factsheet - The Work of the Blacksmith

(Compiled by Brian Hoban for Clogher Heritage)

The Blacksmith creates objects from wrought iron or steel by forging the metal, using tools to hammer, bend, and cut). Blacksmiths produce objects such as tools, agricultural implements, cooking utensils, and weapons. The person who shoes horses is a farrier (though a blacksmith may make the shoes).

Origin of the term

The term “blacksmith” comes from the activity of “forging” iron or the “black” metal - so named due to the colour of the metal after being heated (a key part of the blacksmithing process). The term “forging” means to shape metal by heating and hammering.

The process

Blacksmiths work primarily with wrought iron and steel. The “black” in “blacksmith” refers to the black fire scale, a layer of oxides that forms on the surface of the metal during heating. The word “smith” derives from an old word, “smite” (to hit). Blacksmiths work by heating pieces of wrought iron or steel, until the metal becomes soft enough to be shaped with hand tools, such as a hammer, anvil and chisel. Heating is accomplished by the use of a forge fuelled by coal, charcoal or turf.

Colour is important for indicating the temperature and workability of the metal: As iron is heated to increasing temperatures, it first glows red, then orange, yellow, and finally white. The ideal heat for most forging is the bright yellow-orange colour appropriately known as a “forging heat”. Because they must be able to see the glowing colour of the metal, some blacksmiths work in dim, low-light conditions.

Forging

Forging is the process in which metal is shaped by hammering. Forging is different from machining in that material is not removed by it; rather the iron is hammered into shape.

There are seven basic operations or techniques employed in forging: drawing down, shrinking (a type of upsetting), bending, upsetting, swageing, punching and forge welding.

These operations generally employ hammer and anvil at a minimum, but smiths will also make use of other tools and techniques to accommodate odd-sized or repetitive jobs.

Drawing

Drawing lengthens the metal by reducing one or both of the other two dimensions. As the depth is reduced, the width narrowed, or the piece is both lengthened and “drawn out.”

As an example of drawing, a smith making a chisel might flatten a square bar of steel, lengthening the metal, reducing its depth but keeping its width consistent.

Drawing does not have to be uniform. A taper can result as in making a wedge or a woodworking chisel blade. If tapered in two dimensions, a point results.

Drawing can be accomplished with a variety of tools and methods. Two typical methods using only hammer and anvil would be hammering on the anvil horn, and hammering on the anvil face using the cross peen of a hammer.

Another method for drawing is to use a tool called a fuller, or the peen of the hammer, to hasten the drawing out of a thick piece of metal. Fullering consists of hammering a series of indentations with corresponding ridges, perpendicular to the long section of the piece being drawn. The resulting effect will look somewhat like waves along the top of the piece. Then the hammer is turned over to use the flat face and the tops of the ridges are hammered down level with the bottoms of the indentations. This forces the metal to grow in length much faster than just hammering with the flat face of the hammer.

Shrinking

Shrinking, while similar to upsetting, is essentially opposite the process of drawing. As the edge of a flat piece is curved—as in the making of a bowl shape—the edge will become wavy as the material bunches up in a shorter radius. At this point the wavy portion is heated and the waves are gently hammered flat to conform to the desired shape. If you were to compare the edge of the new shape to the original piece, you would discover that the material is now thicker. This change in thickness is due to the excess material that formed the waves being pushed into a uniform edge having a smaller radius than before.

Bending

Heating iron to a “forging heat” allows bending as if it were soft, ductile metal, like copper or silver .Bending can be done with the hammer over the horn or edge of the anvil or by inserting a bending fork into the Hardy Hole (the square hole in the top of the anvil), placing the work piece between the tines of the fork, and bending the material to the desired angle. Bends can be dressed and tightened, or widened, by hammering them over the appropriately shaped part of the anvil.

Upsetting

Upsetting is the process of making metal thicker in one dimension through shortening in the other. One form is to heat the end of a rod and then hammer on it as one would drive a nail: the rod gets shorter, and the hot part widens. An alternative to hammering on the hot

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end is to place the hot end on the anvil and hammer on the cold end.

Punching

Punching may be done to create a decorative pattern, or to make a hole. For example, in preparation for making a hammerhead, a smith would punch a hole in a heavy bar or rod for the hammer handle. Punching is not limited to depressions and holes. It also includes cutting, slitting, and drifting—all done with a chisel.

Combining processes

The five basic forging processes are often combined to produce and refine the shapes necessary for finished products. For example, to fashion a cross-peen hammer head, a smith would start with a bar roughly the diameter of the hammer face: the handle hole would be punched and drifted (widened by inserting or passing a larger tool through it), the head would be cut (punched, but with a wedge), the peen would be drawn to a wedge, and the face would be dressed by upsetting.

As with making a chisel, since it is lengthened by drawing it would also tend to spread in width. A smith would therefore frequently turn the chisel-to-be on its side and hammer it back down—upsetting it—to check the spread and keep the metal at the correct width.

Or, if a smith needed to put a 90-degree bend in a bar and wanted a sharp corner on the outside of the bend, he would begin by hammering an unsupported end to make the curved bend. Then, to “fatten up” the outside radius of the bend, one or both arms of the bend would need to be pushed back to fill the outer radius of the curve. So he would hammer the ends of the stock down into the bend, ‘upsetting’ it at the point of the bend. He would then dress the bend by drawing the sides of the bend to keep the correct thickness.

The hammering would continue—upsetting and then drawing—until the curve had been properly shaped.

Welding

Welding is the joining of the same or similar kind of metal.A modern blacksmith has a range of options and tools to accomplish this. The basic types of welding commonly employed in a modern workshop include traditional forge welding as well as modern methods, including oxyacetylene and arc welding.

In forge welding the pieces to be joined are heated to what is generally referred to as “welding heat”. For mild steel most smiths judge this temperature by colour: the metal will glow an intense yellow or white. At this temperature the steel is near molten.

Any foreign material in the weld, such as the oxides or “scale” that typically form in the fire, can weaken it and potentially cause it to fail. Thus the mating surfaces to be joined must be kept clean. To this end a smith will make sure the fire is a reducing fire: a fire where at the heart there is a great deal of heat and very little oxygen. The smith will also carefully shape the mating faces so that as they are brought together foreign material is squeezed out as the metal is joined. To clean the faces, protect them from oxidation, and provide a medium to carry foreign material out of the weld, the smith will sometimes use flux—typically powdered borax, silica sand, or both.

He will first clean the parts to be joined with a wire brush, then put them in the fire to heat. With a mix of drawing and upsetting the faces will be shaped so that when finally brought together the center of the weld will connect first and the connection will spread outward under the hammer blows, pushing the flux

The dressed metal goes back in the fire, is brought near to welding heat, removed from the fire, and brushed. Flux is sometimes applied, which prevents oxygen from reaching and burning the metal during forging, and it is returned to the fire. The smith now watches carefully to avoid overheating the metal. There is some challenge to this, because in order to see the color of the metal it must be removed from the fire, and this exposes the metal to air, which can cause it to oxidize rapidly. So the smith might probe into the fire with a bit of steel wire, prodding lightly at the mating faces. When the end of the wire sticks on to the metal, it is at the right temperature (a small weld has formed where the wire touches the mating face so it sticks on to the metal). The smith will commonly place the metal in the fire so as it can be seen without letting the surrounding air come into contact with the surface.

Now the smith moves with rapid purpose. The metal is taken from the fire and quickly brought to the anvil—the mating faces are brought together, the hammer lightly applying a few taps to bring the mating faces into complete contact and squeeze out the flux - and finally returned to the fire again.

The weld was begun with the taps, but often the joint is weak and incomplete, so the smith will again heat the joint to welding temperature and work the weld with light blows to “set” the weld and finally to dress it to the shape.

Finishing

Depending on the intended use of the piece a blacksmith may finish it in a number of ways:

A simple jig (a tool) that the smith might only use a few times in the shop may get the minimum of finishing: a rap on the anvil to break off scale and a brushing with a wire brush.

Files can be employed to bring a piece to final shape, remove burrs and sharp edges, and smooth the surface.

Heat treatment and case-hardening to achieve the desired hardness.

The wire brush either as a hand tool or power tool can further smooth, brighten and polish surface.

Grinding stones, abrasive paper, and emery wheels can further shape, smooth and polish the surface.

There are a range of treatments and finishes to inhibit oxidation of the metal and enhance or change the appearance of the piece. An experienced smith selects the finish based on the metal and intended use of the item. Finishes include but are not limited to: paint, varnish, bluing, browning, oil, and wax.