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A Brief History of Metalworking Techniques on Armour

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BRIEF HISTORY OF METALWORKING
TECHNIQUES ON ARMOUR

CHERYL M. BANNES

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A BRIEF HISTORY OF
METALWORKING TECHNIQUES ON ARMOUR
(TITLE)

BY

CHERYL M. BANNES

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

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CHARLESTON, ILLINOIS

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YEAR

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Abstract

Metalsmithing has always been a challenge to me when pursued on a large scale. This challenge prompted me to look into large body pieces, and led to an extreme interest in armour, particularly since it was often decorated with chasing and repoussé, techniques with which I had been working. At about this time, while on a visit to England, I was able to view many types of armour at first hand. I was impressed by the technical construction and decoration used. This led to curiosity about how the armourer worked then, and whether the techniques used were much different than those of the metalsmith of today.

This paper deals with a brief history of the development of armour, and a summary of some techniques used. It concludes with a brief summary of the importance of the armourer in the 15th and 16th centuries and acknowledgement of the fact that metalsmithing tools and techniques have virtually remained the same throughout the centuries.

Metal techniques discussed in the paper include etching, engraving, gilding, and chasing and repoussé. Most of these techniques have been known since early civilization. Few changes have been made except for the introduction of newer tools because of modern technology. However, there is little recorded information on many techniques. This is

also true of the development of armour. Much information is gathered through manuscript illustrations, paintings, and other art forms. There are also records that were kept by Kings and Nobles for the ordering of armour and armourers tools that have shed some light on the subject. However, many fine points of construction were kept secret within a guild to keep competitors from discovering any "trade secrets".

Armour development was dominant in two centers: one in Italy, and the other in Germany. Each center developed its own distinct style, but eventually styles and decoration intermingled. Designs on armour have a direct relationship to other art forms. Guilds employed blacksmiths, locksmiths, metalsmiths, and engravers, as well as the armourer. Designs from armour can be seen in paintings, printing, ironwork, and in decorative arts as well as functional objects.

In discussing these aspects, no attempt is made at technical research of a technique, or at an in-depth study of the history of armour. Rather the reader is presented with a brief history for a better understanding of the metalwork of the armourer of the time.

TABLE OF CONTENTS

	Page
List of Illustrations.....	v
Acknowledgements.....	vi
Introduction.....	1
Glossary of Armour Terms.....	4
History of the Development of Armour.....	5
Glossary of Engraving Terms.....	14
Engraving.....	15
Glossary of Etching Terms.....	18
Etching.....	19
Glossary of Gilding Terms.....	23
Gilding.....	24
Glossary of Repoussé Terms.....	26
Repoussé and Embossing.....	27
Glossary of Iron and Steel Terms.....	31
Iron and Steel.....	32
Conclusion.....	38
Bibliography.....	41

List of Illustrations

Page

- 10 Armour for Man - illustrating common names for
 sections of armour.
- 11 Armour for Horse - illustrating common names for
 sections of armour.
- 12 Examples of Maximillian Style Armour.
- 13 Examples of the Grotesque Style Armour.
- 21 Designs for Armour by Albert Dürer.
- 22 Engraved Design by Étienne Delaune.
- 30 Example of Embossed Armour.
- 36 Ironwork for Keyholes.
- 37 Ironwork Keys.
- 40 Knights and their Ladies.

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Introduction

Metalsmithing has always been a challenge to me when pursued on a large scale. This challenge prompted me to look into large body pieces, and led to an extreme interest in armour, particularly since it was often decorated with chasing and repoussé, techniques with which I had been working. At about this time, while on a visit to England, I was able to view many types of armour at first hand. I was impressed by the technical construction and decoration used. This led to curiosity about how the armourer worked then, and whether the techniques used were much different than those of the metalsmith of today.

This paper deals with a brief history of the development of armour for war and parade, and a summary of the techniques most widely used. It concludes with a brief summary of the importance of the armourer in the 15th to 16th centuries and acknowledgement of the fact that metalsmithing tools and techniques have virtually remained the same for centuries.

Many of the types of metal techniques being discussed have been around since the earliest recorded civilizations. Many developments since antiquity have been the result of the introduction of newer tools through modern technology. Techniques such as engraving and etching have been used for centuries, but there is little recorded information about their introduction and development. This is also true of the development of armour. Much information is gathered

through manuscript illustrations, paintings, and other art forms. There were also accounts kept by kings and armourers about armour ordered, armour delivered, tools ordered or needed, and material needed, that have shed light on the actual working of the armourer. However, again we find many of the fine points of actual construction unrecorded since techniques were handed from generation to generation, and any special way of handling the material was kept within the Guild to keep other armourers from discovering any of their "trade secrets".

Two centers for armour developed and became dominant through the centuries, one in Italy and another in Germany. Each had its own distinct style at first, but later a relationship can be noticed as style and decoration intermingled. Many times armourers were lent by one Noble to another as a sign of good faith, so that styles that may have been popular in one country would spread and change in another country.

The designs used on armour had a direct relationship to the arts. A Guild not only employed the armourer, but also goldsmiths, blacksmiths, embossers, engravers, locksmiths, and designers. Often, many of the members of the Guild were related by marriage, so that there was a constant interchange of design and technique. Designs from armour can be seen in painting, printing, ironwork, in decorative arts, and in functional objects.

In discussing these aspects of the armourers art, no attempt is made to do technical research of the techniques,

or to do an in-depth study of types of armour and their development. Rather the reader is presented with a brief history of the armourers craft for a better understanding of the metalwork of the armourer of this period.

Glossary

Backplate - piece or plate of armour for the back.

Besaques - small plates which protect the gap in armour at the armpit.

Bevor - plate protecting the lower part of the face.

Bufte - piece to protect the chin and throat.

Breastplate - protects the front of the body.

Coif - hood of mail.

Comb - crest of the helmet.

Cuirass - protects breast and back.

Damascening - metal decor produced either by surface pattern or inlaid decor.

Fauld - skirt of armour, often a series of narrow plates.

Gauntlet - armour to protect the hand.

Gorget - armour to protect the throat.

Greave - protects the lower leg.

Hauberk - mail shirt.

Mail - defense made up of interconnected metal rings.

Mufflers - mittens of mail attached to the Hauberk.

Pasguard - piece to reinforce the left arm.

Pauldron - for shoulder and upper arm.

Poleyn - protects the knee.

Repoussé - form in relief pattern in metal beaten from underneath.

Tassets - protect the loins and thighs.

History of the Development of Armour

From the beginning, when man first appeared on the Earth, there has always been a need for protection. Whether the threat came from man or beast, men have always armed and protected themselves.

The earliest form of armour appeared as heavy leather garments and wooden shields. Evidence of metal protection dates back to the Parthians, who had developed chain mail, a series of interlocking iron rings, for both warrior and horse. It was little used by Western countries until the 12th century due to poor quality and lack of knowledge of sound construction. As chain mail was perfected, it proved to be good protection from most weapons, but a warrior was still vulnerable to arrows and pikes. Full suits of mail were worn, but more protection was needed, especially for the horsemen whose legs were very vulnerable to blows from foot soldiers.

The first plates of armour appeared around the beginning of the 13th century as shin guards for horsemen. Plates were then added to strengthen the most vulnerable areas of the knight. First the greaves, then the poleyn, the pauldron, and the gauntlet all appeared by the end of the 13th century. Plates continued to be added, with the breastplate and backplate being the first pieces to be connected, often with leather straps, forming the cuirass.

During the third Crusade in the 13th century, the first form of decoration appeared as a functional development. Often a coat of silk or other material was worn as an overcoat by the

soldiers. Its original purpose was to cut down on the reflection of the sun on the steel and to protect the metal from rain. These coats also served to identify soldiers, by the embroidering of heraldry or the insignia of the noble on them. They were often highly embroidered with gold and silver and made in rich materials. It was also common practice to wear an elaborate gold and jeweled belt around the hips over the coats.

In the 14th century, armour was very diverse. The transition from mailed armour to plates or iron or steel, called plate armour, dates approximately from the first thirty years of the 15th century. During this Feudal period, as the need for armour increased, the early armourer was faced with some basic rules he needed to follow.

The first rule was suitability for purpose. This took into account the need for a form that would deflect blows, and the need for some areas, such as the chest, to be thicker for greater protection. The second rule was convenience in use. Not only was protection important, but movement was necessary. Many areas were made of several plates with sliding rivets or leather straps to facilitate movement. Third was recognition of materials, allowing the armourer to use the metal to its fullest in terms of decoration and construction. Fourth was soundness of construction methods. Various methods of attaching armour were used, including the use of turning hooks and pins, sliding rivets, and hinges. Fifth was subservience of decoration to the preceding rules. This meant that the most

practical armour was left undecorated.

The early plate armour was very plain and smooth, so that tips of arrows and swords could not catch on the metal. The most susceptible areas were thicker for greater protection. By the middle of the 15th century, armour had reached its functional perfection. Armour had developed a style with a center ridge to deflect points of arrows and swords. It was impervious to most weapons, including early crossbows and swords, while weighing only approximately sixty pounds. Soon, two styles of armour appeared from two major centers of armour production. These were the Maximillian or Gothic style from Germany, and the Italian armour.

The German style emphasized a graceful line which was decorative in its simplicity, and took an angular appearance with fluting, except on greaves, which were always left plain. The fluting gave strength to the armour, and also helped to deflect blows. The Italian armour was rounder and fuller. It was left smooth and plain, and was beautiful in its simplicity.

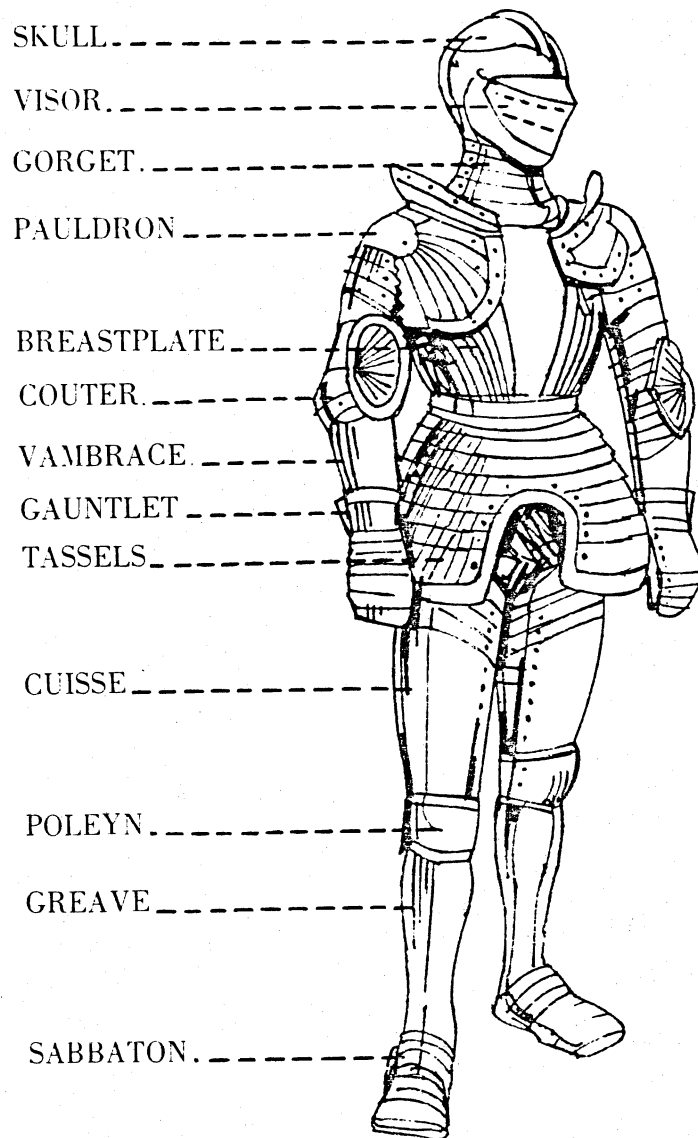
By the 16th century, armour was technically perfect. This perfection in protection, ironically, also started to lead towards non-function. There was a desire for the richness and the opulence of court life, that led to highly decorative armour. The armorer, being able to make functionally perfect armour, turned to decoration to show his skill. The first style to make its appearance was known as grotesque armour. This armour, especially the helmet, became exaggerated, often taking the shape of human or animal faces. The work was formed out of one sheet of steel, which was then embossed, chased,

etched, engraved or gilded.

During the 16th century, armour took on characteristics of the clothing of the period, with elaborate puffs and sashes. The custom of tournaments, designed to show a man's virility, began about this time, so there was a need for show or parade armour. Armour created for tournaments was different from that worn on the field. Additional pieces were added for greater protection during jousts. Armourers were also allowed to decorate fully on the armour without regard to cost. Most of the armour produced at this time was strictly for show, many times given away as elaborate gifts. Since parade armour was for the wealthy, the pieces could be executed in the finest materials, often gilded and inlaid with silver. The craftsman was given free rein over the pieces, choosing decorating techniques best suited to the desired form. In many respects, armour became a sort of fancy dress, so richly decorated with repoussé work, engraving, and etching, that it lost all of its original defensive quality. The fluctuations of surface served to catch and hold the point of a sword or lance rather than deflect it. It had become worthless as field armour, having lost all of its simple line qualities.

Requests for defense armour also died as arms improved from the middle of the 16th century to the 17th century. The perfection of crossbows and the introduction of firearms made penetration of armour possible. It was possible to create armour impenetrable to firearms, but it was so heavy, in excess of one hundred pounds, that parts of the armour had to be left off. Little by little, in order to reduce weight, knights dis-

carded pieces of armour, so that by the 17th century there was little defense armour in use.



Armour for Man

illustrating common names for
sections of armour.

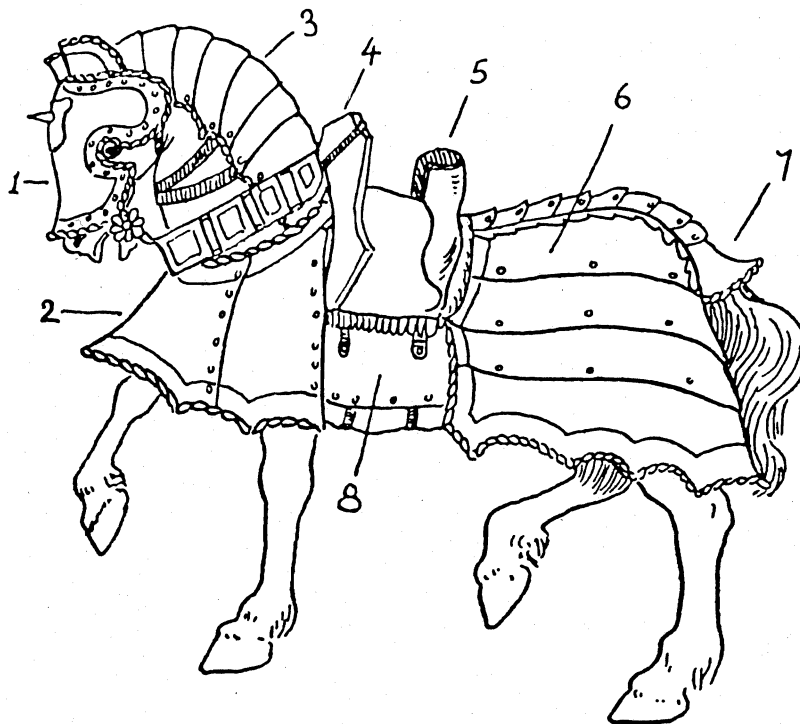


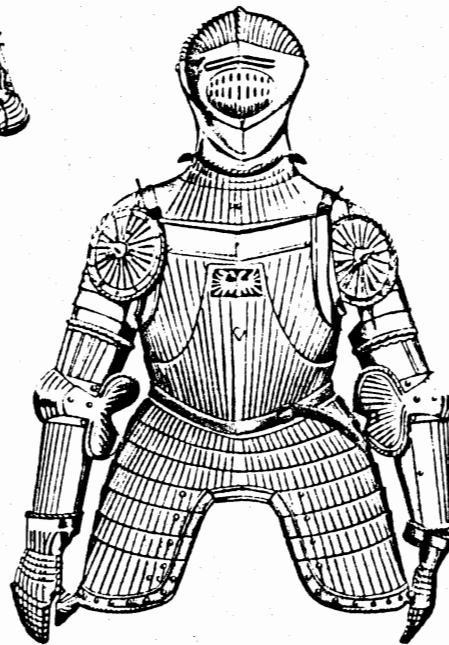
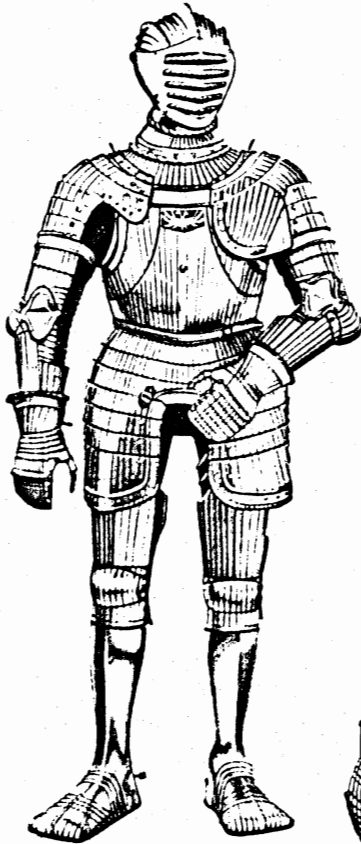
FIG. 5. Horse Armour, sixteenth century.

ENGLISH	FRENCH	GERMAN	ITALIAN	SPANISH
1. chanfron	chanfrein	ross-stirn	testiera	testera
2. peytral	poitrail	brust panzer	pettiera	pechera
3. crinet	crinière	{ mähnen panzer kanze	{ collo	cuello
4. pommel	{ pommeau arcade de devant	{ sattel-knopf	primo arcione	pomo del arzon
5. cantel	{ troussequin arcade de derrière	{ rückenstück pausch	{ secondo arcione	zaguero
6. crupper	croupière	{ krup panzer	{ groppa	grupera
7. tail-guard	garde-queue	{ lenden panzer	guardacorda	guardamalso
8. flanchard	{ flancois flanchière	{ schwanzriem panzer flanken panzer	fiancali	flanqueras

Armour for Horse

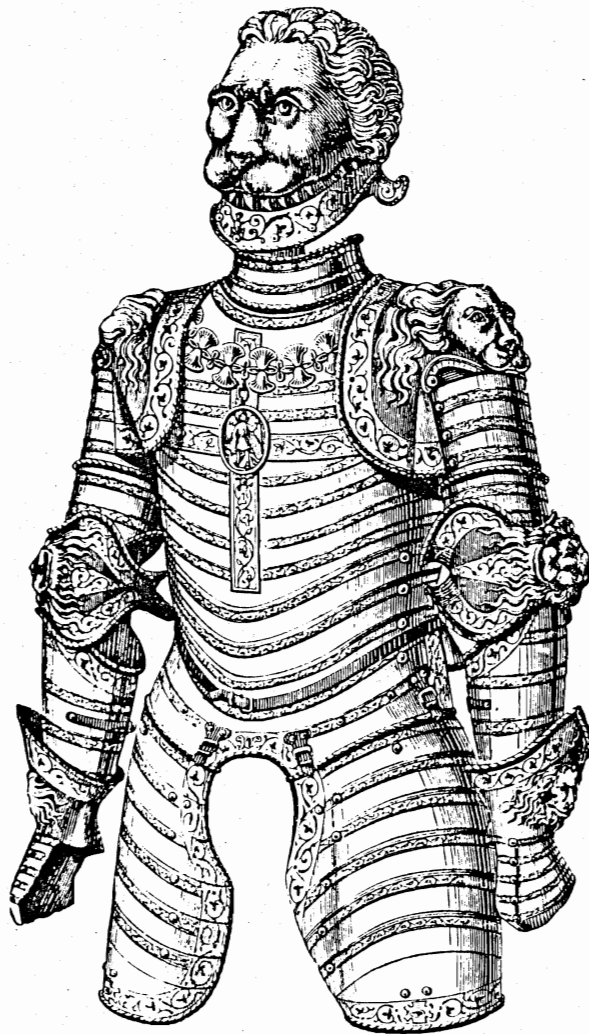
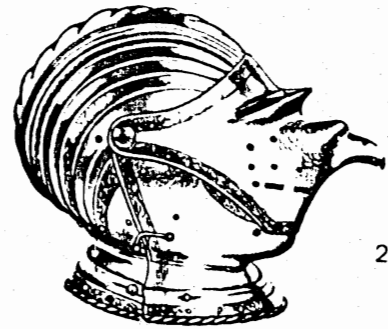
illustrating common name for
sections of armour.

Both armors exhibit the common features of the Maximilian style, with the lines of fluting covering the greater part of the surface. They date from about 1540 and were made in Nuremberg.



84

Examples of Maximillian Style Armour



Examples of the Grotesque Style Armour

Glossary of Engraving Terms

Burin - engravers tool, also known as graver or scorper.

Burnisher - a smooth steel tool used to smooth metal.

Chisels - metal tools with a cutting edge at one end, used to shape or work a solid material.

Gravers - tools with cutting edges; same as burin or scorper.

Niello - a decorative process in which a combination of sulphides of silver, copper, and lead are fused into depressions of a metal surface to produce areas of line.

Pitch - a black or dark viscous substance obtained as a residue in the distillation of organic materials especially tars.

Scorper - varishaped small chisels used for engraving metal.

Scriber - sharp pointed tool for making marks in metal to be worked.

Tang - end opposite cutting edge.

Engraving

The engraved line was one of the simplest and most universal techniques for goldsmiths and metal workers throughout antiquity. The actual origin of engraving is vague, but seems to have derived from wood engraving. The first actual recorded metal engraving seems to date from approximately 1450 A.D. It is one of the first techniques used in the decoration of armour.

There is a direct link between engraving, intaglio printing, etching and niello. In the niello process, the base metal was engraved, then the grooved lines were filled with a powdered sulphur mixture fused into the recessed lines to create black areas that would contrast with the base metal. It was the practice among armourers of that time occasionally to fill the lines with ink to get an idea of what the finished pieces of armour would look like. From these proofs, designs could be changed and altered. It also seems that the engraved line may have sometimes been left as a way of preserving the pattern for niello work.

By the 16th century, it became common to decorate armour with engraving and chiseling. The engraving did not detract from the original function of armour, that of protection, when it was used in limited areas and when it was not too deeply engraved. Nobles often had their armour trimmed with engraving, and edged in gold.

Direct metal chiseling and engraving were used on many objects other than armour. Iron chiseling was a popular

technique, especially for locks, keys, and clocks. Engraving and chiseling also appear on saddles, stirrups, and firearms, in patterns involving figures, animals, hunting scenes, floral patterns, and mythological and allegorical scenes.

Very important to the engraver and later to the etcher, were pattern books designed by leading artists of the time. Among these artists were Albrecht Dürer and Etienne Deluane. These pattern books were widely available to the armourer and metal engraver. They provided popular designs for the metal workers to use on their pieces.

In Italy, Milan was famous for their arms and armour manufacturing. Among the most widely known metal workers were the Negroli family. Highly skilled in many techniques, they were famous between 1530 and 1580 for their ceremonial armour that was intricately engraved and chiseled in relief and bas-relief.

The Germans were also fine engravers, although they were more successful in decorative line than in large mass. Their armour and other metal works were engraved with patterns of great richness, where motifs of the grotesque and floral forms were carefully combined to create a beautiful overall decorative effect.

In the process of engraving, the basic tool used is the graver. The graver, which is also known as a burin or scorper, is available in a variety of cross-sections or shapes, making many types of lines possible.

The shaft can be straight, angled, or curved. The graver should be held firmly during the engraving process,

and the cutting edge should not extend much more than one-half inch beyond the finger tips. The tang, fitted with a wooden handle, is placed snugly into the palm of the hand. To keep a piece in place during the engraving process, pitch and a pitch bowl, or an engravers block may be used. In the case of large pieces, a board covered with pitch or wax is used, and often clamped into a vise for stability during engraving. Large curved pieces can be braced against or between sand bags.

The pattern to be engraved can be drawn directly onto the metal, or the metal can be covered with a thin layer of gesso or thin white paint and the pattern scratched in lightly with a scribe.

The engraving is done by holding the graver firmly in one hand, while turning the piece with the other hand. A slip in engraving is very difficult to repair, as the metal is actually being removed by the graver. A burnisher can be used in the case of a mistake to smooth out the area, or in places where the metal is thick enough, the metal can be sanded or filed smooth and engraved again.

In the case of engraving on armour, or on other decorative ironwork, armourers found the engraving process slow and tedious. As the demand for decorated armour increased, etching was used along with engraving to increase the depth of the engraved line. Soon etching was used almost entirely due to the ease of execution.

Glossary of Etching Terms

Bas-relief - a mode of sculpture in which design is sunk
or in the negative.

Mordant - corroding substance used in etching.

Relief - a mode of sculpture in which forms are distinguished
from surrounding plane surfaces.

Resin - any natural organic substance formed especially in
plant secretions.

Scriber - sharp pointed tool used to inscribe lines on metal.

Etching

When man first noticed the action of acid on metal is unknown. However, it is known that Pre-Columbian Indians used oxalic acid obtained from plants to dissolve the copper in copper and gold alloy to obtain pure gold.

Etching does not appear as a decorative technique in Europe until the 15th century. Etching was used by goldsmiths, armourers, and gunmakers long before it was used for the production of prints. Etching appears on armour in the middle of the 16th century. Many times etching was used along with other techniques, especially engraving. It was not uncommon for armour to have bands of engraved and etched decoration. Much of the early etching appeared as bands of design trimming the armour, which looked impressive, but was of poor quality.

Etching, which involves the use of a tool called a scriber to draw out the design, allowed the armourer much freedom in this decorative work. Often designs could be drawn freehand as if they were drawn with a pencil.

Here again as with the engraver, design books were available to the etcher. Daniel Hopfer of Augsburg was one of the first German artists to use etching for armour. Many of his rough etchings were intended to be patterns for goldsmiths and other metal workers. Pattern books by Dürer and Deluane were also used as they were by engravers.

Basically, etching is simply a line obtained by corroding the metal plate with an acid. The plate to be etched is

cleaned, and then covered with a thin layer of etching ground. Grounds are mixtures of different waxes, gums, and resins. A traditional resist for etching is asphaltum. A harder ground used by most early etchers contained similar ingredients combined with nut oil. Resists can be brushed on, rolled out on flat metal with a brayer, or daubed on.

In the middle of the 16th century, two methods of etching were available to the artist. The first was to cover the entire surface with the resist, and then the design was scratched in with an etching needle. The acid would eat away the design, so that it was sunken or incised. The other technique was to paint on the resist in the desired design. This left the background to be eaten away, leaving the design in relief. The latter method was especially popular with the German etchers.

Once the design was drawn the acid had to be applied. The oldest method of applying the mordant was to build up a little wall of wax around the edge of the plate so that the acid could be poured in as a bath. The acid could also be poured over the plate, or placed in a dish with the plate and left to etch.

The three most common mordants in general use were dilute nitric acid, dilute hydrochloric acid mixed with chloride of potash, and a solution of perchloride of iron. The oldest of these was nitric acid which worked the quickest and was the strongest.

As with engraving and chiseling, etching was also used on other metal works.



DESIGNS FOR ARMOUR BY ALBERT DURER, 1517

Designs for Armour by Albert Dürer



Engraved design by
Etienne Delaune.

Glossary of Gilding Terms

Amalgam - an alloy of mercury with another metal; a mixture of different elements.

Goldbeaters Skin - special parchment made from internal membranes of animals; used by Goldbeaters in the making of Gold Leaf.

Gilding - covering a surface with gold.

Gold Leaf - a very fine tissue of gold.

Parchment - skin of a sheep or goat prepared for writing on.

Silvering - to cover with silver; to coat with a substance resembling silver.

Gilding

Gold leaf or silvering applied to armour added a glitter and richness that was popular in the 16th and 17th centuries, especially with nobles. Many suits of armour intended for show or gifts were intricately decorated, and then to add splendor and elegance were gilt.

As with the other techniques, gilding was used in other areas of art as well. Goldsmiths, sculptors, gunmakers, and painters all used gilt in their particular works. Painters often used gold leaf along with gold or silver that was powdered and then made into a paste to paint. Silver was often used to depict armour in painted battle scenes.

To gild a metal object, a workman would clean the surface of the base metal carefully, and then rub mercury on it. This would form a layer of amalgam on the surface of the metal to be gilded, making an alloy of the base metal with the mercury. Layers of gold leaf were then laid on to form a sort of triple alloy, consisting of gold, mercury, and the base metal, with the gold and mercury in greater excess. The object was then heated, which turned the mercury into a vapor, converting the original triple alloy into a double alloy of the base metal and gold. Additional gold could then be added and rubbed in until the desired thickness was obtained.

Gold leaf is very thin. When a metal in sheet form is fairly thick, it is called sheet metal. When it is thinner, about the thickness of paper, it is called metal foil. The thinnest metal, thinner than the most fragile of tissue paper,

almost like a cobweb, is called leaf.

Beating out gold into leaf must be done carefully and slowly. Goldbeaters place small squares of pure gold approximately one and one-half inches on a side in the middle of parchment. They then pile squares of parchment and gold alternately on top until they have a small stack. They very carefully hammer in circular motions on top of the pile, until the gold spreads out to the edges of the parchment. The metal, if not thin enough, is taken out and cut into squares with special shears, and the process is repeated. The special parchment used for this process is called Goldbeaters Skin. This technique for making gold leaf has changed little over the years, and still is used in parts of India, Japan, and other countries.

Gilding, when used with other decorative techniques, added glitter and highlights to a piece. This was especially true when used on embossing and repoussé work, which showed the full depth and dimension of the relief work when gilt.

Glossary of Repoussé Terms

Anneal - to heat metal to dull red color to make the metal more soft, less brittle.

Chasing - defining and detailing relief work or decorating metal by use of hammers and punches.

Dapping Punch - tool with rounded ball end used to sink areas of metal in repoussé work.

Embossing - to form metal in relief with the use of die forms and pre-cut shapes.

Pitch - organic substance from residue of distillation of organic compounds, especially tars.

Repoussé - technique for forming design in relief by working from the back of a sheet of metal with hammers and punches.

Work hardened - condition of metal when hammered or worked so that it becomes hard or brittle.

Repoussé and Embossing

In researching decorative techniques, it was found that the terms "embossing and "repoussé" were used interchangeably. After much reading, it seems that for the most part, the term "embossing" was used in the sense of the repoussé technique: that of beating out a flat sheet of metal into relief with hammers and punches. In this chapter, embossing and repoussé are used to describe the same process and decorative results.

Embossing was used for centuries by goldsmiths and metalsmiths to create fascinating surfaces in their works. Armourers used the technique to create intricate design, texture, and movement in the surface of armour. Embossed work was frequently gilded or blackened in areas to show the full depth of the relief.

As embossing became popular on armour, it completely destroyed the defensive quality of the armour. The undulating surface allowed arrows and spears to catch too easily on the armour. When the need for defensive armour subsided, the techniques of repoussé and chasing were used freely on parade or show armour, to create magnificent suits of armour that bordered on fantasy.

The Negroli family from Milan were not only known for their engraved designs, but also for their embossed armour. Their signatures appeared on the most elaborately decorated pieces of armour and shields.

The pieces were beaten out of single sheets of metal, and the details sculptured in cold steel. Their work is

recognizable by its bold design and skillful execution.

Repoussé work traditionally is working from the back of a piece of metal, and pushing the design out in relief. It is common in repoussé work to use chasing also. In chasing, the design is refined and detailed from the front. For chasing and repoussé, the piece needs to be held firmly. Pitch has been used for centuries for this purpose. A common pitch consists of burgundy pitch, tallow, plaster of paris and a little linseed oil. Usually, pitch is put into a pitchbowl, which is placed in a leather ring. This ring holds the bowl in place while working. For larger pieces, pitch can be used in a large tray or on a board, with the metal placed on top. The pitch must be warmed to a thick, sticky consistency, and then the metal is placed on it and pushed into it. Pitch can be pushed just slightly onto the edges of the metal to help hold it in place.

The punches are held in one hand between the thumb and first two fingers. The ring finger and little finger are left to rest on the metal and to guide the tool. A chasing hammer is used to hit the top of the tool, while the punch moves slightly in a forward progression with each blow of the hammer. When sinking an area, the tool should be constantly moved to avoid working one area too intensely, to avoid making the metal brittle and prone to tearing. Rips in metal can be repaired by soldering. One can then carefully work around the area.

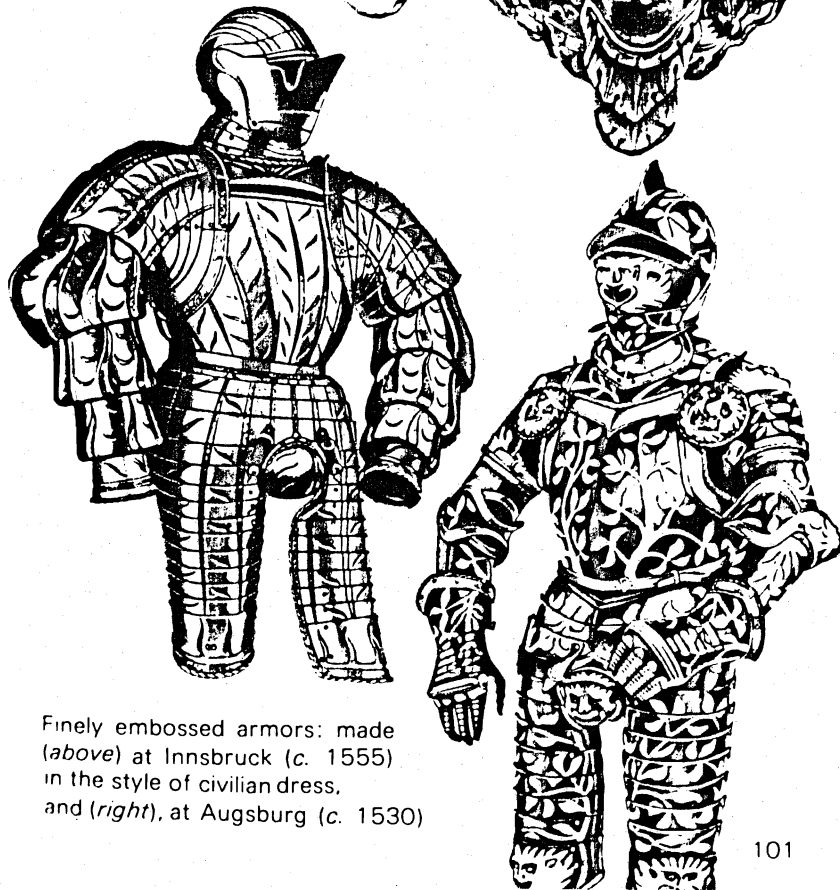
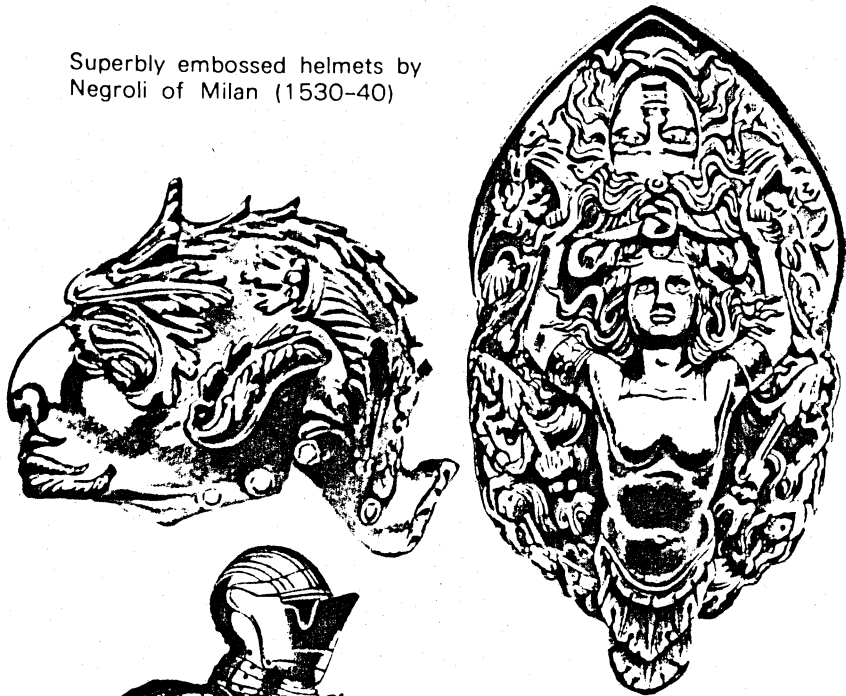
In chasing, some of the same tools and techniques are used. However, chasing can be used to create pure surface

textural design. Chasing tools may have a particular shape or design, and then the texture desired can be created by a single hammer blow. Chasing can be done on flat metal also, in which case the piece can be held in place on an anvil.

Repoussé and chasing will cause the metal to become work hardened. When the metal becomes hard, and the chance of breaking through the piece increases, the work must be removed carefully from the pitch, and annealed before work can be continued.

Repoussé work can be done in any metal. In armour, the suits were worked out of sheets of iron and steel. Designs were transferred from pattern books available to the armourers, etchers, and engravers as previously stated. Repoussé has been used for centuries, and has changed little from antiquity in technique or tools.

Superbly embossed helmets by
Negroli of Milan (1530-40)



Finely embossed armors: made
(above) at Innsbruck (c. 1555)
in the style of civilian dress,
and (right), at Augsburg (c. 1530)

101

Example of Embossed Armour

Glossary of Iron and Steel Terms

Iron - malleable, magnetic, metallic element found in igneous rocks.

Steel - commercial iron containing carbon. It is malleable and has a lower carbon content than casting iron.

Smelting - to melt or fuse with an accompanying chemical change, usually to separate metals.

Sow - a mass of metal solidified in a mold.

Temper - to harden steel by reheating and cooling in oil.

Work harden - condition of metal when hammered or worked so that it becomes hard or brittle due to the compression of the molecules.

Iron and Steel

The motivating force behind the growth of the iron trade was the basic struggle for existence on the battlefield, rather than inspiration of artists or craftsmen.

There is evidence of iron tools in use through past civilizations as Early as the Egyptians. However, the history of the development and consequent use of iron is vague and obscure. In the middle ages, iron appeared in many facets of life, such as household objects and armour, and its use grew rapidly during this period.

Iron is obtained from iron ores, oxides, and carbonates. Carbon and carbon monoxide were used to extract the metal. Iron was used for defensive armour in the early suits of armour. Chain mail was originally made of iron links, but it tended to be heavy and clumsy. The introduction of steel was very important to the armourer. It allowed armour to be made stronger and lighter.

The discovery of steel was probably an accident, and it is uncertain how or when steel first occurred and how it developed. It is known that the first smelters were fueled with charcoal, which will de-oxidize iron and turn a portion of the metal into a natural steel. German steel was superior to other steel, and it was in high demand for armour. This steel tended to be harder and better tempered. It is possible that the Germans may have discovered the properties of magnesium, which hardens steel, thus producing a superior metal.

As the elegance of armour decoration showed rank and

superiority, so did the use of the material. For common foot soldiers, armour was made of iron. Steel was used more for knights, and combinations of materials, such as steel with silver and gold, were in use for kings and the nobility.

The tools and the work of the armourer varied little from the work of the blacksmith. There were the hammers, chisels, vise, pincers, and anvil of the common village blacksmith. However, there were also stakes made for use in armour manufacturing, and problems special to the armourer. For example, helmets were beaten out over a rounded stake that was roughly the shape of the helmet. Another problem they faced was the necessary thickness of the armour corresponding to the body area it was made for. For example, breastplates needed to be thicker in the center than at the edges. In helmets, the technique was basically a raising technique such as one would use for a bowl. However, in raising a bowl, the edges are thinner than the middle, and in helmets the armourer had to keep the metal an equal thickness throughout.

The main task of the armourer was to beat out the rough shapes and plates from a solid ingot of metal. The designing and decorating were often done by individuals employed in the guild, such as the engravers, etchers, goldsmiths, or locksmiths. They all played vital roles in the production of armour.

In making plates to be made into armour, the metal was first cast into "sows" of six hundred to two thousand pounds. A piece of the sow would then be melted off, and beaten with sledges to about a size of two square feet by approximately

three and one-half inches. This could be made into a plate sized approximately thirty-three square feet by one-sixteenth inch thick. A thickness of one-sixteenth inch was common, but it was especially in use for horse armour. These sizes were approximate, and they were not standardized. It seems that the ingots were beaten out into whatever size the ingot would give. It is fairly impossible to tell what size sheets were delivered to the armourer.

Rolling mills and trip hammers were in use to help form the sheet metal. These tools were commonly run by water power. For example, the trip hammer consisted of a water wheel with a long pole weighted at one end, that would drop onto an anvil. This was originally called a drop hammer. The rolling mill was of similar construction, and also run by a water wheel.

Iron and steel works were also important in other aspects of daily life. Iron was the first metal to be used for tableware, and until the 17th century was used mostly for domestic purposes. Iron work could be found in the form of locks, keys, screens, and hooks for holding pots, lanterns and torches. Iron hooks or rings used to tie up horses could be found on the outside walls of houses.

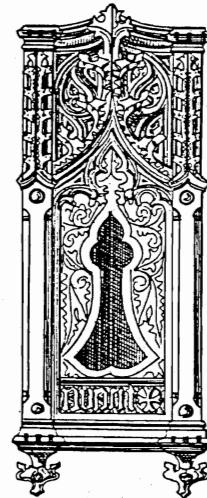
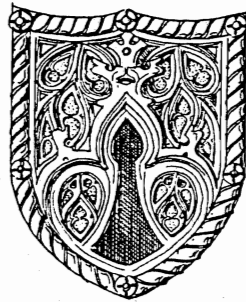
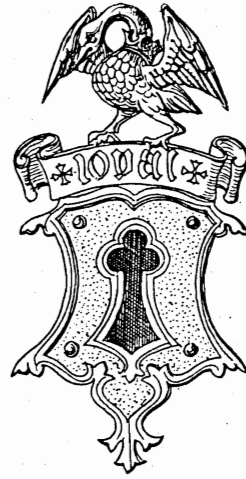
Designs and decoration on iron have a direct relationship to other fields of art. Engraving and chiseling on iron have a direct relationship in design to prints and manuscript illustrations. Patterns were taken from the pattern books mentioned previously. Iron chisellers and carvers were held in high esteem, and they created magnificent shapes in locks and keys. They

were frequently employed by the armourer as a vital member of the guild.

In the 15th century, there was the discovery of pig iron. A strong bellows draft caused the iron to flow out of the furnace in a liquid form which hardened quickly. When this iron was smelted again, it was very malleable throughout, and free of impurities. This was known as wrought iron, and it was used for most of the decorative iron work.

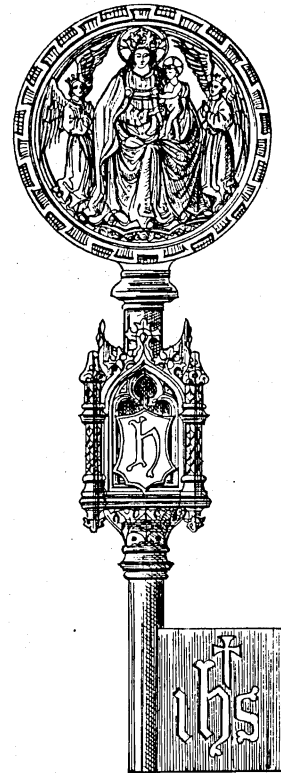
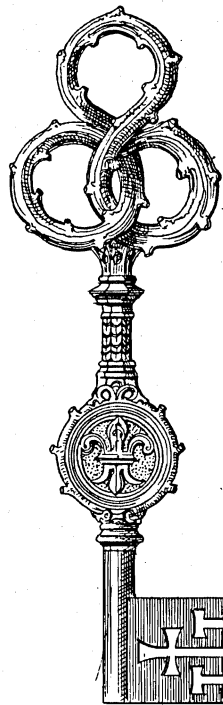
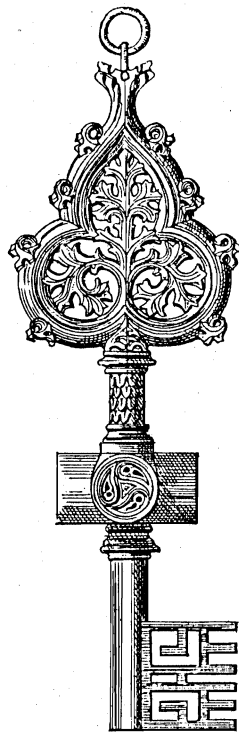
The first decorative iron work developed from functional fittings. Iron bars were used to reinforce and strengthen doors. This reinforcement became decorative by making use of the space to create interesting patterns of ribbon scrolls and floral motifs. Lanterns, torch holders and window trimmings were designed and executed with great care, and reveal the great originality of the artist-craftsman. During the early Renaissance, all houses had ornamental door handles, hinges, and door knockers. Iron work designers used decorative motifs in the form of flowers, leaves, scrolls, knots, interlaced grotesque patterns, sprays, and interlaced networks of line. Buildings, gardens, and trimmings all show the desire for luxury and indulgence in elegance.

The iron worker never achieved the status of a true artist; his work was considered a functional trade and not an art. However, the iron worker was an integral part of society. He was capable of creating functional objects beautifully designed, and so complex and skillfully created that they amazed the viewer and added elegance to everyday objects.



for
keyholes

Ironwork for Keyholes



Here in

40

Ironwork Keys

Conclusion

To us in this modern world, the periods of the 15th to 16th centuries could seem a rather romantic time. There were kings and queens, ladies-in-waiting, elegant court proceedings, and of course, the Knights in shining armour. This was, however, a time of much social and political upheaval and there was much warfare. No matter how gallant the armoured Knights may seem now, they were in fact dressed for war. The armour had, as its first and foremost purpose, that of keeping the wearer alive. Armour had become a necessity and the armourer a necessary part of society.

The armourer played a vital role in the decorative arts and in the development of metal techniques during the 15th to 16th centuries. He is linked to the artists although his work was never awarded the status of a true art form. Rather, his work was accepted as an important craft in society.

All of the artists and craftsmen had influence on each other and all were involved with the development of armour and decorative techniques. Without the pattern books of Dürer, Deluane and others, and without the influence of goldsmiths, locksmiths, and iron workers, armour could not have become as functionally perfect as it did, nor as skillfully decorated as it developed in later showpieces.

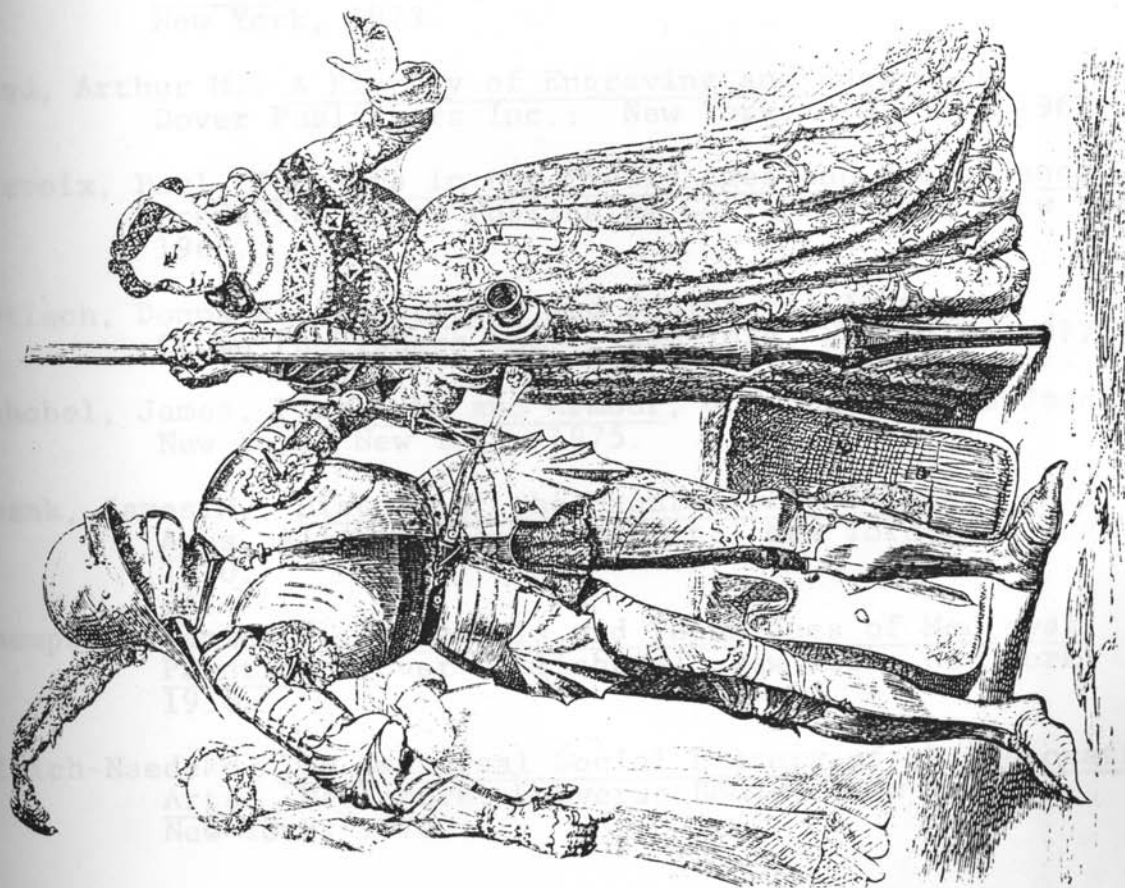
Many fine examples of armour exist today that show the full extent of the armourers craft. The metalsmithing techniques are much the same as used by today's metalsmiths. However, one can only stand in awe of the fine etchings, engravings,

and the detailed embossing that were executed on such large scale works as armour. Many of the favorite designs involved mythological battles, heroic deeds, animals and floral patterns. No matter what subject was depicted, one thing remained consistent; the elegance and beauty the armourers had attained in their work.

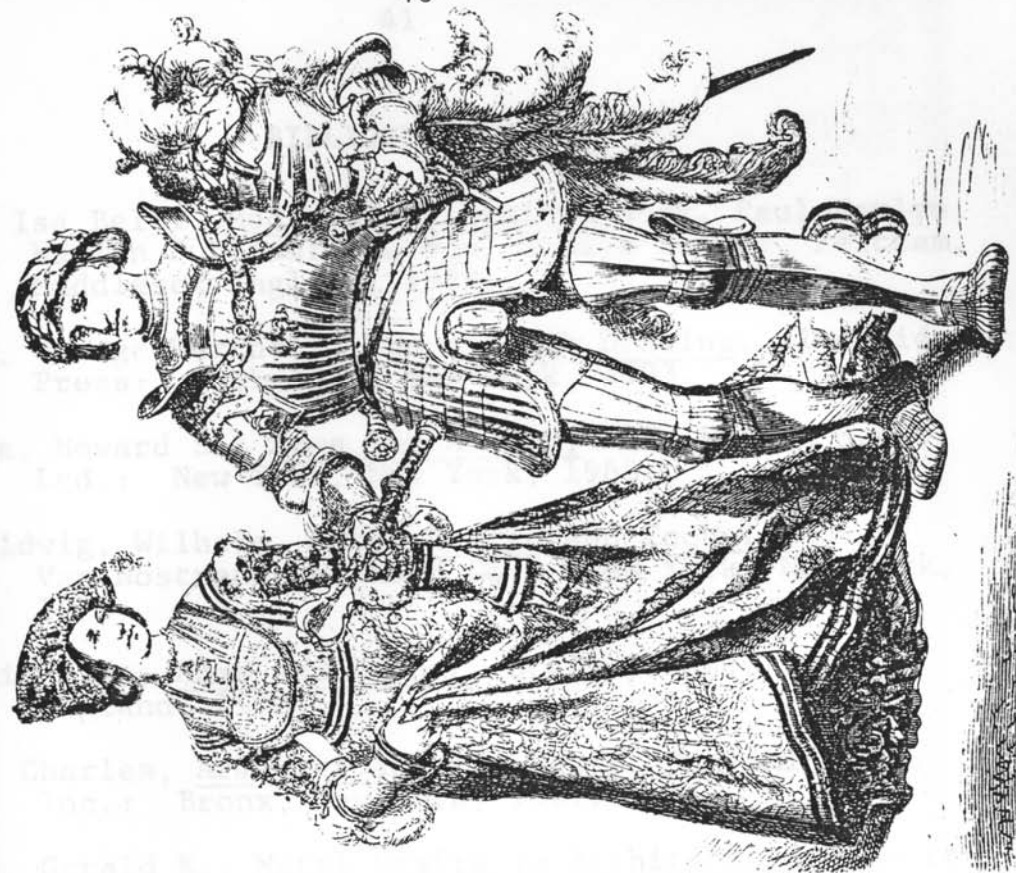
The metalsmiths of today use many of the same techniques as the armourer did. Major changes are improved tools due to modern technology, and the purpose for which pieces are created. From my research, I can conclude that metalsmithing techniques have virtually remained the same throughout the centuries.

15TH AND 16TH CENTURIES

40



German knight and noblewoman (mid-15th century)



Prince and princess (1st third of 16th century)

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