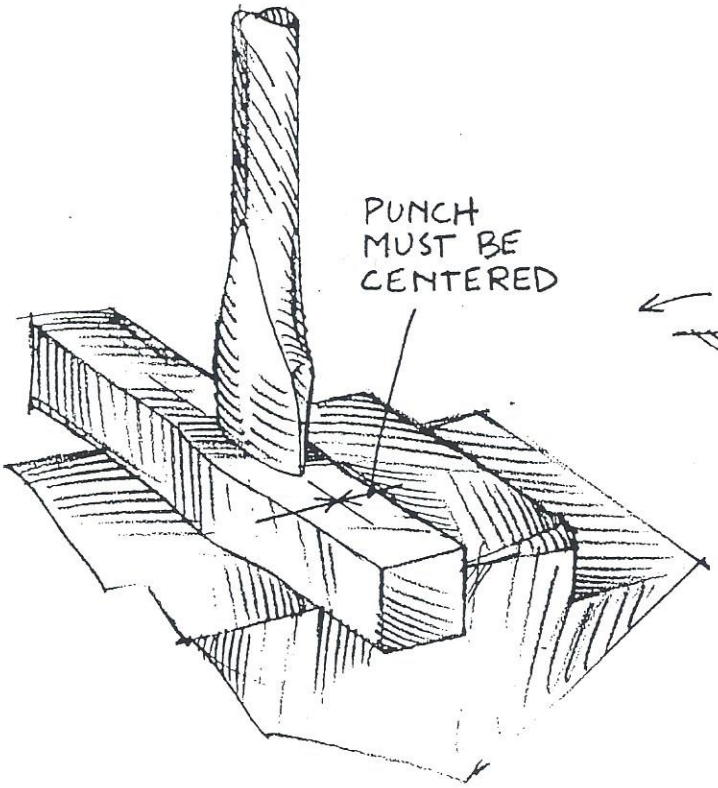
HOT RASPING

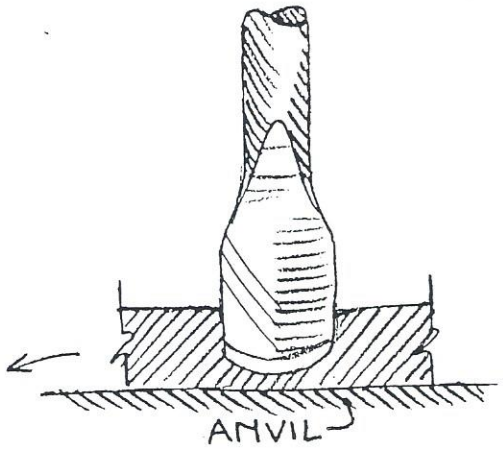


Material can be quickly removed by hot rasping. Using this technique will often save a trip to the grinder for removing edges that may end up as cold shuts and for general shaping and smoothing. The heat range for hot rasping is between bright cherry and yellow. It is best to use a worn rasp that is not quite good enough to use for woodworking any more. Used horseshoeing rasps are good for this purpose.

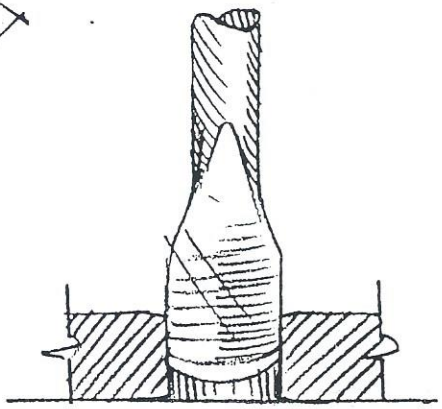
FIFTH PERIOD

MAKING AN EYE

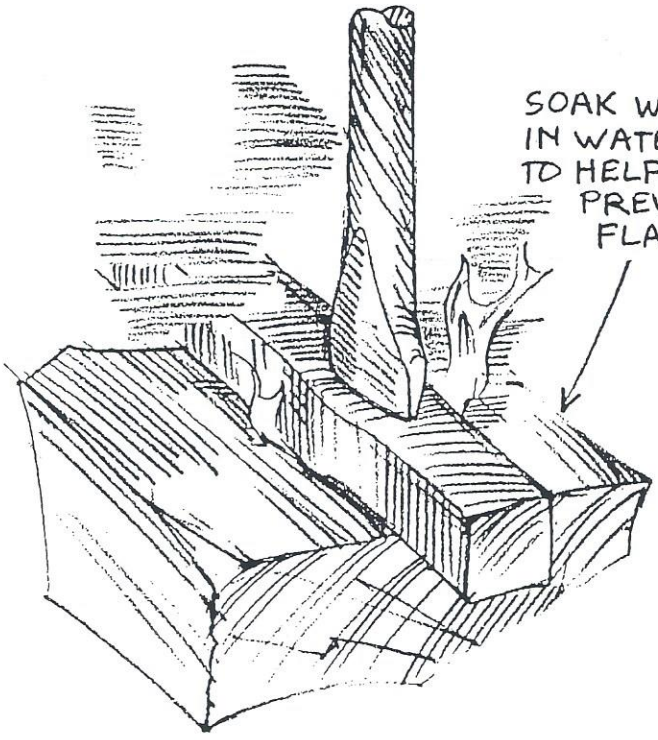




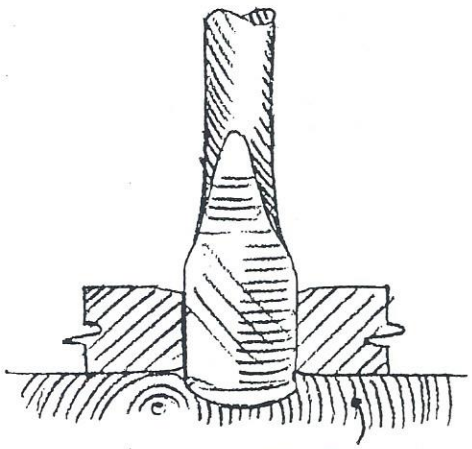
1. PUNCH 2/3 THROUGH



2. TURN OVER & PUNCH

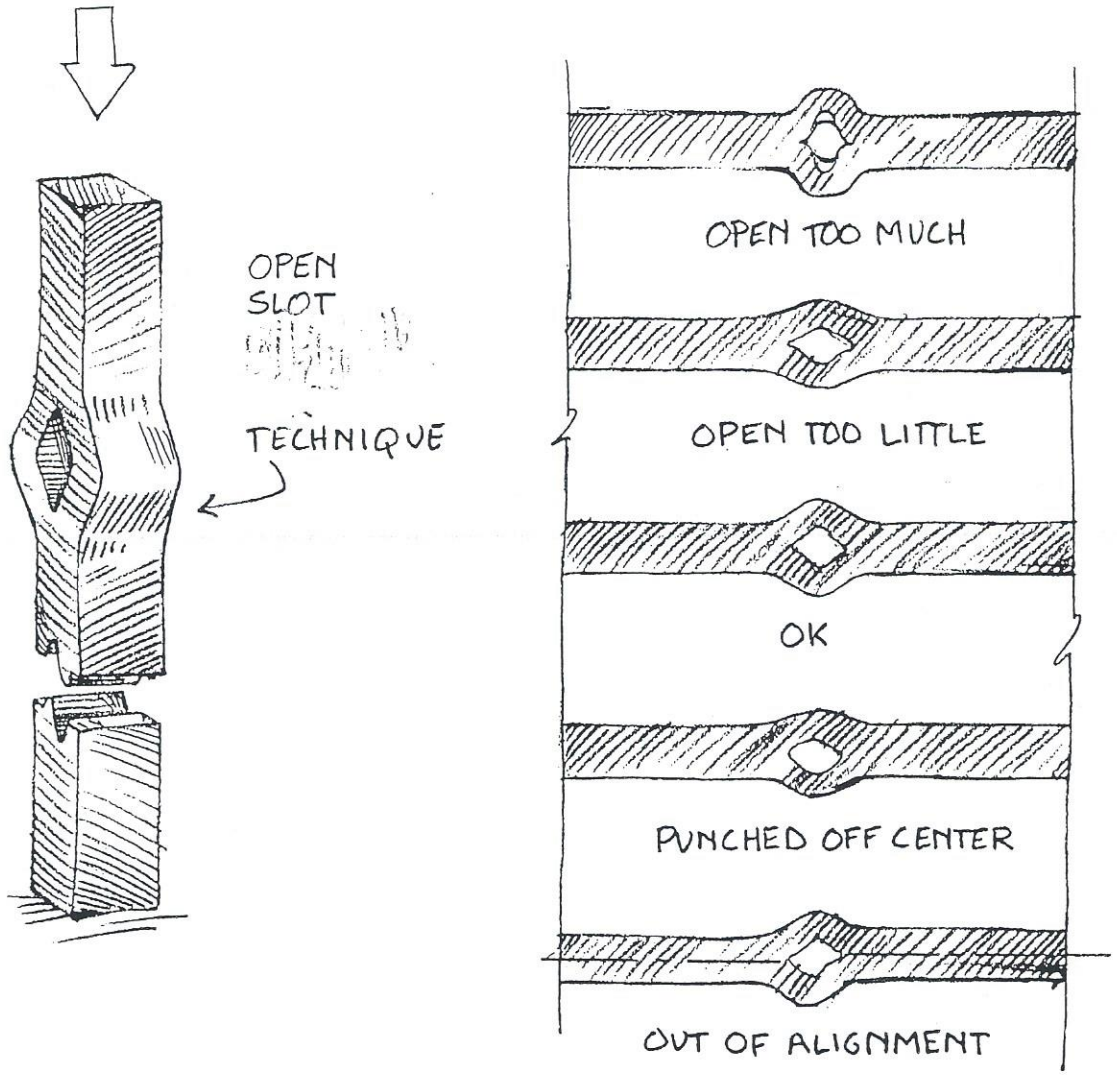


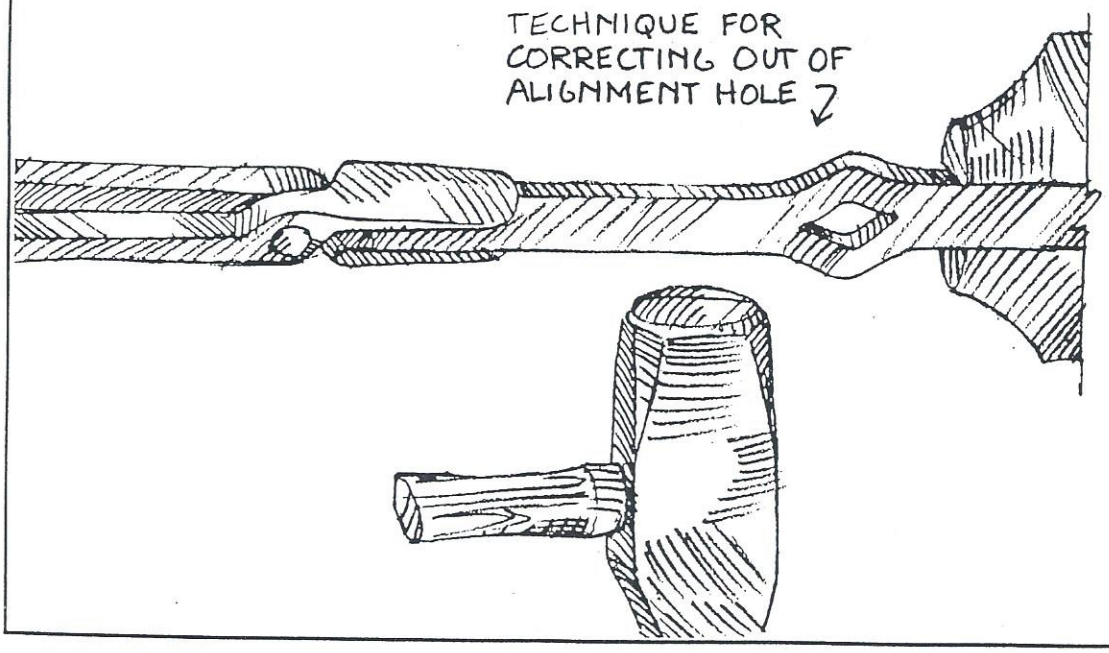
Hard wood block or copper plate



3. DRIFT

MAKING AN EYE

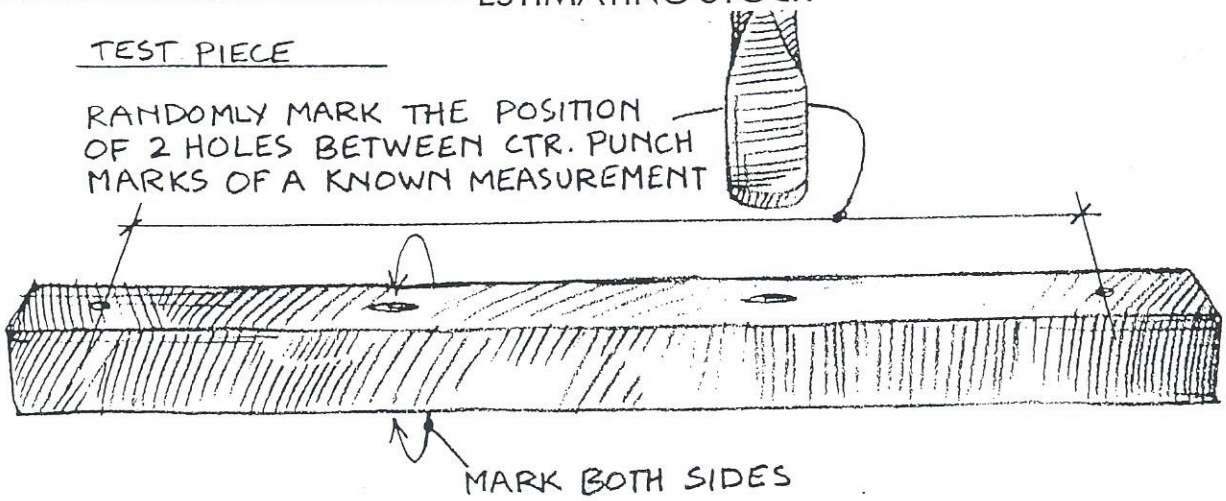




ESTIMATING STOCK

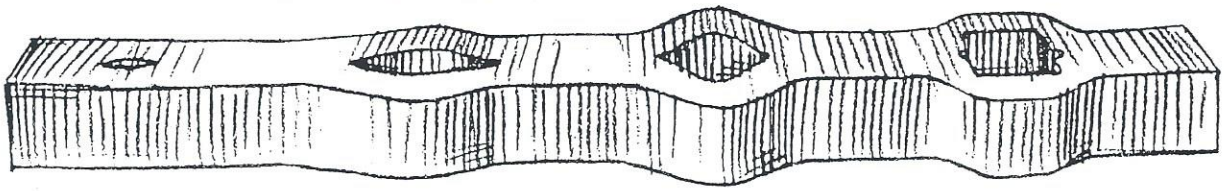
TEST PIECE

RANDOMLY MARK THE POSITION OF 2 HOLES BETWEEN CTR. PUNCH MARKS OF A KNOWN MEASUREMENT

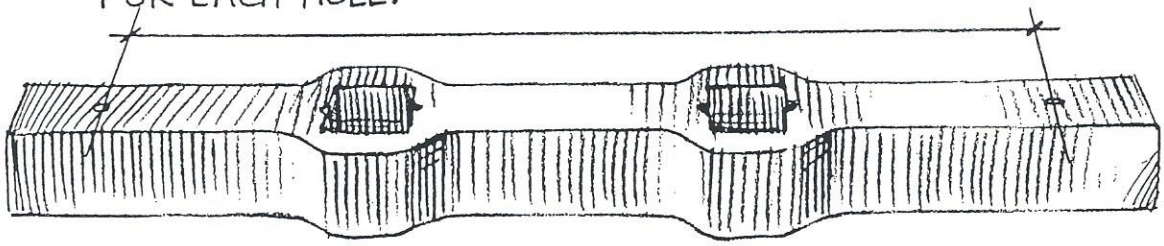


MARK BOTH SIDES

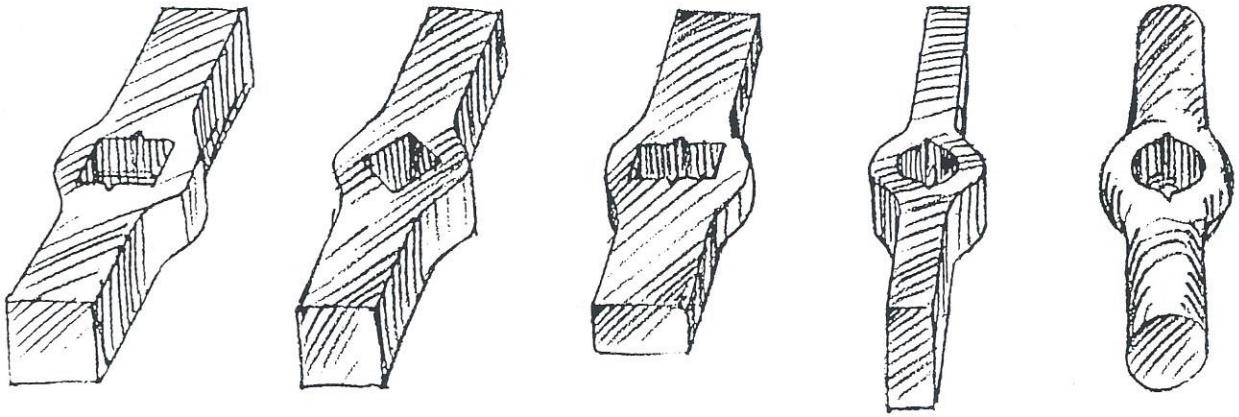
PUNCH THE TWO HOLES



MEASURE BETWEEN MARKS AGAIN, SUBTRACT FROM KNOWN MEASUREMENT, & DIVIDE X 2 TO FIND AMOUNT OF SHRINKAGE FOR EACH HOLE.



VARIATIONS



SIXTH PERIOD

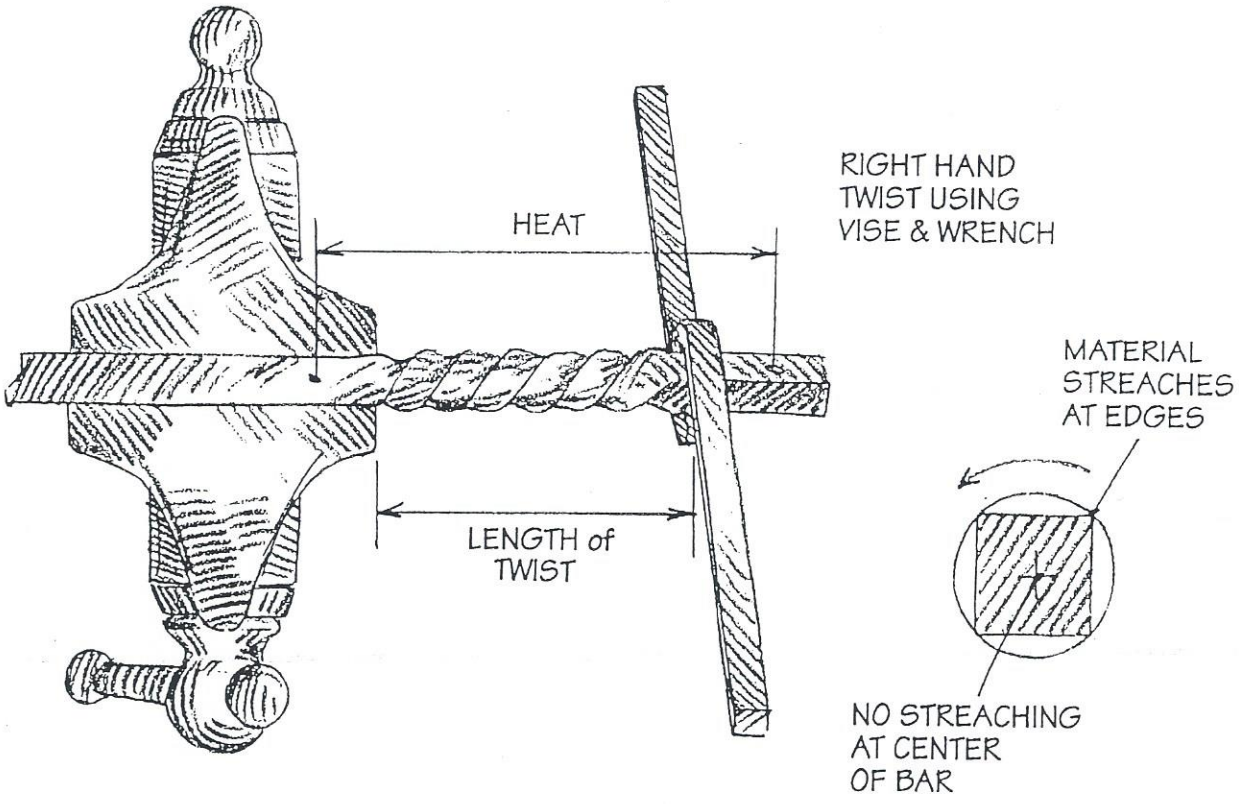
TWISTING

Twisting is an important technique, unique to our medium, that enables us to create complex helical designs using just basic tools. Following are some fundamental considerations for twisting square bars.

Ill. 74-2 shows how the edges of the bar stretch while the center of the bar remains unchanged. The same effect occurs in round bars but it is not visible unless the surface is out of round, grooved, or changed in another way. In Ill. 74-3 you see the effect of the number of revolutions in a twist vs. its length. Because the center of the bar does not twist, the length of the bar always remains the same.

Using a vise and wrench (as opposed to a twisting jig or machine) makes it more difficult to keep the stock straight as it is twisted. Twist the stock in a horizontal position and use equal force on the wrench; always straighten before returning stock to the forge as shown in Ill. 74-7 & 74-8. Use a torch to heat areas of a twist that need to be tightened, and cool areas already tight enough with water (see 22-1 & 22-2).

It is often necessary to take more than one heat to complete a long twist due to the heating limitations of a forge. To keep twists uniform, the last section of the twist from the first heat is not tightened all the way. On the second heat this section is "blended" into the first section of the second heat.



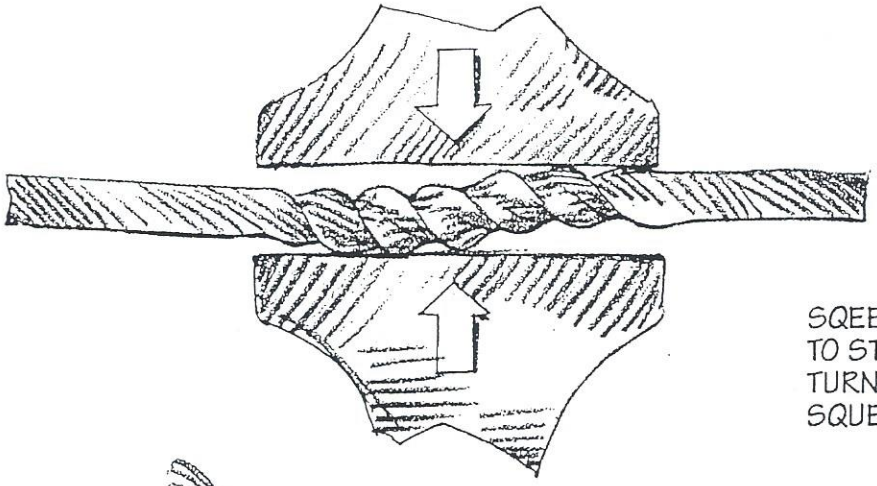

1 REVOLUTION, 1x LENGTH


2 REVOLUTIONS, 1x LENGTH

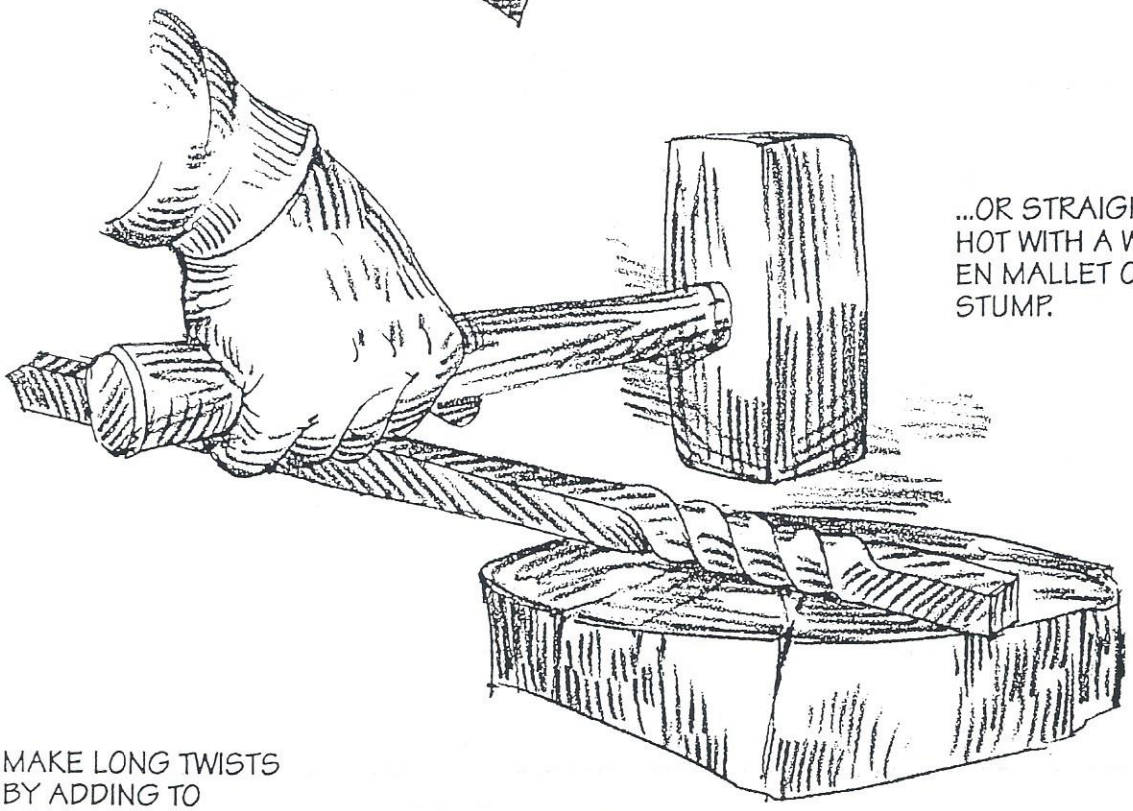

2 REVOLUTIONS, 2x LENGTH


3 REVOLUTIONS, 1x LENGTH

TWISTING



SQEEZE IN VISE
TO STRAIGHTEN TWIST.
TURN 90° AND
SQUEEZE AGAIN...



...OR STRAIGHTEN
HOT WITH A WOOD-
EN MALLET ON A
STUMP.

MAKE LONG TWISTS
BY ADDING TO
PREVIOUS TWIST

DO NOT TIGHTEN
ALL THE WAY

TIGHTEN ON
NEXT HEAT

HEAT #1

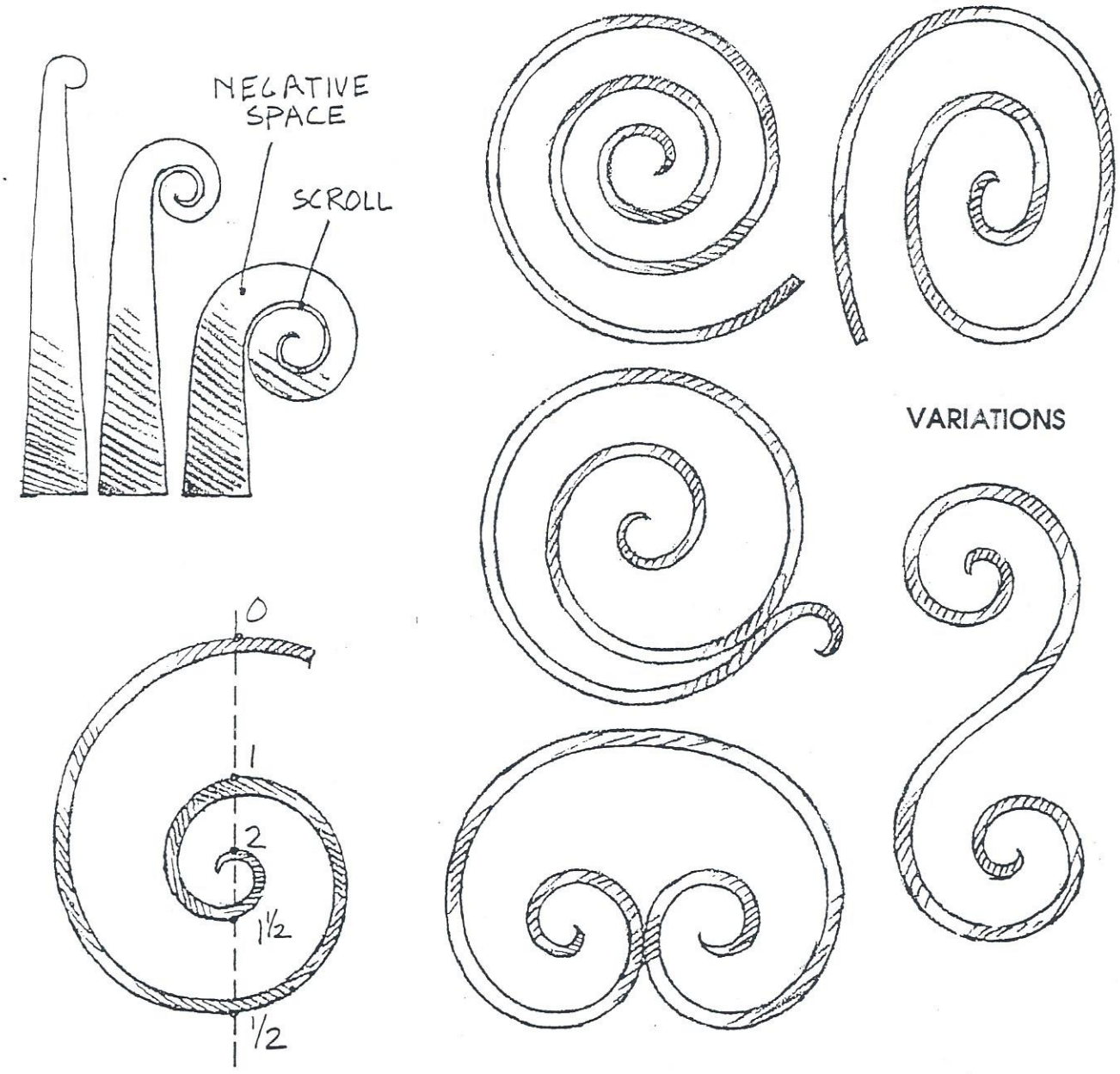
HEAT #2

SCROLLS

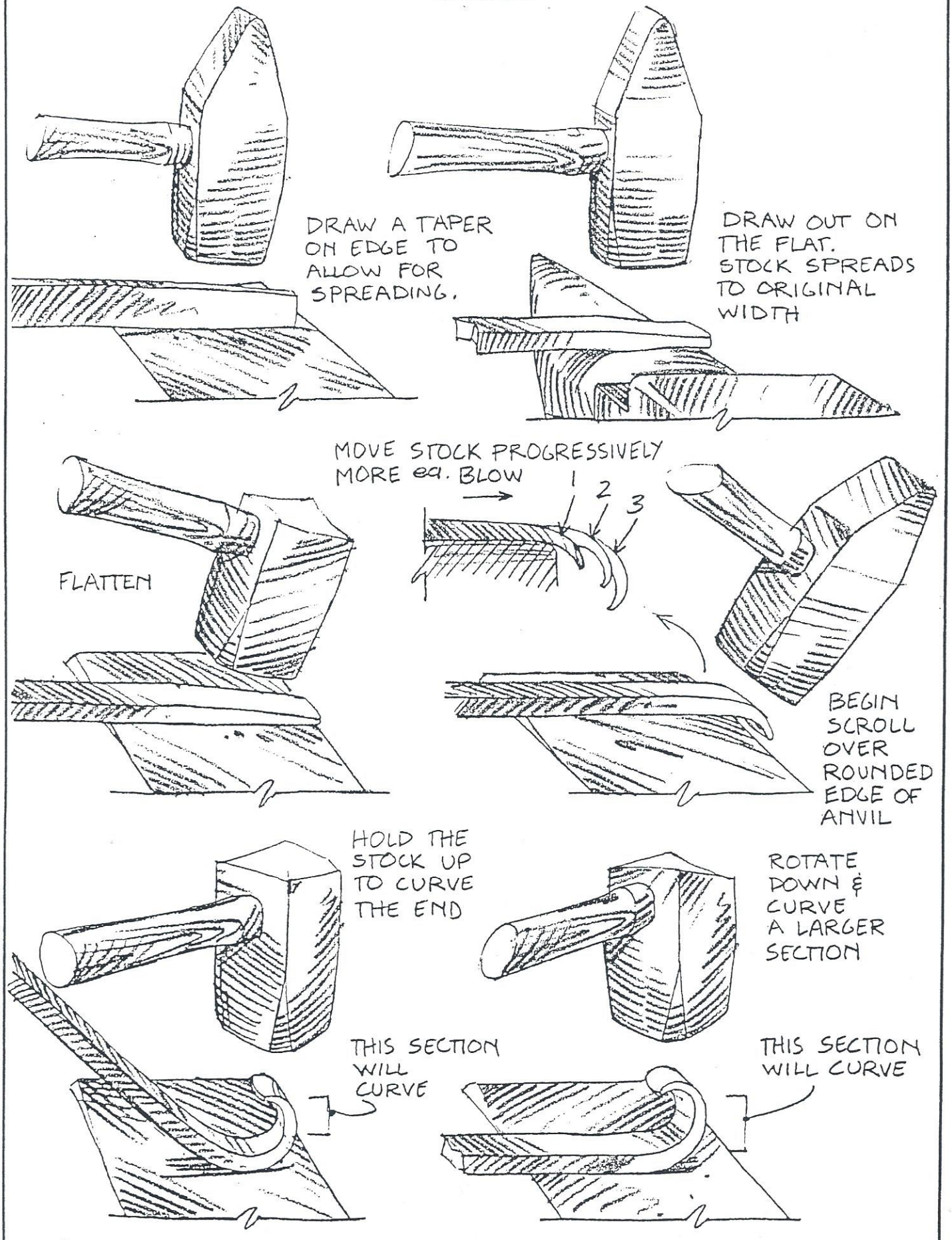
The size and shape of a scroll should be determined by the layout drawing of a particular design. See Ill. 30-4 & 39-2 for examples of scrolls made to fit specific designs. Attempting to make the design fit the scroll will often compromise the integrity of the work.

Take the time to make a scale drawing, and then re-draw full size on a steel layout surface (see Ill. 39-1–39-6). A scroll jig can then be made from your full scale drawing. Eventually you will have enough jigs to use for subsequent designs. Save one scroll made from each jig you have to use as a scroll drawing template for making full scale drawings. See page 142 for a full size drawing of a "generic" scroll that you can use as a guide for making a scroll jig (re-size on a copy machine if necessary).

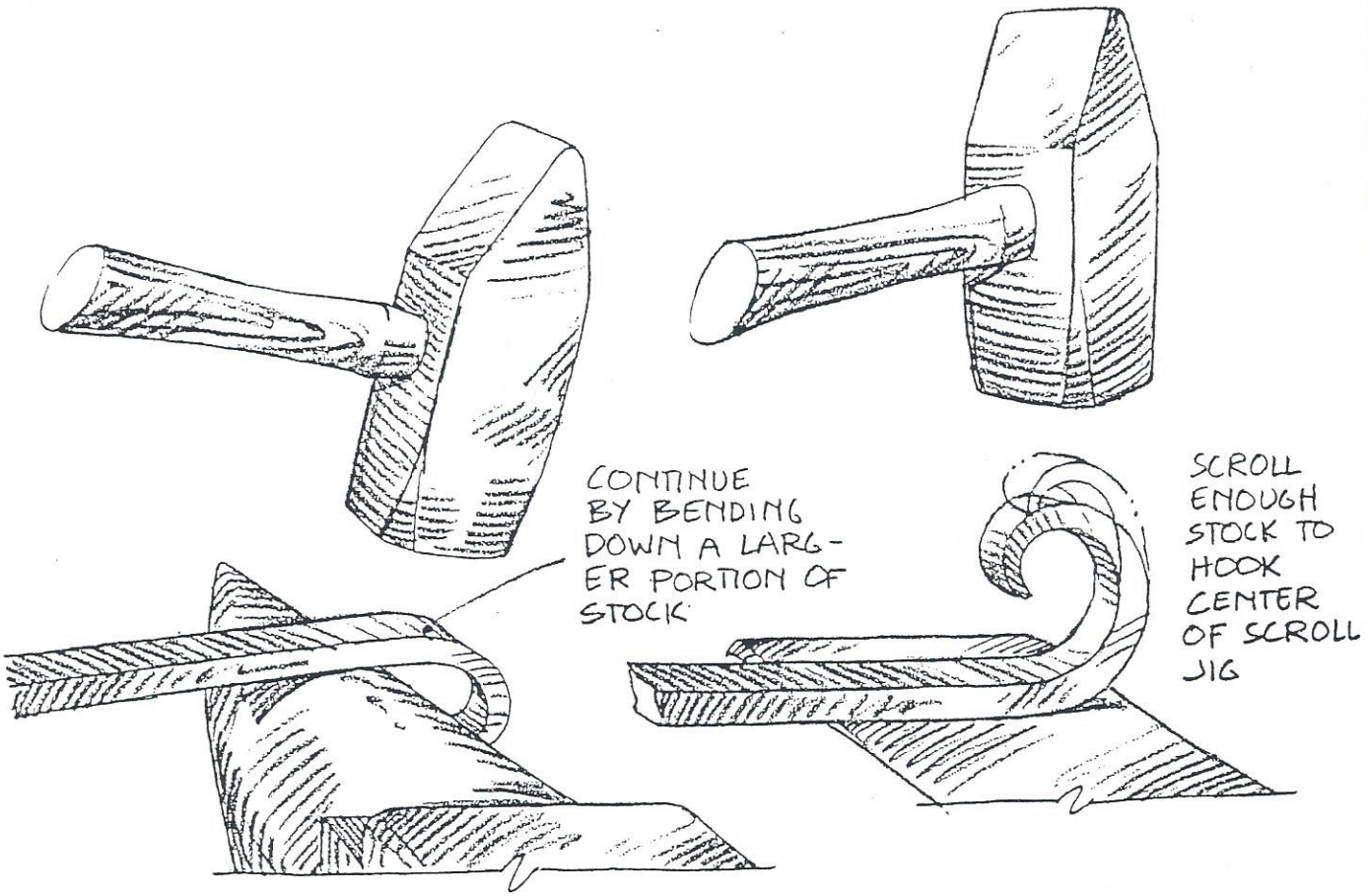
Although the shape of a scroll will vary depending on its specific use, there are some general rules that should be followed. If you look at the negative space in the spiral of a scroll, it should taper evenly to the center. Ill. 51-1 illustrates this point by changing the negative space to positive and unrolling it to reveal its shape as a straight taper. The proportion of negative space can be changed by varying the number of revolutions the spiral makes within a given space. Ill. 51-2 shows a scroll with two revolutions. The number of revolutions depends upon size, application and other design considerations.

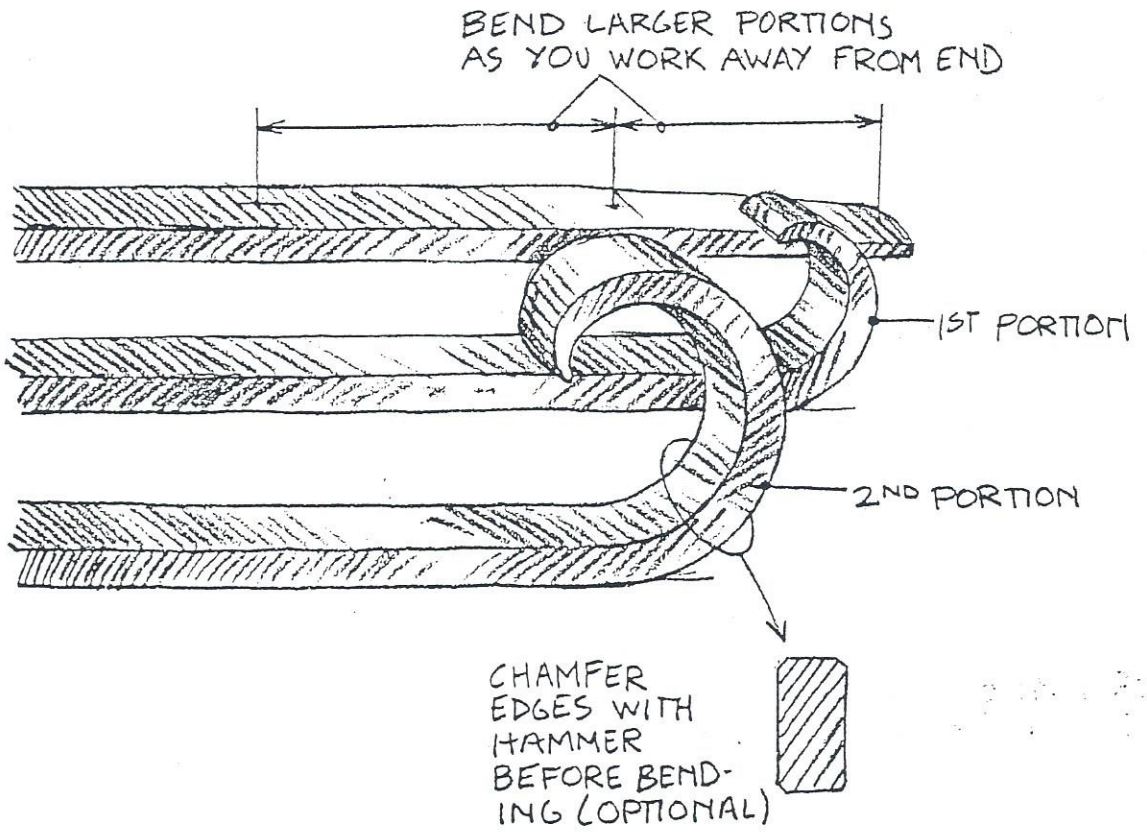


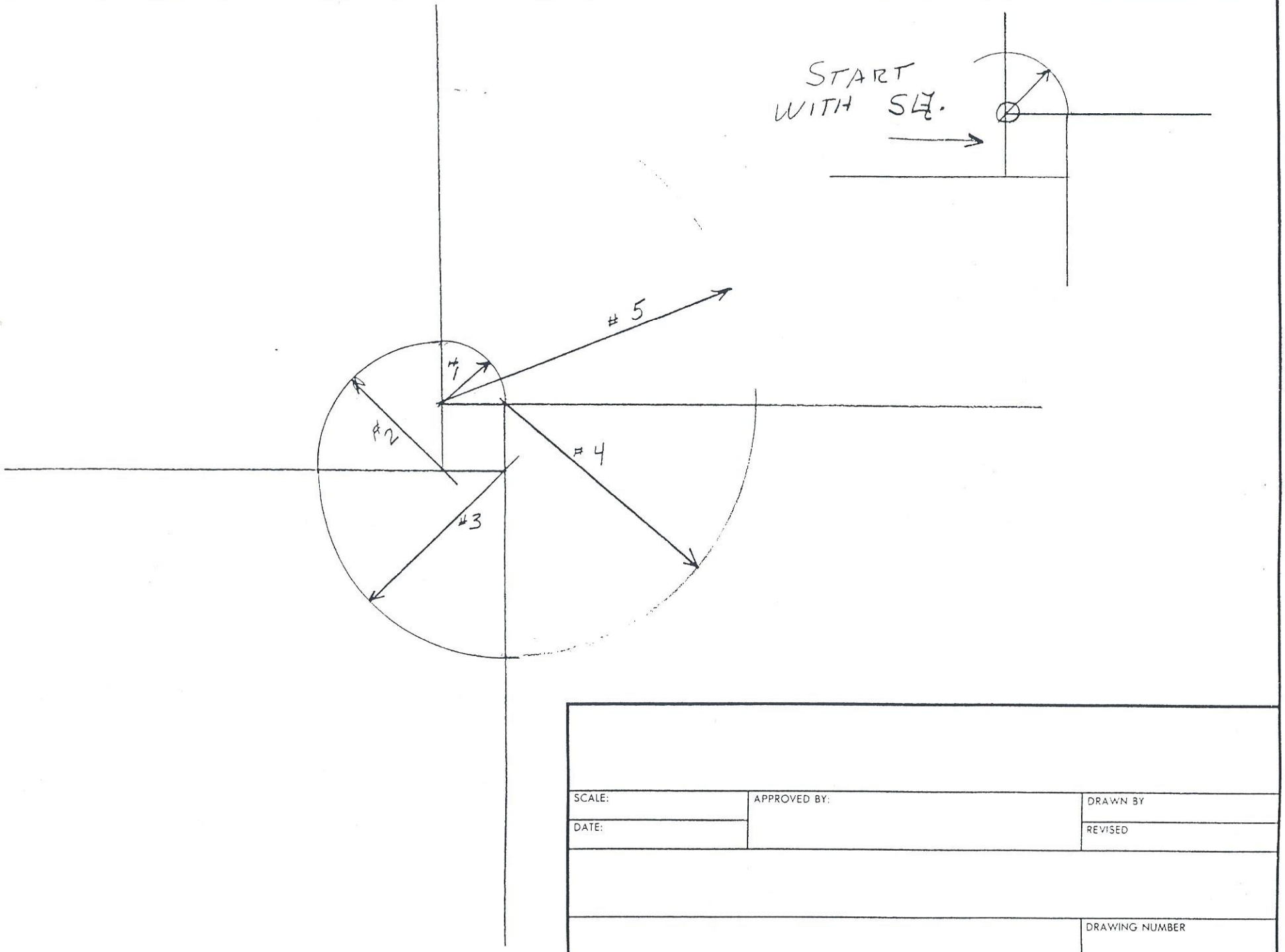
SCROLLS


DRAW A TAPER ON EDGE TO ALLOW FOR SPREADING.
DRAW OUT ON THE FLAT. STOCK SPREADS TO ORIGINAL WIDTH
MOVE STOCK PROGRESSIVELY MORE eq. BLOW
1
2
3
FLATTEN
BEGIN SCROLL OVER ROUNDED EDGE OF ANVIL
HOLD THE STOCK UP TO CURVE THE END
ROTATE DOWN & CURVE A LARGER SECTION
THIS SECTION WILL CURVE
THIS SECTION WILL CURVE

SCROLLS


CONTINUE BY BENDING DOWN A LARGER PORTION OF STOCK
SCROLL ENOUGH STOCK TO HOOK CENTER OF SCROLL JIG


BEND LARGER PORTIONS AS YOU WORK AWAY FROM END
1ST PORTION
2ND PORTION
CHAMFER EDGES WITH HAMMER BEFORE BENDING (OPTIONAL)



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
		DRAWING NUMBER