[Excerpts from Ian Cnulle's draft of the 2nd edition of The Moneyers Handbook, by Master Emmerich.]

Tools and materials - Ian's discussion

Rather than providing a checklist of tools, my preference is to discuss s a set of functions that can be accomplished by various tools. Rather than trying to duplicate exactly the list of things used by whoever takes the time to tell you what they use (different people are successful with a variety of different things that do the same job) consider alternatives with an open mind, then be flexible, imaginative, and aware of opportunities to exploit chance and serendipity (i.e. scrounging). It's also very helpful to cultivate the friendship and interest of jewelers, armorers, and machine shop guys in general.

To strike coins (logically starting with a pewter penny), you need:
1. pewter blanks to strike the coin on (for silver and gold, see Appendix C),
2. a pair of dies to strike the blanks with,
3. an anvil/stump for the lower die to rest on or sit in, and
4. a hammer to strike the upper die with.

1. You could buy sheet pewter from a jeweler's supply company, such as Rio Grande, but it's really expensive that way. Even if you do that in the beginning, eventually you'll want to make your own pewter blanks anyway, so start there if you can. There are two ways to make pewter blanks:

a. 'the old method' (as it's called in the MGW) of making them one at a time, for which you'll need:

1) a spool of leadless solder,
2) a chunk of ferrous metal with a fairly smooth flat top surface to beat the solder on,
3) a small propane torch of the type used for soldering copper plumbing pipe,
4) a hammer - 16 oz. is adequate, preferably a ball pein, but even a claw hammer will do.

b. A more efficient way is to make 'plates' or strips of sheet pewter that you can cut several blanks out of. For the simplest form of this process, you'll need:

1) the pewter - either the spool of solder or pewter mugs, bowls, platters, &c. that you can often find cheaply at second hand shops,
2) something to melt the pewter/solder in - I use a cast iron ladle, but an old junk saucepan will do,
3) a source of heat - I melt the solder on a gas burner on a kitchen stove, but you can also use the propane torch, for which you have other uses as well,
4) a mold to pour the molten metal into - what I use is a piece of channel iron laid on the stove top with its 'back' flat surface facing up, and two rectangular section pieces of scrap steel laying on the

channel iron parallel to each other to define the space you pour the pewter into (with just the two pieces of scrap iron, the mold is open on the ends, but if they're long enough the bar you're pouring won't run out the ends - you could use additional scraps to close the ends, but the open ended form gives you more flexibility in the amount of each pour).

Once you've poured a bar in whatever you're using for a mold, the next step is to beat it thin and flat with the hammer [1.a.4) above] on the 'anvil' [1.a.2) above]. You can beat it all the way down to the thickness desired for the coin blanks (a truly medievally long, slow, and tedious process), or you can just beat it thin enough to fit between the rollers of a rolling mill.

rolling mills -

A rolling mill is a wonderful invention dating from the late 15th century. However, it is usually the most expensive piece of equipment that SCA moneyers use (a few hundred dollars). If you know a jeweler, you might be able to talk him/her into letting you use their rolling mill, but jewelers are usually reluctant to allow their mills to be used on pewter because it's a flaky metal that tends to stick to the rollers and subsequently contaminate gold and silver rolled on the mill afterwards. You might be able to make arrangements with another moneyer to get your pewter rolled for you.

If you're going to acquire a rolling mill, there are several choices to be made. They come with and without an electric motor to drive them. The powered mills are really expensive (a couple of thousand dollars), so they're only worthwhile if you're keeping a guild full of moneyers busy cranking out thousands of coins. They come with and without gear reduction. Gear reduction makes the work easier, but slower. If you find yourself breaking down ten ounce bars of silver or making your own copper sheet, you might well decide that it's a necessity, but otherwise it's not necessary. There are three types of rollers, 'wire' (with grooves for rolling wire of various thicknesses and cross sectional shapes), 'flat' (for rolling sheet metal), and 'combination' (half flat/half grooved). Unless you think you might be minting a lot of Russian style 'wire kopeks', get a mill with flat rollers only.

The hand cranked mills have been made with single cranks and with double cranks. A single crank mill has a crank on the end of one roller, and that roller is directly geared to the other roller to rotate it in the opposite direction. A double crank mill has a separate crank on each roller, on opposite sides of the mill; the cranks turn in opposite directions. The result is that, through part of the rotation, you find yourself doing a kind of dipping motion that engages the largest muscles in your body - your thighs - and the force is balanced throughout your body throughout the rotation. With a single crank mill, you're mainly using your arms, shoulders and back - which can be very much physically stressful, especially at the top of each rotation. Consequently, I highly recommend double crank mills, but they don't seem to be available any longer from the big jewelers suppliers. (Apparently jewelers were disinclined to buy them because the work spaces in jewelry shops tend to be tiny and a double crank mill has to be mounted in a way that takes up a lot more space. Also jewelers tend to work smaller amounts of metal at a time, so the benefits of the double crank are insignificant, while jewelers who do 'mass' production can afford powered mills.) If you can find a double crank mill on eBay, grab

it.

Rolling mills are generally simple, sturdy - and therefore durable - machines, and consequently are a life-time tool for a jeweler; usually when a jeweler upgrades his mill or retires, another jeweler is ready to snap up his old mill, so used rolling mills can be hard to find. If you do find a used mill, it may not be a lot cheaper than a new one - unless it needs work, most commonly re-finishing the rollers, which can get scratched or pitted from corrosion if not properly cared for. Over the years, the Moneyers' Guild of An Tir has purchased one old mill for $150, which proved to be just adequate after a lot of work on the rollers, and three new mills for $400+ apiece (plus shipping). The new ones are all non-powered, single crank, flat roller Cavalins (Italian made with German rollers). I've heard that similar type mills can be found at Harbor Freight for half of that; a lot of the tools sold by Harbor Freight are Chinese made with poor quality materials and workmanship, but they may be adequate for the purposes of part-time SCA moneyers.

blank cutting -

Once you've got your plate or strip of sheet pewter, there are two ways to cut circular blanks out of sheet metal:

1. with shears - i.e. a pair of tinsnips. If you have to cut a lot of blanks, normal tinsnips can be very wearing on your hands. (See Appendix A for instructions on how to convert an old pair of tinsnips into the style of blanking shears actually shown in period illuminations.) When you do cut blanks with shears, you'll need to scribe circles on the sheet metal to follow in cutting. Use a scribe tool (even a sharpened nail will do in a pinch) and either a circle template or scribe around a coin of the same size as the desired blanks (e.g. a Lincoln cent works just fine for blanks for a medieval 'broad' penny).

2. with a hammered punch - This is the 'quick and dirty' way, for which there is only the most slender evidence of possibly having been used in period. There are (relatively expensive) disk cutter punches (two parallel plates with aligned holes and a rod to drive through them) available from jeweler's supply complanies, and 'ring punches', or 'annular punches', or 'stirrup punches', available from plumber's supply, leather worker's supply, or large, well stocked general hardware stores. You'll also need something to hammer the latter type punches against - a polyethlyene cutting board from a specialty kitchen shop works pretty well. You can also use a flat bar of pewter as the backing; it tends to get chewed up pretty fast, but beating on it with a hammer closes up the circular cuts pretty quickly. The hammer can be the same one you use for striking the coins.

To make dies, you'll need:

1. two pieces of steel bar stock - I use W-1 drill rod - it's not necessarily the best alloy or the only one to use, but I like it as it is easy to work with both punching and engraving. I use 1" diameter for penny size dies, and 1 ¼" for anything larger than a penny. I have minted a few tiny coins that only require 3/4" diameter dies. I use pieces 4" long for both the 'pile' or 'staple' ('anvil die' is the modern term) and 'trussel' or 'punch die' ('hammer die' is the modern term). Some SCA moneyers use longer dies, but it is not

necessary, and the longer the die is, the more an uneven hammer blow will exaggerate a mis-strike.

2. tools for 'sinking' the design into the end of the die:

a. punches - a few simple shapes - dot, line, rectangle, crescent, various triangles - are adequate to start with. I make them out of 3" long pieces of 'music wire' (as it's called in hobby shops where it's most convenient to find it). To make the punches you'll need:

1) a vise to hold the rod in while working on it,
2) files - a mill bastard for rough work, and a cheap set of jeweler's/ watchmaker's files is adequate to start, although for more advanced punch making I recommend a high quality super fine (~200 cuts/inch) 'knife' (i.e. the shape of its cross section) watchmaker's file (which can cost as much as the whole cheap set of half a dozen to a dozen different shapes - but it's the shape you'll use the most).
3) the good old propane torch to harden the punch, and
4) a small container of oil (any old oil - cooking oil, motor oil, whatever) to quench the punch in after heating it.

b. engraving 'burins' or 'gravers' - Burins are simply thin steel rods of various cross sectional shapes set in a wooden handle. From a jewelers supply, they typically cost $4-$8 apiece (depending on the size and the quality of steel), and the wooden handles (also in a variety of shapes) are sold separately for ~$1 apiece. 'Square' and 'oval' are the basics shhapes, and are pretty much all the medieval die engraver needs. Various sizes of 'round' gravers are useful for more elaborate Renaissance style die work. (There are many other shapes in the jewelers supply catalogues, but little use for them in coin die engraving.) Engraving is generally considered a relatively advanced technique, so the newbie SCA moneyer really doesn't need to make provision for it until after mastering basic punchwork.

3. means of holding the die stock while sinking the design on it -

For engraving, I just set the die blank in a hole drilled through a block of wood to hold it upright and steady at a convenient height. For doing punchwork, you also need a generous mass of ferrous metal under the die (i.e. an 'anvil' of some kind - I do the punch work on the same anvil I use for striking the coins).

4. hammers for sinking punches -

The same hammer used for beating pewter is generally adequate. However, for larger punches, particularly any flat faced punches that have a surface area of about two square millimeters or more, it is better to use a heavy hammer, rather than hitting it harder with the same hammer used for smaller punches. I use a 3# hammer for larger letter punches, and the same 4# hammer I use for striking pennies for sinking large design element punches.

5. means of getting the face of the die blank flat and smooth -

Wet or dry emery on a very flat smooth hard surface, e.g. a piece of plate glass -

I use a piece of synthetic marble made for remodelling bathrooms. With a die blank cut and squared with a machine shop chop saw or on a lathe, you'll start with coarse emery (~80 grit) and work up from there. I go to 600 or even 1200 grit, because I like to make shiney coins, but nothing over 200 or 300 really looks period.

6. to layout the design on the die face:

a. I use a scribe (which works well with a highly polished die face), but some people just use a sharpie felt tip pen.

b. circle templates - same old plastic things used for mechanical drawing There is evidence that, in period, the border circles were sometimes laid out with a compass set in a dent punched in the center of the die.

c. a straight edge for scribing center lines Some people also use a 'center finder' type try square to lay out the center lines and mark the center point for a compass or dividers. I just use a 6" steel ruler and eyeball it.

7. really good light -

I use two swing-arm lamps with the compact flourescent equivalent of 100W incandescent light bulbs (I use compact flourescents as an ecological value rather than as being necessarily superior for this kind of work).

8. magnification - optional

Spectacles date from the late 13th century, and there's plenty of evidence in the coins themselves that die cutters probably started using such optics to be able to do more finely detailed die work as soon as the technology became available. Whether you use magnification depends on how nearsighted you may or may not be, how late a period style of die work you want to do, and how pretty you want your die work to look to modern eyes. I normally wear tri-focals, and I do die work with an 'Optivisor' head band loupe with 2.5X magnification (any greater magnification makes it too tempting to do die work too fine to look period). If you wear glasses normally, you can also get loupe lenses with wire frames that clip on to your spectacles. Some people even use the traditional jeweler's loupe in a cylindrical base that you hold against the underside of your eyebrow by flexing your cheek (I've never used one, but expect it would be uncomfortable for long periods of die work).

To strike the coins:

Once you've got the blanks and the dies to strike them with, you'll need something to hold the lower die while you hit the upper die. Some moneyers are successful with just using a fairly massive hardwood 'stump' with a hole drilled in the top to hold the pile. Grunal in England reports using a stump weighing 150 kilograms (over 330#), but smaller wooden stumps have been successfully used in the West. However, most SCA moneyers have better success with an 'anvil' or 'bolster' consisting of a mass of ferrous metal resting on a stump (the primary function of the latter then being to hold the work at a convenient height). Regardless of whether a wooden stump or metal anvil is used, the depth of the hole for holding the die in position should allow half or more of the length of the pile to project up above the top of the stump so your hand can

overlap both dies while striking.

A blacksmith's anvil could be used, but you don't need its specialized forms. SCA moneyers in the western kingdoms have developed a form of anvil for moneying that's fairly massive (100# +/-20#) with handles and holes for different sizes of dies. However, a newbie can get by with just about any chunk of ferrous metal (i.e. cast iron, mild steel, scrap steel of various forms). Having some means of holding the pile steady on top of the 'anvil' (e.g. a hole drilled in it, or a hole drilled in a block welded onto it, &c.) is helpful, but not necessary. In order to get one apprentice up and running in a hurry, we just went to a junk yard, where, in the bottom of a scrap bin, we found a piece of mild steel about the size and shape of a brick and weighing, perhaps, 15-20#. At fifteen cents a pound, the guy didn't want to bother with writing up a bill of sale, so he just said 'you can have it - no charge'. ('Scrounging' is a very use skill for SCA moneyers.:-)

As for the stump, if you don't happen to know somebody with a woodlot on their property, your next best bet is a firewood dealer.

As for the hammer, for striking pennies, I use a Sears 4# sledge with a foot long handle. Some people may be more comfortable with a 3#. Hammers in the same head weight range, but with even shorter handles, called 'drill hammers', are also commonly available. For coins larger than a penny, I use various 6# sledges with handles 2' - 3' long.

As for sources, in general (except as noted above) just about everything you need can be found in hardware stores, second hand shops, and junkyards (ahem, excuse me, these days often called - 'recycling centres' - although they're still jumbled, muddy, greasy, rusty places).

The Process

Acta non verba “Deeds not words”

There are four steps in the process of creating a coin:

1. Make punch tools and prepare the die blanks
2. Lay out the designs and sink them on the dies
3. Make the coin blanks
4. Strike the coin

1. Punch tools and die blanks

There are three methods of sinking the design on the dies:

1. Punch work – which is really nothing more than a method of artfully denting the metal
2. Engraving – cutting away metal to create a design
3. Combination – using both Punch work and Engraving

Even a modest artist can make attractive medieval patterns using punches. More time and skill is required for engraving. A fair amount of patience is in order for any method

you pursue. Punch work is the logical place to start, as practically all medieval coin dies had at least some punchwork, while many had no engraving. (For Ian's introductory comments on engraving, see Appendix B.)

Making punch tools

Take your center/pin punches out and prepare them for work. Some people opt for the Craftsman sets. Others make theirs from music wire. This is mild steel that can be bought in rod form three feet in length. Most good hobby stores or tool houses stock it.(Apparently the origin of the name “music wire” is that it was used for making the chimes in cuckoo clocks.) It is best when cut into three-inch lengths and about 3/16" in diameter. Anything bigger than a quarter inch just requires unnecessary filing away of excess metal to make the shapes you need, while anything smaller than an eighth of an inch tends to 'snap' laterally and sting your fingers when struck.

There are quite literally hundreds of punches that can be made depending upon your needs, skill, and time. A moneyer needs at least seven punches to do basic work. Some of the more basic shapes are as follows:

· Small dot or pellet ·
·

· Small triangle ∇	· Large triangle ∇
· Small straight line -	· Large straight line
· Small crescent (	· Large crescent (
· Small roundel o	· Large roundel O

Specialty punches can be added as needed. Cut the punches down with your needle file and touch them up with emery. Make use of a magnifying glass to check your work. Sizes should be tailored for the coin. Allow for a fair number of words to occur around the edge of a coin.

The one exception I have to making punches is the roundels. I prefer to buy the Black and Decker nail sets. Not only do they come in different sizes, I have yet to wear one out.

Really, all you need to remember in most coin designs is that all art is made of many parts. The letter “R” can be formed from a small vertical line for the spine or 'stem', a small crescent for the arch or 'bow', and a small triangle for the foot or 'tail'. Using three separate punches, you will have created a single complete letter. For later period styles, whole letter punches can be made with a little work.

Building up patterns like this can yield wonderful works of coin art; after all, most pictures you see are made from many small dots. Keep this in mind as you work.

For making the punches out of music wire rather than adapting ready made punches, Ian cuts the rod to length, rounds the end to be hammered and squares the end to have the design using the mill bastard file. The 'face' of the punch is prepared as if it were a miniature die blank (see die blank preparation below), and the shape

scribed on it. It's not strictly necessary to scribe the design on for the simplest shapes, but scribing can be helpful when you need to make that shape of a very precise size.

With the punch held upright in the vise, use the mill bastard file to cut long tapers on the sides to the end, so at the end of this first stage, it's kind of shaped like a screw driver for a slotted screw head. These cuts should be parallel to each other and to the vertical axis of any shape, such as a whole letter, so that you can use them as a reference to align the punch when using it on a die. Then (in most cases) make cuts perpendicular to the first two to cut the face of the punch down to the area of the general shape being made. Then the jeweler's files are used to refine the outline of the desired shape.

Some more elaborate punches have 'interior' shapes. Some such interior shapes can be made by using another punch on the punch you're making. For example, a method of making an 'O' punch is to use a bead punch to make a dent in the middle, and then use the files to trim the punch down to a thin circle around the bead dent. Trimming around two bead dents can make an S for 16th century Roman Capitol style letter punches, as well as making an 'Arabic numeral' 8. However, most interior shapes for more elaborate shapes have to be cut with engraving tools.

hardening punches

After completing your punches, those made from music wire must be hardened, as any tool used on the die has to be harder than the die itself. This is done by heating the tips of the punch with your torch one at a time. When they reach a bright incandescent orange color, then dip them in oil (motor oil, olive oil, &c.) to quench them.

Clean the punches with a bit of emery or a wire brush and they are ready for use. Test the hardness by trying to cut a notch into the shoulder of the punch just below the point with the edge of a file. You should not be able to cut it. If you have made a mistake, don’t worry. Just start over by heating the punch and letting it air cool. This will soften (anneal) it for re-filing.

Emmerich says, If your punches are cut from tool stock, pin punches, etc., they will seldom need hardening. While it is true most of them fit the hand nicely, you will find the three-inch music wire ones work just as well. Most punches should last a good long while before needing to by reworked (about two years - although Ian has been using some of his for a dozen years).

Prepare the Die blanks

Having picked yourself a good work site, make sure you have a usable wooden stump or Traveling Die anvil and a chair. I personally enjoy working outdoors (and if you live with people who are sensitive to the noise of lots of hammering on metal, they enjoy it more if you work outdoors too.)

finishing the faces -

Take your dies in hand now and finish the two surface ends that will meet. This involves taking the Mill Bastard file and slowly smoothing the faces down. Flat and evenly matched is your goal. Simple rotation every few passes will make this quicker. A final phase of continued strokes in one direction for a time will create an even grain. Burrs can cause deep scratches, so clean the file's teeth with a wire brush often.

If you can get a friend with a machine shop to square the die blanks on a lathe, it saves a lot of work and produces better results. Ideally you should be able to put the two die blanks face to face and not see any light between them. Unevenness in the die faces can result in certain areas of the design always being more difficult to get struck up clearly.

From this point, the die blanks are ready for the design. Yet having come this far, why not make them better? Using emery, you can finish them well down to a mirror surface. Using 200 to 300 grit emery will give surfaces close to what was used on period dies, while finishing with 600 or even 1200 grit will give a mirror sufrace that makes a very pretty, although not period looking, coin. Place the emery on the smoothest, flattest surface you can find, e.g on a piece of glass or a synthetic marble tile made for decorating bathrooms. Use long straight strokes, rotating about a quarter turn after each pass. Finish with circular motions. Hold the die blank with your fingers as near to the abrasive surface as possible to prevent rocking and rounding or 'doming' of the die face.

die storage -

If you need to store your dies before use, a little oil on the surface with a wrapping of wax paper does a good job. You can hold it in place with a rubber band. A ziplock baggie also works. The Apprentice's first lesson regarding dies is "ferrugo nunquam dormi" (Latin for "rust never sleeps"!).

terms -

Bearing the obverse or face side of the coin design, the lower of the two dies is called the 'pile' (or the 'staple' -'anvil die' is the modern term), and will rest partially inserted into the stump or anvil/bolster. The upper die or 'trussel' (also called a 'punch die' - 'hammer die' is the modern term) bears the reverse of the coin. It will be hand held and receive repetitive hits over its working life. So much so, that it will mushroom out at the top. This is ok! Just check it for severe cracks. These may warn of future danger and if present, the die end should be dressed. If the cracks are too severe, just replace the die.

This kind of abuse suffered by the trussel resulted in the trussel wearing out about twice as fast as the pile; consequently a simpler design (a cross on the majority of penny size coins) was used on the trussel since more of them had to be made, hence the association of the anvil die with 'obverse', 'face', or 'heads' and the hammer die with 'reverse' or 'back', or 'tails'. (In period, when flipping a coin, people called it 'cross or pile' instead of the modern 'heads or tails'. It's likely that some cheeky moneyer used two trussels to strike a special coin to take to the local tavern, where he won everybody else's pennies in the coin matching games - until the other guys figured out they'd been 'double-crossed'.)

In the past, die sets were sometimes defaced after the order was completed. This was originally done to recycle the diestock. This is seldom done today. We prefer to shelve them against future strikes if ordered.

2. Design layout and sinking

Coin Sizes

Guild moneyers in the West and An Tir mint pennies of ¾" diameter. In the West "shilling size" coins are 1" diameter. In An Tir, Guild moneyers mint coins of "half groat" size at 15/16" diameter and "groat size" at 1 1/16". Compare this to the dimensions of modern coins. Note that it is NOT a good idea to create coins that have the same dimensions and weight of legal tender coins (minting something that fits in a vending machine can get you in trouble.)

Coin	Diameter	Thickness
US cent	0.750 in	0.062 in
US Nickel	0.837	0.073
US Dime	0.700	0.055
US Quarter	0.955	0.065
US Half Dollar	1.200	0.077
Medieval 'broad'Penny	0.750	0.0197
Medieval Half Groat	0.937	
Medieval Groat	1.062	
Medieval Shilling	1.000	

Table 1: Coin Dimensions

Coin design and layout

period style fabric and design -

It is best to sit down with paper and pencil and some history books to design your coin (even at this stage, remember that you'll be reversing the design on the die). Ideally, one should study actual medieval coins; some are quite affordable to acquire (some of the most common types are in the $15-$30 range for decent specimens). Studying a coin in three dimensions provides useful information (e.g. re: depth of relief) that two dimensional photos of coins can't. Once you've studied some actual coins, then you can also interpret photos more accurately. (You can also review the coins that other Moneyers have already created in Figure 10.)

While a lot of your SCA customers want designs such as SCA heraldry that don't really look much like what was used on period coins, it is important to try to duplicate the style of original medieval coins because the period moneyers had centuries of experience in dealing with the problems inherent in the medium. A typical example is a

common problem seen on period coins known as "bleedthrough" weakness resulting from the metal of the coin blank not being thick enough to fill deep areas of the design on the die.

A familiar example is that the 14th and 15th century English beardless king head pennies usually had a cross shaped dent over the king's face, so often the king had no nose because of the bleedthrough of the cross from the other side. Large shapes on the dies should be shallow to minimize the bleedthough. Smaller shapes can be deeper. Large blank fields in the coin design should be avoided to minimize the amount of lateral displacement of the metal as the coin is struck. This is why you often see superfluous 'filler' of dots and similar elements on period coin designs.

A lot of period moneyers evidently didn't care about bleedthrough weakness, so if it occurs on coins you mint, it's authentic. However, if you carefully manage the depth of the design on the dies to minimize bleedthrough, you can mint coins that look more pleasing. Even if your dies are deeply sunken, striking on thicker blanks can minimize bleedthrough, although striking thicker coins is more work and results in a less period feel to the coins.

border circles -

The largest period pennies were around ¾ of an inch in diameter. Even with this small size, your will be surprised at the art that can fit in. Start with a beaded border. On more neatly struck period coins it helped to deter coin clipping, which was a form of theft in which small slivers of metal were cut from the edge of the coin. Unless you look closely, one cannot tell that the diameter of the coin has decreased. The resulting collection of precious metal slivers from many different coins was melted down and sold. The short weighted coins were then passed along to the unwary. However, the beaded border primarily served to define the edge of the design in a way that was inspired by ancient Roman style of border 'dentilation'.

Most period coins also had an inner circle (usually beaded or dentilated) to define the space where the inscription goes. Make sure the size of the inner circle leaves enough space between it and the outer border for the size of letters your letter punch tools will make. Nota Bene, larger letters limit the length of your inscription.

design proportions -

In preparing a design copied or adapted from a period coin's design, it is very important to observe very closely the proportions of the design. You can exactly duplicate the shapes and sizes of the elements that make up a coin's design, but if the proportions aren't right, the result will look very different from the original in a way that doesn't look 'period'. A common example is that all too often beginning moneyers bead their border circles without attending to the spacing of the beads. On originals, typically the beads were touching, sometimes overlapping, but practically never more than the radius of a bead apart. Nothing says at a glance 'non-period looking amateurish SCA token' than spaces between the beads equal to (or greater than) the diameter of the beads. When you do successfully duplicate the typical proportions of particular original medieval coins, then you will find it easier to adapt non-period designs so that the resulting SCA tokens will still have a convincingly period look to them.

guidelines and reference points -

Many medieval coin designs were deliberately symmetrical (e.g. crosses, and facing king heads instead of profile busts), probably for ease in laying out the design by

hand. This is where laying out vertical and horizontal center lines first helps a lot in laying out the design on the die. Even if you don't feel highly skilled in drawing, sketching an image on the die is much easier if you can estimate the relative positions of various design elements relative to the center lines. Look for key reference points in the design, e.g. the tip of the chin, the nose, the brow, &c. Once you fix the position of such reference points, the rest of the design tends to fall together fairly cohesively.

To sum up, start with your circle template (which usually has marks at 0, 90, 180, and 270 *degrees* on each circle). Scribe the outer border circle guideline, and then using the N, S, E, W marks on the same circle, layout the vertical and horizontal center lines. Then, centering the smaller size circle's right angle marks on the center lines to center the smaller circle within the larger circle, scribe the guideline for the inner circle. Even if the design you're using doesn't have an inner circle, you'll still want to lightly scribe a circle marking the position of the bottom of the letters around the edge of the coin. Then, using the center lines as references, at least mark the positions of the design elements of the image, if not sketching the whole image on the die.

reversing layout and errors -

With respect for what you are about to do, there is one very important thing to keep in mind, you must work in reverse or mirror fashion. You can sketch your design on a small piece of paper and then tape it to the edge of a lampshade while you're working so that you can see the design showing through from the back to see how it should look in reverse.

To get a positive coin, one must produce a negative die. The problem of errors in reversing design elements on the dies was minimized by the symmetry of many medieval coin designs, so it's mainly a problem with the lettering. There are examples of retrograde letters on period coins. If you make such an error, don't panic. Many small errors can be corrected with a little creative punchwork, and some small errors can simply be overlooked (only another moneyer will notice, if anyone notices at all). If the error is too big, you can always regrind the die and start over. Ouch!

Sinking the Dies

setup -

With your punches complete, secure your first die into a bench vise, bolster or anvil. (For engraving, Ian just uses a block of wood with a hole that is the diameter of the die stock drilled into it to hold the die upright. Using a piece of drill rod 4" long for the die, it should extend a couple of inches above the wood so that you can grip and turn it.)

checking progress -

A way to check your work as you go is to press a piece of child's modelling clay into the die face; that will show you how the finished coin will appear. If you'd like to keep a permanent record of the stages of sinking your die, once you have another die to use for the other side, you can simply do a trial strike on a pewter blank.

punch technique -

Working with your small hammer, you may find that larger and blunter punches need more force. However, for better control, it is better to use a heavier hammer such

as a three-pound hammer, rather than more force on a lighter hammer. It really does diminish skipping and flying punches. While the smaller pointed punches need less force, lots of heavy bashing is not only wrong but also dangerous. A flying punch is not only hazardous to the user but the pattern as well. Skipping punches can leave scratches and dents or worse. Make a point of holding them firmly.

Having two light sources can help you see where you're positioning a punch with respect to scribed guidelines. Once you've got the punch set where you want it, then, holding it firmly in that place, look at the top end of the punch (i.e. rather than the end with the design shape) to make sure you hit is squarely with the hammer. It can take several blows to sink a punch, especially with the larger ones. Naturally a punch with a flat face will take more force to sink than one than has a tapered entry into the metal, e.g. a beading punch (which should have a hemispherical end) or a chisel shaped punch used for making lines.

Some think it best to start with the most difficult part of the design such as a profile or figure. This way if you make a mistake and have to regrind the die, you don't waste the time redoing the simple parts such as the border beads. For border beads, there is no need to sink the bead deeper than the radius of the hemispherical end of the beading punch.

hardening dies?

When you are done, complete the other die in the same fashion. Once the Pile and Trussel dies are finished, you can strike coins right away. If you are working with tougher coin blanks, you can even harden your dies. This however could prove costly and the results are sometimes uncertain. One problem that has been encountered is a frosted appearance on the die surface. This occurs because professional heat treaters are accustomed to sandblasting the fire scale off of the machine parts that they harden. They have to be specifically instructed not to do so and they cannot always be counted on to follow the instruction.

Emmerich reports the cold rolled steel dies that he uses are fine. He has never treated a set of dies. The working life of a set of dies is outstanding when striking pewter - as many as two thousand one inch diameter pieces struck with little or no wear to be seen.

Alignment marks:

One final note on dies, many Moneyers and their patrons like to have the coins aligned to a specific orientation. For consistent alignment of the designs of both sides of the coin to each other, place the dies face to face with the desired alignment and then scribe a line across the edges of both dies where they meet. Then use the edge of a file to deepen the line into a notch on each die. (These notches can also be made on the edge of each die at the top of the design at the time the design is first laid out on the die blank.) This makes the notches readily visible to align the dies in setting up each strike.

This also is often done to keep the pattern clear if a hole needs to be placed later. The Guild has had many requests for this feature when doing site tokens. Also, if a coin needs to be restruck, it can usually be fitted into the pattern and finished. Just move it around till it clicks in place on the lower die. Place and click in the upper die as well and strike. It is a method to make the most of expensive blanks (e.g. silver or gold).

Coin Blanks

Coin blanks from pellets -

You now only lack the coin blanks themselves. Get out your propane torch and anvil. Also find your spool of 95/5 solder mentioned in the materials list. Start reeling the solder off the spool and cutting it into one-inch lengths until the whole spool is finished. Place the pieces one or two at a time on the anvil. Heat them with the torch. They will ball right up into little pellets in no time. As you get faster you can do three or four side by side. As they cool back to solid form, push them off the edge. The anvil should be resting on a cooling plate of steel or aluminum. With care, you can work anywhere in this fashion. Allow for the anvil to cool between batches of pellets; then you can do more. The cooling plate can also make a good surface for pouring out ingots for the rolling mill.

When the pellets and anvil are cool, put a pellet on the anvil and work it flat with the flat-faced hammer. Start hitting it in the middle and then toward the edge only after the middle is thinner than the edges. Keep going till you get a generally rounded piece of flat pewter with an even thickness and a little larger than the desired blank - unless you can beat it round enough and to the right size in the first place. Finish all of the pellets down to the required thickness you want. Then scribe circles the size of blank you want on the ones that turned out larger than the target size in beating them to the desired thickness or making an odd shaped one larger enough to get the right sized circle out of. Then trim to the circle with the tinsnips.

Coin blanks from sheet -

Pouring bars

Reel a whole layer off the spool of solder, roll it up into a ball and drop it in your ladle (or old saucepan, &c.). Melt it on a stove burner (gas is more efficient) or with a torch. (While the metal is melting, use your torch to warm up the mold so that atmospheric moisture won't condense on it - hitting it with molten metal at twice the boiling temperature of water can cause it to flash into steam, the vapor bubbles making pits on the bar of metal.) Once it has all slumped into a puddle, swirl it around a bit to make sure it's all melted. Fairly quickly the surface with start to freeze into a crinkly skin. If you're recycling skizzle from cutting blanks out of sheet, there may also be impurities, which should rise to the top. By pouring carefully with a slow start, you can pour clean fresh metal out from under the skin, leaving the slag in the ladle. It takes a little practice to pour at the right speed so that the liquid metal fills the space in your mold evenly without freezing before it's all poured.

Once poured, the mercury-like shiney surface of the liquid metal with change to a dull crystalline texture as it freezes. The bar can be removed from the mold by gripping it with a pair of plyers, as it will be just a little too warm for comfort to handle with bare hands.

beating bars -

Once you're done pouring bars, start beating them with a hammer of convenient weight and a smooth face. As with the pellets, work from the middle out toward the ends and edges to keep it even thickness. If the edge of the hammer face makes

dents in the surface, then tilt the hammer to one side or the other to compensate until the only dents are made by the whole hammer face evenly across its width. With practice, the only dents will be shallow. Start beating with a long swing of the hammer - coming down from above the level of your head - to maximize the power of gravity in moving the metal maximally. As you approach the desired thickness, shorten your swing to concentrate on smoothing the surface of the metal rather than squashing it thinner.

thickness -

If you don't have a rolling mill, continue beating the metal until it's sheet of the thickness you want the blanks to be. (Period silver alloy coins were typically about half a millimeter or 20/1,000ths" thick, but that's rather thin for pewter as it tends to bend too easily; anything over 1mm or 40thou is a lot of hard work to strike up well, so about three quarter millimeter or 30thou is a good compromise.) If you do have a rolling mill, then beat the bar down from it's poured thickness (usuallly ~5mm) to the maximum gap between the rollers of your mill (usually no more than 3.5mm).

rolling strip in a mill -

Each pass through the mill at the next stage of reduction of the gap between the rollers (called the 'pinch') is about a third of a millimeter (my mill is callibrated metrically) for a good balance between not having to do more pinches than you have to and not having to push too hard on the crank (for a mill without gear reduction or powered drive). That's for rolling strip wide enough for a single row of penny size blanks. Rolling wider strip requires more force on the crank - or smaller pinches.

cleaning the metal -

Beating on pewter and rolling pewter tends to bring up a black residue on the surface. This results in sheet and coin blanks that are rather too dark gray to suggest a coin that would have been of silver alloy in period, and often the color is uneven and streaky. If you have to make a lot of blanks, you can ignore it. However, if you want to make your coins as pretty as you can - bright, shiny, pewter of the lightest color you can get the metal and without streaks - you can minimize or eliminate these unappealing effects with frequent wiping of the pewter bar, the hammer face, and anvil with a rag. During rolling, a little oil on the rag used for wiping the rollers between each pass, and wiping the strip with a dry rag between passes can produce sheet metal that is only a little darker in color than silver - to the extent that a lot of people wouldn't notice the difference without comparing the metals side by side. The down side is that you'll spend twice as much time wiping as actually rolling, as well as using up lots of clean rags. However, if the rollers on your mill are as smooth as they should be when new, and you strike with highly polished dies, the coins will have blazing brilliant mirror-like 'proof-like' surfaces that look nothing like a medieval coin, but sure are purty.

cutting blanks with shears -

Once you've got either hammered sheet or rolled strip, the next step is to cut the blanks out. The primary period method was to use the long handled 'blanking shears' (a form of tool similar to what modern machinists call 'beverly shears'). [See Appendix A on how to convert a pair of tinsnips into medieval style blanking shears.] Most SCA moneyers just make do with tinsnips, and for small quantities of blanks, it's not a problem. Even though the period style blanking shears, with one handle fixed, are a lot easier on your hands (as well as being educational for doing public demos), they're still

relatively slow if you have much more than a hundred blanks to cut.

cutting blanks with a punch -

The 'quick and dirty' SCA moneyer method is to cut blanks out of the sheet with one of the punch tools described in Ian's discussion of tools above. The resulting perfectly circular blanks don't look period, but when you're faced with pulling an all-nighter to get the presentation pieces struck in time for Court, most find it an easy compromise to make.

With a little practice and a hammer of adequate weight, each blank can be cut out with one or two blows. With the stirrup and annular punches, usually the blank will remain inside the punch; you can accumulate a small stack of them before removing them. Often the last blank will stick, jammed in the cutting end of the punch; it should be pushed out against a piece of wood (I use the corner of my anvil's stump) rather than the fingers, as a slip can cut your finger if the cutting edge of the punch is as sharp as it should be for making clean cuts with minimum force. The outer edge can be sharpened with a fine flat file or on a whetstone. The inner edge can be dressed, if necessary, with a fine rod file, but you don't want any taper on the inside of the cutting edge, as that will guarantee the blanks jamming inside the punch.

flattening blanks -

The jeweler's type rod and plate disk cutter will make flat blanks, but the other types of punch will make a domed or cupped disk. These can be flattened out prior to striking by pressing down on a stack of them on an anvil using the end of a hammer handle.

edge finish -

Once the blanks are cut out, the edges can be finished in a couple of different ways. They can be filed smooth by holding the edge of the blank against a file and running it down with a turn of the wrist, rotating in between strokes to go all the way around.

Another method apparently used occasionally in period is to beat the edges of a whole stack of blanks with a small, light hammer. While originally the stack of blanks was held in a clamp while beating it on an anvil, Ian has done this by holding the stack in a metal trough made by taking the piece of pipe from the materials list and cutting it lengthwise. One half should have two holes drilled into the bottom. Mount this into a similar shaped recess in wood. Use two countersunk screws to secure it. With one or two dozen coins stacked together, stand them vertically on their edge in the half pipe. Tap the coins with a hammer and rotate the coins. The edges will smooth and true up. This “hammer planishing” of the edges is seen on some period English and Bohemian coins, but was otherwise probably not a common practice. It provides a nice finishing touch, if you are obsessive, but is generally not necessary. It also has the effect of making a slight rim on the coin. David Holland of the Bigbury Mint in England, who recommended this procedure, believes this edge treatment was done after the coins were struck.

A similar technique was used in English mints from 1279 onward to make the blanks. The blanks were cut from the end of a square section cast bar of silver using a chisel. These square pieces of metal were then held in a stack in a clamp and beaten on an anvil to make them round. Ian is not aware of anybody in the SCA attempting this method.

Having cut and shaped your blanks save all of the accumulated scrap by making good use of a drop cloth. Sitting around and cutting blanks makes for good fill time at events or at home. Just beware of what we call "*The Ring of Fire*". This will be a nice bit of bruising around the base of the thumb. The cause is the tin snips. It is just local muscle ache and will pass with time. [Or see Appendix A]

praise of pewter -

The ability to reuse the scrap of 95/5 is one of the reasons it has endeared itself to the Guild. It took some effort on my part to harness its usefulness.

Ranked as copper less pewter but sold as leadless solder. For me it was worth every penny of $7 per pound in the mid '80's. California passed a no lead plumbing law at about this time and the price shot up to $18 plus retail. We kidded ourselves that we were responsible for the hike, buying more pounds than I can remember the first year of its use. It is still not too hard to believe the jest. West, AnTir, and Caidian Moneyers have all used it to date.

In An Tir, a quick thinking Moneyer started melting down old pewter tankards and trenchers a few years back. This proved to be a most excellent source for coin and a good recycling method. In many ways the Guild has learned to collect and mix metals well. Of late, we have been buying metal in bulk wholesale. This has greatly reduced our costs. Tin is a wonderful nontoxic metal that even anneals at room temperature. Coupled with its silver like color and easy melting, it has been a boon to the Guild.

hardening pewter coins -

Now for its greatest secret, one that the Guild has closely guarded; for all its softness after being worked, tin can be hardened. When cast, this alloy will be very hard, yet continued rolling and hammering will soften it. Other metals will work harden when hammered, not so with tin.

As a test, take a finished coin and rest it on the anvil. Lightly heat it with a torch and then plunge it into cold water. Its tensile strength will increase. You will have to be careful not to melt your coins. It will take a bit of practice to get it right. Moving up to larger batches, you can do them on a cookie sheet in the oven on low. Too much heat and you will get blobs again. This is called "*cooking your coins*".

From the continual rain of orders that the Guild receives, it is often not possible to cook coins. So we often end up circulating them uncooked. "Tankard pewter" is commonly a 93/7 tin/copper alloy, so coins struck in that metal are less likely to need this kind of treatment. This procedure remains a useful if somewhat esoteric bit of technique. Drop a treated coin on an anvil though and the jingle will delight anyone.

Strike the Coin

Once your dies are sunk, the striking process is rather simple. Place the Pile in the recessed hole in the stump or bolster. Place a blank over the design on the die, centering it on the beaded border circle. Now rest the Trussel over the pile and blank, creating something like a metal sandwich. Bridge the two dies with your hand to stabilize things. Wearing a glove on that hand prevents the palm of the hand from getting pinched between the edges of the dies if they rock when struck. Many Moneyers don't use a glove. Period dies were often beveled which prevents pinching, but can slow down precise die positioning. You might want to rock the trussel a little,

this way and that, to feel that you've got it sitting on the blank evenly.

Deliver one heavy, yet precise, blow to the back of the Trussel die. Repeat as often as you have coin blanks to strike. Try and set a rhythm with perhaps a helper placing blanks. Before you know it, all of your coins are done.

Comments on Hammer Technique

Part of the appeal of SCA recreation of pre-industrial Arts & Sciences is that it re-connects people living in an ever more ethereal existence of cybernetic technology with our roots in physicality. The hammer is the most basic tool, the first tool, the mother of all tools, being an extension of holding a rock in your fist. However, if you haven't happened to have had occasion for your muscles and nerves to learn the relevant motions by, e.g. nailing together pieces of lumber, then some more basic familiarization would be a good idea before swinging a three or four pound hammer at a piece of drill rod in your other, very vulnerable feeling hand.

What I suggest is rounding up some scraps of 2x4 (stack them so they're thicker than the length of the nails), a hand full of nails (start with 8d box or common nails and work up to 16d sinkers), and an ordinary household 16 ounce claw hammer (work up to a long handled 32 ounce framing hammer). What you're going to be practicing is sinking the nails with three blows.

The efficient construction worker's professional technique of driving each nail with three blows is: first a light tap to set the nail (after which you don't need to hold it), second a full swing, with the hammer held near the end of its handle for maximum leverage, to drive the nail 90+% of its length into the wood, and finally a moderate blow to drive the head of the nail flush with the surface of the wood. The pattern is 'tap, WHAM!, thump, tap, WHAM!, thump' - with a steady rhythm of this pattern, a section of wall framing or a 4x8 sheet of plywood goes up in minutes.

The part of this pattern relevant to coining is the second (or first and second) blows. Analogous to the first tap, I often set the hammer on top of the trussel without actually hitting it in order to align my body to return the hammer to that point when striking (particularly when doing demos, which typically consist of five minutes of talking for every strike) . When you first try striking a coin, you might want to go through the motion slowly several times before actually striking.

What you're practicing by driving nails is your muscles and nerves learning the responses to control the hammer motion through a progressively longer swing with a longer 'lever arm' by holding the handle closer to the end. When you first try striking a coin, typically you'll have to choke up on the hammer handle too much and use too short a swing to actually get a good strike in order to adapt to using a hammer twice as heavy as needed for driving nails.

To get good strikes with either nails or coins, you'll ultimately need to start the swing with the hammer above the level of your head for a hammer head travel of a couple of feet or more. Instead of trying to 'push' the hammer down from about chest height, the necessary technique is to 'pull' the hammer down from above your head. However, for about the bottom half of the stroke, your muscular force input is more in 'steering' the hammer than driving it. Let gravity do most of the work.

Since steering is the critical part of the striking blow, the other thing you're practicing by driving nails is aim. A framing hammer has the power to drive a nail

almost all the way in one blow; the trick is to hit it straight enough not to bend the nail. It's like the old rule from 'besoboru' (as the Japanese would say) - "keep your eye on the boru". In fact, on a number of occasions I have used a punch to make a dent in the center of the top of the trussel as a target. Keep your eye on that spot and, with practice, that's where the hammer will hit it (don't look at your hand out of fear that it'll be in the path of the hammer - or it will be!). That focus is the essential part of 'paying attention', which is essential for safety.

Driving nails is good practice for striking pennies; for practicing the skill needed for two man striking of larger coins where you need both hands on the hammer (typically a 6# sledge with a handle 30" - 36"), the best practice I can think of is splitting firewood with an 8# maul. (I go through two to three cords per winter, mostly maple, although this year it's ash.) Don't let Sears try to sell you a 6# maul - with the lighter tool, you're doing more of the work - the idea is to make gravity work for you so you can concentrate on aim.

Sledge hammers and mauls are not about physical strength - it's all a matter of balance, timing, and leverage. I don't know how much artistic license there is in the 'toon on Grunal's website of the big husky Anglo-Saxon guy toting a log over his shoulder, but I'm only 5'6" and 146#. An example of balance & timing, &c. is that you can avoid a lot of wasted effort and fatigue in repeatedly picking up a maul or sledge by lifting it straight up by instead grasping the end of the handle (in between using it I set it down standing on its head with the handle straight up) in the right hand, and then giving it a gentle swing; as the head comes up foreward, give a tug backward, and the head swings up until the handle is level with the ground - then catch it behind the head with the left hand - it feels almost effortless. Similarly, when raising the hammer to head height to strike, my left hand is just behind the head during the lift (so that leverage isn't working against you), and then I slide it down toward my right hand at the other end of the handle as I begin the strike swing.

If a new moneyer is coming from an SCA combat background, think of it in terms of martial arts; keep balanced, focus your intention without attachment, and your qi will flow to the target without turbulence. Some of our best hammermen have been knights skilled in throwing a lethal shot with rattan.

However, unlike a combat blow, to get a good strike in coining, it is critical that the hammer blow be square and flat. Adjust your body height so that when the face of the hammer head is resting on the head of the trussel, the hammer's handle is level with the ground. Visualize the vertical central axis of the hammer's head aligning with the vertical central axis of the dies.

While two man striking is necessarily with the hammerman standing, period illustrations usually show one man striking with the moneyer seated. I strike standing because being seated feels awkward. However, your body geometry in one man striking is always going to feel more or less awkward because your hammer arm is 'longer' than the arm holding the dies by the length of the hammer's handle. You have to compensate by either bending your hammer arm or by twisting your shoulders, and that latter feels more awkward to me when sitting. It is a matter of personal preference. The height of my anvil and stump requires me to bend over when one man striking, which stresses the back when large numbers of coins must be struck. A taller stump would help (I just continue to use what I happened to acquire before addressing this

posture issue).

When the die is struck by the hammer, it tends to rebound upward. If it is not permitted to rebound up away from the coin just struck, e.g. if the hammer is not drawn away at the completion of the stroke, then the die can come back down onto the coin, practically never in the same position, resulting in what I call 'die rebound nicks', usually on the lettering around the edges. The period solution to the die rebound phenomenon is hand holding the dies with your hand overlapping both dies. Hold with a firm, but not tight, grip, until the hammer hits the die and then grip tightly to prevent the die coming back down on the coin, causing 'secondary contact marks'. You can feel the die jumping upward when hit, and with practice in co-ordinating timing of hammer blow and grip some people just continue the motion of the die rebound to lift the die away to remove the coin and set the next blank.

Well, things look pretty good if you have gotten this far. The finished coins your promised your war band are nearly in sight.

Da dextram misera “Lend a hand to the wretched”

astly, a few more notes on striking coins by hand. The term self-strike is often employed by the Guild to denote when a single Moneyer is striking coin. It is a critical skill needed for any independent Moneyer to carry his craft with him. For larger orders or dies, it is advised to create a division of labor among your helpers. One will act as the hammer man and stand opposite the seated die holder and stump. The holder will place the dies and give the signal for the hammer man to strike. In between strikes, the blank keeper will flick off the finished coin and apply a new blank. Caught on the Moneyers drop cloth, the coins are sorted and checked for errors. They are then separated into pouches or the melting pot. This is where teamwork can make the coins really pile up.

Everyone should have a chance to try the different jobs. Be assured that most will orient towards where they feel the most confident. To be sure, there are fearful Moneyers who will not hold dies being struck. I, however, have little fear concerning any major injuries. To date, no broken bones have been reported in the Guild. A number of skinned knuckles and blood blisters do make up our history. Still, these are just badges of honor to the veteran Guild member.

Many have tried to avoid their fears by using such things as armored gauntlets and long-shank holding tools. After a decade of holding dies and on occasion hitting myself, I must say, where is the spirit of moneying the old way if you will not hold the dies? Indeed!

Safety issues

A necessary part of becoming a medieval moneyer is getting over the psychological hurdle of fearing that you're going to hit your hand. Trying to invent some mechanical means of holding the die so that you never take that risk reflects an industrial age mentality. Part of the point of re-creating pre-industrial technology is to experience the 'working without a net' attitude toward the work; when you can't afford to

miss - you don't miss (unless you're pushing yourself beyond your limits, e.g. of fatigue).

To anyone not accustomed to working with heavy hammers, it looks dangerous. When doing two man striking in public demos, in spite of our announcing "We're professionals - do NOT try this at home, kids!", it is as predictable as the sunrise that one observer will say to the man holding the dies, "You must really trust him" (i.e. the hammer man) - to which the hammer man's stock answer is, "If I hit his hand, then it's my turn to hold the dies" (always elicits nods of understanding of folk wisdom). Then a second observer invariably starts making jokes about moneyers named "Stumpy" and "Two-fingers" - to which the stock answer is, "It's not as dangerous as it looks - if medieval moneyers had been hitting their hands all the time, they'd have damned quick figured out a different way to make coins, instead of using the same technology to mint billions of coins over a thousand years."

Then there's always some guy, usually a backyard mechanic/basement inventor, who says to us (with a smug, although paternalistically helpful, tone of voice that says 'you medieval guys must be really stupid if you can't figure out something this obvious'), "What you fellers need to do is get yurself a piece of pipe, see, and put one die down in the pipe, and then drop the blank in and put the other die in - so you don't have to hold it." I actually enjoy stunning them with, "We don't do it that way because, 1. they didn't do it that way in period - and doing the period way is the whole point of our re-creation, and 2. they didn't do it that way in period because it doesn't work." "Huh? What?" they say. I elucidate, "What happens when you hit the die?". Never having done it, they can't imagine. "The die bounces upward, the coin jumps around, and die comes back down... (see discussion above). There are a lot of different kinds of striking defects seen on medieval coins, but die rebound nicks aren't one of them. Hand holding the dies is the period way.

As for it not being as dangerous as it looks in terms of the actual tools involved, the only way you can really smash your hand against the anvil is if you miss the die completely - and if you can't hit the die at all, you shouldn't be doing this. What is actually likely to happen is that, if your blow is not centered, the hammer clips the edge of the head of the trussel. If you clip the edge of the die on the far side, the near side, or the right side (assuming you're holding the die in your left hand while doing one man striking), that tilts the die, deflecting the hammer away from your hand (what you find yourself worrying about is the danger of the edge of the trussel scraping the face of the pile). If you clip the left edge of the die, the hammer slides down your knuckles, scrapes and stings a bit - and reminds to you to PAY ATTENTION!

(Once you've learned to pay attention, there are conditions that can diminish it. The only time a member of the An Tir Guild has ever hit his hand hard enough to go have it X-rayed (the bones weren't broken), was when Thomas Nothelm was pushing to finish a big project at three in the morning, bleery-eyed with fatigue. Medieval Guild rules actually forbade people to work after dark.

(In fact, I have a tiny scar on my left middle finger; I was holding the trussel while a bladesmith friend was wielding a long 6# hammer for me. I made the mistake of teasing him on a point I hadn't realized he was sensitive about. I don't think he missed the die deliberately, but he was certainly distracted. There are different kinds of things one has to learn to pay attention to.)

The whole point of the pre-industrial attitude toward work is that it is NOT a

disregard for safety, but rather a different means of safety. You have to rely on focusing your attention on the work instead of depending on a mechanical device to eliminate the need to pay attention. Working safely with pre-industrial technology requires learning a different mind set to avoid injury - but isn't that the purpose of our historical re-creation? We're not just creating props for an image of medieval life, but trying to experience life as they did.

That orientation to work is illustrated by an anecdote from Japanese Homes and Their Surroundings, a book by an American living in Japan in the 1880's, observing the traditional, pre-western influenced architecture and building techniques. The posts and beams were squared by the carpenter standing barefoot on a log and rapidly chopping it with a razor sharp adze cutting inches from his bare toes; the author reported that he never saw a Japanese carpenter missing any toes.

Appendix A - how to make a set of period style blanking shears
by Ian Cnulle

f you have ever cut a large quantity of blanks out of sheet using tin-snips, you know what is meant by the “ring of fire”, that aching inflamed arch across your palm around the base of your thumb. It’s almost enough to make you want to go back to beating solder blobs into blanks. You still have to trim the beaten blobs and it’s not an option when you are using a harder metal. In An Tir, a party of volunteers who were cutting brass blanks with tin-snips all went home with blistered and bleeding hands.

Making money the really old-fashioned way makes us appreciate the labors and suffering of our distant occupational ancestors. But, did medieval Moneyers have to endure the ring of fire all the time? They may have been illiterate low-tech barbarians, but after all, they were smart enough to be Moneyers!

Most detailed period illustrations of mint operations show a very distinctive tool that, for want of knowing the specific period technical term, I call “blanking shears” (see Figure ??). Their distinctive features are long handles, perhaps up to two feet long, and a right angled spike or tang at the end of each handle.

The mechanical advantage of the long handles is leverage; a larger version of the tool was used up into the Industrial Revolution to cut ingots. The function of the tang on the lower handle was to fix the handle in place. It is usually shown spiked into the top of the workbench or a wooden anvil block. Having one handle fixed enables you to apply all of the muscles of your arm, or your shoulder, or even your whole back, if necessary, to the leverage, instead of only using the muscles of your hand in a squeezing motion, as with tin-snips. The function of the tang on the upper handle was probably to stop the handles from closing together all the way to prevent one’s fingers from being squashed between the handles.

Any blacksmith capable of making a pair of tongs for his own use should be able to reproduce a pair of blanking shears on the basis of a good illustration. If you don’t happen to know a blacksmith, you can quickly and cheaply adapt a pair of tin-snips to work the same way. The resulting tool won’t look period because each half of the period blanking shears was forged in one piece, but then who cares when your choice is between getting the work done with or without pain and injury.

I adapted an old pair of tin-snips by hacksawing the loops off the handles (see Figure ??). It took a little filing to get the resulting straight handles to fit inside pieces of 5/8" inside diameter iron pipe that I happened to have laying around. I shoved the handles into the pipe until they jammed solidly. This left about 3" of the original handles below the pivot exposed. The pieces of pipe are 20" long and threaded on the bottom end. I simply screwed iron pipe elbows onto the treaded ends. Once the elbows were firmly seated, I twisted the pipe to align the elbows with the jaws of the tin-snips. With the elbows in place, the total length of the handles is two feet. The elbow on the upper handle hitting the lower handle's elbow is enough to keep the handles from closing on one's fingers.

My last step was to screw a 6" long pipe nipple into the elbow on the lower handle. This nipple fits into an angled 1" diameter hole I drilled into the side of my wooden anvil base near the top. It just happens to work out that way, when sitting in its hole, the lower handles of my shears jams against the edge of my steel anvil block insert or the "bolster" to keep the shears from swinging from side to side (see Figure ??) . However, it shouldn't take to much tinkering to come up with other methods of mounting the shears. For example, a method resembling the original period technique would be to hammer the end of the pipe nipple flat, and then hammer the flattened end into a slot chiseled into the wooden anvil block.

However it is mounted, the resulting tool works like a charm; it cuts sheet brass as easily and as smoothly as pewter. All that you have to remember is to turn the blank into the jaws as you cut and keep a pair of pliers handy to tighten the pivot nut to keep your cutting sharp and even. With a pair of tin-snips from a garage sale and pipe pieces from a junkyard, your material costs should be under $5. If you buy everything new, you might pay $10 to $20. Black iron pipe won't look so glaring and might be a little cheaper than galvanized pipe. Assembly time is half an hour to an hour. However much time and money you spend, it is well worth it. Period blanking shears are such a distinctive and indispensable tool for period moneying that I've made them part of the device for my badge.

Appendix B - notes on engraving, by Ian Cnulle

The place of engraving in period and period style diework -

Many ancient coin dies were entirely engraved with no punchwork at all. Where punching was used, usually it was little more than dots for borders, letter ends, and decorative elements. Many medieval coin dies were entirely punchwork with no engraving at all. However, many, if not most, medieval coin dies did include some engraving. Toward the end of the middle ages, as the mechanization of minting began, engraving came to be increasingly, and ultimately exclusively, used on master dies and 'hubs' used for mass producing working dies on a much larger scale and with a far greater consistency than typical medieval die work. From the 1820's onward, engraving came to be practically exclusively done mechanically to reproduce sculpting done by other means.

Most SCA moneyers do not do any engraving at all, producing perfectly satisfactory dies entirely by punchwork. Some, interpreting medieval coins they examine in the context of their familiar punching techniques, believe that engraving was

not used at all on medieval coin dies. Being familiar with both punchwork and engraving and the diagnostic artifacts made on the actual coins by each method, I conclude that, engraving not only was in fact used on medieval coin dies, but that it was more widely used than most people assume.

Many are reluctant to try engraving because, 1. it seems to be an intimidating technique ('steel' is synonymous with 'hard' - cutting steel with steel by hand has got to be difficult, right?), and 2. it is time consuming slow work. It is not, in fact, as difficult as people assume, but it is unquestionably time consuming.

A neat, penny size die with a simple design can be sunk by punching in an hour or two; I typically take about five hours to engrave such a die - including punching the inscriptions. I commonly spend up to a couple of dozen hours on a die for the shilling size An Tir/West War commemorative medals with an elaborate image. If you (as most) don't have the time to do tedious work at a medieval pace of life, you needn't feel that you're a lesser moneyer for it. However, if you can spend some time on engraving, you'll find that you can engrave some design elements that cannot be made as well by punchwork - and some that cannot be done at all by punchwork.

the tools -

The tools and techniques are really very simple - most of what there is to learn can only be learned by practice. The tools are acquired from a jewelry supply, such as Gesswein, if not a local jeweler's supply. They consist of the gravers or 'burins' (thin pieces of steel rod of various cross-section shapes) and wooden handles (bought separately). You'll also need a whetstone for sharpening the graver, and a burnisher (a polished tapered piece of steel in a wooden handle) for rubbing closed unwanted scratches (to a limited extent, a kind of 'eraser' for mistakes - by the way, tiny ridges in the field of coins often show that medieval die engravers didn't bother to burnish out graver slips - further evidence that, in fact, engraving was a die sinking technique they used).

how to set up the graver -

The graver has to be fitted to the user's hand. Hold the graver along your index finger with the base of it about where it will be seated in the wooden handle against the heel of the palm of your hand, and note where the piece of steel extends beyond the tip of your finger by a quarter inch or so. Then clamp the graver in a vise with the excess extending beyond the jaws of the vise and snap it off with a tap of a hammer (the graver should be brittle hard when you buy it).

Then drill a hole in the handle slightly smaller in diameter than the thickness of the graver and to a depth about to where the end of the handle mushrooms out, and press the graver into the hole until it seats firmly. Graver handles usually have a flat spot on one side of the flat end; this allows a lower angle of cutting (with the burin almost parallel to the surface being engraved), as well as preventing the graver from rolling around when you set it down. Set the burin into the handle with the point oriented downward as the handle lays on its flat spot.

Then grind a bevel on the end of the graver. For engraving precious metals or soft non-ferrous metals (e.g. copper) the jeweler's textbooks tell you to bevel the end to about 45 degrees and then temper the graver by heating it to a temperature below what is necessary to harden it, and then quenching it. For engraving steel, the bevel should be closer to about 60 degrees, and the graver is used brittle hard, without being

tempered. To reduce the area of the bevelled end you'll be working down when sharpening the graver, it helps to grind down the 'back' or top side of the end of the graver. However, when bevelling the end and 'relieving' the back of the graver, it is important not to allow the grinding to overheat the graver, or the heating can draw the temper, softening the working end too much for cutting steel effectively.

the uses of the different shapes of gravers -

Practically all line work is done with a 'square' graver, which is bevelled and relieved to a triangular face - you're using the 'corner' of the square or lozenge shaped section to do the cutting. A great deal of sculpting out rounded shapes can be done with an 'oval' graver (with a point like a square graver, but rounded edges to the working face). For sculpting smaller shapes (as well as cutting a right angled bottom to sunken shapes on a die) various sizes of 'round' gravers (i.e. with semi-circular working end) are used. There are other shapes of gravers, but they have little use in die cutting. The round gravers are rather more specialized - useful for ancient and Renaissance style die work; 90% of any engraving on medieval style die work can be done with just the square and oval burins.

how to engrave -

The technique of using the burins is to push with the palm of your hand against the wooden handle while controlling the point position with the fingers. (The angle of the graver to the surface of the die must be very shallow.) The tip of the index finger presses the tip of graver into the metal. With the oval and round gravers, some of the shaping is done with a sideways scraping motion of the tip, while the square graver has to be pushed foreward as straightly as possible to avoid any lateral pressure on that tiny sharp brittle point. Because of that, cutting circular lines is best done by rotating the die in its holder while holding the graver steady instead of swinging your wrist to change the direction of the cut.

To work right, there is a very narrow window between the tip of the graver being absolutely perfectly razor needle sharp - and won't work at all (skipping and gouging). That means you'll spend a lot of time sharpening the square graver (the oval and round gravers are much more forgiving, needing comparatively very little sharpening). Consequently, the main thing there is to learn in engraving is the feel of the tool and its interaction with the material, i.e. how hard can you push without chipping the tip of the square graver or otherwise losing control of the tool.

The best description I can think of is that it's like learning where the clutch pedal engages in a standard transmission car. You begin cutting a line removing the tiniest bit of metal - a curl finer than a hair on your head. Then you gradually deepen the cut in subsequent passes, taking anywhere from two to twenty passes for a given line, depending on its depth, width, and the hardness of the metal. As it cuts into the metal, a properly sharp point will 'hold' the metal, and what you're feeling is a rather sensuous balance between resistence and yield.

Notes on safety: even when you have a good feel for the graver holding the metal, it's always possible that the graver will slip - with all of the force of you arm behind it. Consequently, always remember to keep your other hand out of the path of a potential slip; that sharp graver will cut to the bone, it will bleed, it will hurt. OTOH, most people only make that mistake once.

A slipping graver nailing your hand causes shock and pain; a slipping graver

causing a gouge across the die face causes anger. Consequently, I always brace the end of my thumb against the side of the die, so that, when the graver slips, it only goes as far as your hand flexes. The main danger of slipping occurs when the tiny tip of the square graver chips; you can instantly feel the difference ('oh, hell, where's the whetstone?') - sometimes it seems you can even hear it snap. Another tip on technique: commonly the tip of the square graver chips on the 'back-stroke' if you develope the bad habit of not relaxing the pressure of your hand when you draw back to have another go at a section of line.

border grooves -

The first engraving that I have an Apprentice of the An Tir Guild do on his mon die is to cut a groove for the border beading. Thus one's first effort is something that is going to be covered by subsequent punchwork, diminishing the temptation to obsess about trying to make it look 'good' when first learning the ornery square graver.

This border groove was the most common use of engraving on medieval coin dies, and one easy to overlook by the advocates of 'nothing but punchwork'. In the MGW, it has long been standard procedure to keep a scribe tool on the anvil's stump available to pry off coins that stick to one of the dies. The most common cause of coins sticking to the die is that a border of deeply punched beads is essentially a row of 'cups' of metal pushed up around each bead as the punch is sunk; the metal of the coin blank fills the cups and locks into position.

The period solution to the problem was to cut a V shaped groove with a square graver for the border circles; the beading punch then rides in the groove (making the beading go much faster and more neatly), but part of each cup doesn't form because of the groove. On the other hand, on many period coins, the border circles don't have beading at all, but rather 'dentilation' (inspired by ancient Roman coins) made by graver cuts into the V groove from the side.

other uses of the square graver -

To one degree or another, practically all punchwork displaces upward from the face of the die ridges around the punched shapes. Novice SCA moneyers are sometimes tempted to file off such ridges because their mental image of a coin is dominated by modern coins struck with perfectly flat die faces. However, the ridges should be left intact, as they actually make it easier to get good strikes when hand hammering cold strikes. On the other hand, when heavy lines are spaced together, e.g. the drapery and hair lines on some Anglo-Saxon profile king busts, the ridges pushed up by punching the lines can overlap and make the design an indistinct hash. This is a case where cutting the lines with a square graver makes a better looking coin, and in fact was done that way in period.

oval and round graver applications -

Many early profile king heads were made of just outlines with no relief modeling of cheek, chin, or jaw (although, if the outlines are close enough, the ridges made by punching the lines can make the edges of the outlined areas rounded for an appearance of overall relief). In other cases, cheek, &c. relief was made separately from the lines on the die. These shapes can be scooped out easily with an oval graver; trying to do it by punchwork by punching down the central areas results in an ugly lumpy mess that doesn't look like the original coins. Some of the finely modelled heads on small module pennies of Offa of Mercia (mid-8th century Anglo-Saxon) would be

impossible to sink by punchwork.

Complex shapes, e.g. heraldic beasts (mostly only seen in late period, particularly in the Renaissance, when there was more interest and effort in reproducing ancient engraved style) are easier to make distinctly by engraving with the oval and round burins. Some designs, e.g. the Edward I type facing king head (used on English coins for more than 200 years) look engraved, but in fact they were sunk with large specialized punches; the engraving was done on the punch tools instead of on the working die. That made sense when they had to produce thousands of dies of the same design with a high degree of consistency. When the SCA moneyer only needs to make one die with that design, it makes more sense to eliminate a superfluous step by doing the engraving directly on the working die, rather than on punches used to sink the die.