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The Classic Suit of Armor

An Interactive Qualifying Project Report

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Abstract

This project studied the evolution of plate armor from the 1350s to the 1700s and used that knowledge to analyze a composite suit of the mid-1500s in the collection of the Higgins Armory Museum. We also created a video documentary of our suit analysis that describes the main features of the suit, and a database of armor artifacts that were compiled during our research. In addition, we created a website to house all of the information for the public.

Introduction

Body armor has been around since the ancient period. During most of the Middle Ages, the characteristic type of body armor was essentially a robe made up of small interlocking iron links known as mail armor. During the 1200s, armor started its evolution into full suits of articulated plate steel that provided the wearer with impressive protection from the 1400s through the early 1600s. However, with more efficient training of infantry, combined with the increasing importance of firearms and necessity for added mobility, the bulky, restrictive suits were left behind by 1700. Over this period the value of armor began to change from a practical tool to an outdated relic and eventually to a collectible artifact, and by the 1800s dealers, collectors, and museums were assembling scattered old elements of armor as "composite" suits, creating modern components to fill in the gaps as needed. This project studied the history of armor and used that knowledge to analyze a composite suit of the mid-1500s in the collection of the Higgins Armory Museum.

A typical full suit of plate armor might weigh about 45-60 pounds. On average, a full suit would be made up of about 12 pieces; however, some suits consisted of upwards of 20 separate pieces. Since mobility was one of the most important characteristics of a suit, the joints were usually made of articulated lames to increase flexibility. Craftsmen spent endless hours heating and hammering pieces of metal in order to create the perfect plate armor. Because of the great skill required to produce perfect plate armor, young men who wished to become a skilled artisan had to go through an apprenticeship program where they learned the skills of the trade.

A wide variety of people in Europe needed armor for one reason or another and the composition and style of armor varied accordingly. Armor can be categorized into three types based on its purpose. The first type consists of armor forged for use in battle. The heavy cavalry at first wore full suits of armor but eventually downgraded to a three-quarter and then to a half suit as the weight of armor increased with the emergence of guns. Wearing less armor than the heavy cavalry, the light cavalry used suits that did not protect as much of the body. Lastly, the infantry required armor that not only protected the vital parts of the body but also allowed for increased mobility. By the late 1500s, soldiers of all three varieties would leave pieces of armor behind as they became cumbersome or too heavy.

In addition to its use in warfare, armor was also used in tournaments. Here, the armor emphasized protection over mobility and vision. The last category of armor was created for ceremonial purposes. This armor was elegantly decorated and embossed to display the wealth or power of its wearer. The distinct differences amongst the types of armor are discussed in the body of the document.

As powerful firearms came into play in the 1500s, the popularity and appeal of wearing armor dropped significantly and by 1700 it had largely become obsolete. By 1800, it had acquired a new importance as a collectible artifact. Some people collected armor for show, some to display their political power, some as a relic of the past, and others to advance scholarly knowledge. Collectors and dealers also refurbished and repaired their suits of armor to increase their visual appeal. Most surviving suits of armor

are actually "composite" suits, which consist of pieces of armor from multiple sources that were assembled together as a full suit. Therefore, a large part of an armor scholar's job is to figure out where the various parts of a suit came from as well what refurbishments to the pieces were done over time.

The suit of armor we choose to study was a composite suit of the mid-1500s that had many repairs. Previous knowledge of the suit was minimal and consisted mostly of where the suit was displayed over time. Our research involved weeks poring over books in the Higgins Armory library, as well as studying the plethora of suits displayed in the Higgins collection. Since a composite suit is made up of pieces of armor from multiple sources that were assembled together as a full suit, we researched the evolution of plate armor in its heyday from the fourteenth to the seventeenth century in order to be able to identify the parts of the full harness. Based on this knowledge, we examined the parts of the suit for evidence of when and where each piece was made and how it had been modified since its time of manufacture. The team made numerous important discoveries: not only were there multiple series of assembly marks that offered clues to the armor's history, but there were three armorer's marks, as well as an inscription—never before documented—that describes the final stage of compositing in 1916 by Raymond Bartel, armorer at the Metropolitan Museum of Art.

We also made an in-depth template of what to look for when analyzing a suit of armor for people in the future. In addition, we created a video documentary of our suit analysis that describes the main features of the suit. Lastly, we pieced together all of our research into a final document and created a website to house all of the information. The

website also contains a database of armor artifacts that were compiled together during the course of our research. The database contains a brief description of each artifact including its place and time of origin, creator, current location and any noteworthy characteristics.

This project was an amazing opportunity for us to develop researching abilities as well as to see what a group of people can accomplish when they work together. We are very proud of our achievements and hope that our project helps you in your own work with the history and structure of armor.

Research on Armor Manufacturing:

By Keith Coleman

Context of Production

Between the 12th and 16th centuries armor was the popular form of defense in combat and there existed many centers of trade. Many families became famous for their skills in armor making throughout Europe. In many parts of Europe craftsmen congregated within these communities to form organizations called guilds in an effort to protect and insure the craftsmen and their work.

Armor Production Communities

Many of the great communities were located in Germany or Italy and most of the great families emerged from the centers within these countries.

> Some of the great family names were from Milan the Missaglias (real surname Negroni);
> the Negrolis (really Barini); from Augsburg the Helmschmids and Seusenhofers; from
> Landshut the Grossschedels; from Innsbruck the Treytz-Seusenhofer.
> (p.12 Pfaffenbichler)

The "great schools in either country like those of Milan, Brescia, Nuremberg, Augsburg, and Innsbruck" (p.13 Ffoulkes) were the foundation for the birth of great armor. The transformation from Italian to German armor came in the 16th century when Germany reached its peak in armor production.

Italian Communities

Brescia and Milan were the most well known centers in Italy. Both centers contributed to evolution of armor but the smiths in Milan were thought to be the best. Many of the craftsmen from Milan were so sought after that they were exported to set up shops in other centers by the request of lords, nobility, or royalty. Milan remained by far the greatest centre in Italy despite this constant export of craftsmen (Pfaffenbichler p.13). Milan was the number-one center for armor production in Europe during 14th century. Milan remained the main armor production center in Italy even after Germany became the armor production power in Europe. Centers such as the one in Milan could produce massive amounts of armor in a short period of time. Milan once supplied four thousand cavalry armors and two thousand infantry armors for the 15th-century battle of Maclodio in just a couple of days (Pfaffenbichler p.13). The centers became popular and had certain clientele that would pay for the quality and punctuality of the armor being produced. Milan reached its height of production at about 1450 and was the greatest center of production in Italy. The biggest rival to the Milan reign in armor production came from the community in Brescia.

Figure 1: Helm by Liccio Piccinino of Milan in 1578 for Alessandro Farnese,, the Duke of Parma

German Communities

Five of the great production centers in Germany were Cologne, Augsburg, Nuremberg, Landshut, and Innsbruck. Cologne, in the Rhine-Westphalian area, was the center for low- to medium-quality armor. Augsburg and Nuremberg, the imperial cities, were in the south along with Landshut and Innsbruck, the princely areas of Germany.

Nuremberg

Nuremberg was famous for its medium quality armor production. Nuremberg was very fortunate to have Amberg-Sulzbach, a district that produced iron. In 1362-1363 the community produced one 1816 sets of armor with the collaboration of the iron producing haven of Sulzbach for Emperor Charles IV. Without the iron producing district providing iron, Nuremberg may not have been able to craft such large amounts of armor. Two of the leading armorers during the mid 16th century were Valentin Siebenburger and Kunz Lochner the Younger (1510-1567). Some of their clients consisted of Emperor Ferdinand I (reigned 1556-1567), Maximilian II (reigned 1564-1576), and members of the Habsburg family.

Augsburg

Augsburg, another German production center, is known for its high quality armor and its rise is connected directly with the Helmschmid family ('helmschmid' means 'helm-smith). The first of the Helmschmids on record was Jörg Helmschmid and he first paid taxes in the year 1439. The first major point in history for Augsburg armor came in the late

Figure 2: Armour garniture made for Henry the VIII in 1540

1400's. Lorenz Helmschmid (active 1467-151) made armor Emperor Frederick III and

his son Maximilian between 1470 and 1480 (Pfaffenbichler p.15). In 1480 Lorenz

Helmschmid also made a set of armor made to fit a horse for Maximilian I, and the

"armour garniture," as shown in Figure 2, under the patronage of the Habsburg family.

The horse armor has not been preserved but a picture of the armor resides in Vienna. The

"armour garniture" was a set of armor that had interchangeable parts for multiple

purposes such as field or tournament use. Lorenz Helmschmid died in 1516 before the

peak in German armor but his son Colman

Helmschmid (1471-1532) and grandson Desiderius

Helmschmid (1513-1579) continued the family

name. While active they both worked for the

imperial family and were the favorite armorers of

Charles V of Spain. In 1560 Augsburg reached its

peak fame. A sketchbook by Jörg Sorg shows forty

five armors by Desiderius Helmschmid, Matthaus

Frauenpreiss, Hans Lutzenberger, Anton

Peffenhauser, Wolf Neumaier, Wilhelm

Figure 3: Armor for a man and horse by Colman Helmschmid for Emperor Ferdinand I in 1526

Seusenhofer, Konrad Richter, and Pankraz Weiss between the years of 1548 and 1563.

These eight armorers are considered the best masters of their time in Augsburg. Augsburg

was an armor producing powerhouse but by the year 1624 there were only four armorers

left because of the poor market.

Innsbruck

Innsbruck and Landshut were the two centers of high quality armor and were influenced by the courts in the cities more than the other armor producing communities. Ulrich was the first Tyrolese armorer. He was a master and opened a shop in Hall, a small town outside of Innsbruck, and worked for Frederick IV. Many of the craftsmen found Hall to be an inconvenient place to have a shop and transferred to Muhlau, a town on the outskirts of Innsbruck, where fast running water was used to generate power. Erzberg supplied "Styrian iron" for the smiths and the ruler of Tyrol offered patronage which made Innsbruck a popular place for armor manufacturing.

Figure 4: Armor of Sigismond of Tirol

Archduke Siegmund (1427-1496) patronized the armorers of Muhlau but did not establish a ducal workshop like his nephew Maximilian I. The first generation of smiths consisted of Konrad Treytz (active 1452-1469) and Konrad Vetter (active 1452-1467). Both of these men set up private shops with private workers and competed with each other for the orders of Archduke Siegmund of Tyrol. The second generation of great armorers from Muhlau were Hans Vetterlein (active 1452-1483), Hans Vetter (active 1452-1478), Christian Schreiner (active 1452-1499), Jorg Treytz (active 1466-1499), and Kasper Rieder (active 1455-1499). The shops were privately owned and operated until Maximilian founded a center in Innsbruck in 1504 headed by Konrad Seusenhofer to fill the Imperial orders. This center caused tension with shops in Muhlau.

Landshut

Landshut, another center for high quality armor in Germany, was the residence of the ducal family of Bavaria. The court in Landshut created the demand for armor but the

Figure 5: 'Burgundy Cross' garniture by Wolfgang Grosschedel for Philip II of Spain in 1551

dukes did not establish their own shops. Konrad Weiss (active 1459-1485), Sigmund Paumgartner (active 1474-1485), and Casper Satzenberger (active 1471-1495) were the first generation of great armorers. Even though no armors have been preserved from these men we do know some of their clients. The importance of their clients has led historians to believe they were of great talent. Records have been found of Konrad Weiss working for the King of Bohemia and Hungary, Duke George of Landshut and Duke Otto von Bayern-Mosbach in 1476.

The only armor that survived from Landshut was made by Matthes Deutsh (active 1485-1495) who produced several armors for the court of Duke Frederick of Saxony. It was not until the Grosschedel family started a workshop that Landshut reached its peak. In 1521 Wolf Grosschedel became a citizen and with his son Franz Grosschedel created a workshop. Phillip II of Spain and his son Don Carlos were two of the Grosschedel's biggest customers.

Other Centers

There were many other communities in Europe such as Bruges in the Netherlands and Tournai in Flanders, but the vast majority of workshops were in Germany or Italy. Spain, France and Poland all show signs of some kind of armor trade but very little is known about their contribution due to the lack of documentation. Like many modern items, when armor became

Figure 6: Breastplate by 'Master H' of the Netherlands for Philip the Handsome in 1490

outdated and before they became antiques, people discarded or recycled the armor because it was of little or no use.

Guilds

Concurrently with the rise of these communities came the craft-guilds. These guilds were put in place to regulate the work conditions and the conditions of the craftsmen's mental, physical, and spiritual health.

> Members were protected from outside piracy of methods and trade-marks, they were
> cared for in body when ill or incapable of working, and in soul by masses and religious
> exercises. (p.120, Ffoulkes)

Guilds protected their members from competition and gave the workers job security but at the cost of social freedom. The quality was also regulated by enforcing approval of armor by guild masters.

Masters

The masters were smiths that had proven themselves to be worthy of making armor and regulating the quality of the armor being produced in their shops. The masters were allowed to have other smiths work under them and the masters would train them to become better smiths. In many cases the master was only allowed two or three journeymen to work under him but occasionally an exception was made for the size of his workforce. In 1543 and 1551 Valentin Siebenburger was given permission to employ more men to finish armors that were wanted urgently by their clients. In Nuremberg the guild subcontracted to privet workshops as long as the armorers were masters and citizens. In 1507 masters were allowed four journeymen because of demand but by 1574 it was pushed back to three because of the crises in the armor trade. Between 1430 and 1469 Vienna set up a strict guild charter that restricted the purchasing of materials and

tools. A master was required to announce to the entire guild when he was purchasing materials or tools to ensure that all the masters could take part in the same deals. A master was also restricted to one shop and one forge to work with.

Apprentice

The charter for the mail-makers guild in Cologne (1293-1391) stated that an apprentice served under a master for six years and each master could have an additional three journeymen working under him. Before 1397 only one official guild member could sell armor but this was changed so any guild master could sell his armor as long as he had the approval of three masters and the guild stamp upon the armor. In a charter from Nuremberg in 1385 states that every apprentice had to be the son of a citizen, an apprentice must serve four years under a master, and each master received one apprentice and two journeymen. Because of the limited market only two journeymen could work under a master at a time. To become a master a journeyman needed to present a trial piece of armor and have it approved by five masters. Pieces for trial could be a helmet, breastplate, arm defenses, leg harnesses, or gauntlets. A master could later do another trial for another piece of armor but no earlier then a year after his first approved piece. Many armorers could make more than one piece of armor but very few could make full sets or armor or "made-to-measure armor."

Quality Control

Regulations were put in to control the industry from itself and to ensure that the product was of the best quality. Augsburg had less specific guild regulations due to impatient customers. It was not until the demand for armor fell around 1562 that regulations were put in place. Unlike Nuremberg the trial piece had to be a full set of

armor and for a master to sell a piece of armor it needed to be approved and stamped for the price of one pfennig and if it was not approved and was indeed sold a fine of two florins was put on the master. In 1587 the workers of Milan were required to work eight years without intermission to open a shop and needed a punch mark registered with the city. In 1347 there are records of guild masters from the Heaumers' guild in England approving the sale of helms by their guild wardens. Records of the Armourers' Company in London begin in 1453 after being established by Henry VI. The guild required the most time to become a master, seven years. In some cases an apprentice had to serve for nine, ten, or even fourteen years in single cases to finish his apprenticeship. Not only did apprentices have to go through such long terms they were given strict rules and regulations to follow.

> …swearing and blaspheming, haunting evil women or schools of Fence, Dancing,
>
> Carding, Dicing, Bowling, Tennis play, using of Ruffs in their shirts, Tavern haunting or
>
> Banqueting, and if any shall be found faulty the same be for with punished by whipping
>
> openly in your hall in sight of other apprentices. (p.124 Ffoulkes)

Apprentices were not even allowed to carry swords without the risk of punishment. Guilds enforced strict and in some cases harsh punishments for rule breaking but protected the workers from outside threats. Even with the guilds harsh rules it is one of the longest lasting guilds, almost outlasting the armor trade. In 1877 the guild made twenty six armors for the lord mayor for the annual Lord Mayor's Show before the guild discontinued. Many of the rules seem harsh and unruly but they were put in place in order to produce the best possible armor possible and to weed out the less qualified and less dedicated armorers since royalty and nobility only wanted the best.

Punch Marks or Stamps

Stamps and punch marks were a popular way to identify the maker(s) of a piece of armor. Many guilds required a guild stamp or a master's stamp on a piece of armor either for identification or quality insurance. Nuremberg required stamps on steel armor and armor that was fifty percent steel but iron armor did not require a stamp at all. The stamp is shown in Figure 7 on the next page. In 1479 Landshut's charter required a stamp on armor. Augsburg and Nuremberg had common stamps of the people for the armor produced such as the Cross stamp for the Helmschmid family, Figure 11.This was different then the Armourers' Company that had a guild stamp of a 'Crowned A', shown in Figure 10. The Missaglia family had a stamp in the shape of 'MY', Figure 9, the Treytz family 'trefoil', Figure 8, and the 'crossed keys' of the Negroli family are all examples of stamps and punch marks used for identification and quality control.

Figure 7: Town mark of Nuremberg
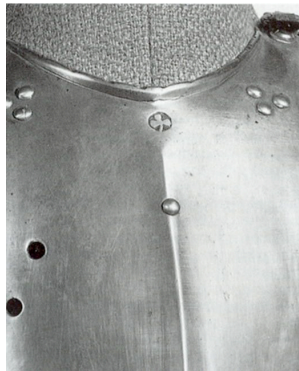
Figure 8: Armorer's mark of Jorg Treytz

Figure 9: Armorer's mark of Tommosa Missaglia
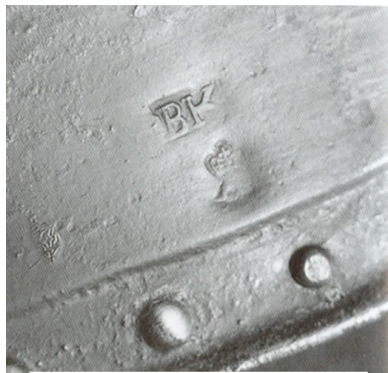
Figure 10: The mark of the Armourer's Company of London
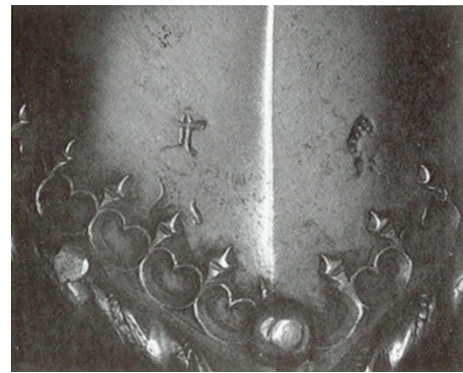
Figure 11: The armorer's mark of Lorenz Helmschmid

Metallurgy

Iron Ore

Metallurgy is the science to do with extracting, purifying, and alloying metals. The primary ore armorers were interested in was iron ore. Iron was used because it was malleable, strong, hard, and abundant. Pure iron is rarely found naturally on earth. In most cases it is found chemically combined with other element in the form of oxides. In addition, it is mixed with other materials, the most common of which is silica. This combination is found all over the earth as rocks, which are known as iron ores. Iron is not useful in the form of ore; it must be stripped of its chemical bonds and rid of most of its containments. The initial steps of purification before smelting were breaking and sorting, washing, and roasting. Breaking and sorting was done throughout the iron purification process. It is simply breaking up the iron and sorting out the pieces that clearly don't contain and iron. The iron could be identified because it would rust to a reddish orange color. Washing is exactly what it sounds like; water was run over the broken pieces of iron ore to wash away other impurities. The reason it worked is because iron was heavier than all the other elements found in the ore so when water was run over them the iron stayed put while some impurities washed away. Roasting was done just prior to smelting to remove and sulfur from the ore. Breaking and sorting was done throughout this entire process. The final step of smelting was a chemical process to remove the oxygen from the ore. The first step was to pile charcoal, flux and the iron ore and cover with a clay hood. The combination was ignited and brought to a very high temperature using bellow to intensify the fire. This would cause the oxygen in the iron

ore and carbon in the charcoal to combine and removed in the form of carbon dioxide. The flux would act as a catalyst and would also help further separate the iron from any silica that was left. This would flow away from the iron in the form of slag. This technique was called blooming because of the blooms of iron left at the conclusion of the smelting. The blooms of iron were then beaten and the smelting process was repeated again. This was done multiple times until the iron was sufficiently pure. It was now considered wrought iron.

There were many mines for iron and one area that was famous for its outstanding ore was located in the island of Elba.

> …the island of Elba which is so overflowing and rich in this ore that it surpasses every
> other place where it is found. Thus not only do the regions of Tuscany share its great
> quantity because their proximity, but more than two-thirds of Italy as well as Sicily and
> Corsica are supplied. (p.61 Biringuccio)

This ore was of such quality it required very little effort to purify it. By placing the ore on the forge in front of the 'tuyere' the very soft, malleable iron can be extracted. Some of the physical characteristics that identify the qualities of iron ore are 1) clear and heavy in weight indicate a very pure and perfect iron that is desirable to work with, 2) shining with a fine grain that crumbles is not sought after, 3) black and coarse grained ore usually means it has copper and is of little use, and 4) black ore with fine graining is usually good depending on the stone in which it is found. In the last case of iron ore (4) the impurities can be removed given the trace is small within the metal through heat treatment.

Charcoal

With such a high demand for forges came the demand for fuel. Charcoal was used for most fires. Some mines are located in Germany, Lombardy, Spain, England, and many other locations.

> Although most of the great centres of armour manufacture were situated in iron-bearing
>
> districts, a brisk export trade existed from Germany, Lombardy and Spain, to less
>
> fortunate areas.
>
> (p.62 Pfaffenbichler)

Knowing this is a possibly reason why Germany was a major iron ore producing country and they were also the leading armor producing country in the 16th century. A factor in the quality of iron was the quality and characteristics of the charcoal used. Soft wood charcoal produced and softer and tougher iron while more coarse wood charcoal produced a very hard, strong but less tough iron. The extra hardness from the coarse charcoal caused the iron to become brittle and was less desirable to use for armor.

Steel

Steel, a superior metal to iron, became a broadly used metal because of its superior characteristics. Steel is created when iron absorbs carbon. This is called carburization. Carburization is evident when the iron turns a whiter and/or lighter color then before. The ideal temperature for carburization is around 1650 degrees Fahrenheit. The best iron for this transformation is iron that melts easily and is very hard when cooled. In one example the iron is treated with crushed marble to purify the iron before it is transformed into steel. A popular method for transforming iron to steel was to add charcoal dust to the iron so it could absorb large amounts of carbon from the charcoal dust. Another way to make steel was documented by Theophilus the Monk. He took the

iron that he wanted to be treated and smeared it with 'old hog's lard'; he then wrapped the item in goatskin followed by a layer of clay and then heated in a forge for an extended period of time. Theophilus only used this method for case-hardening, the formation of steel on the exterior or case of a iron structure, but it still could have been used to transform a whole piece of iron into steel with enough time in the forge and 'old hog's lard' being applied. A more popular method of case-hardening was to take crushed charcoal and clay and pack it around the object being treated and then pack this in an 'iron box' which was then heated to 'red heat' in a forge to produce steel from the iron. In Styria the iron bloom was left in the furnace exposed to carbon dioxide created from the coal. This caused the iron to turn to steel. The transformation was not consistent and folding and re-forging of the iron/steel was necessary before the piece was suitable. The natural presence of carbon dioxide in furnaces that used charcoal could have contributed to an unintentional discovery of steel but this would have been long before this time period.

It is known that German metal was superior to all other metal produced while Germany was at its peak of armor production. Innsbruck became well liked for its superior metal. It is not known for sure why German steel was superior to steel in other countries but it is possible manganese was used to give the steel an extra hard characteristic.

> It is possible that the German iron-smelters had discovered the properties of manganese, which hardens steel, and thus obtained a superior metal to that produced in other countries. (p38-39, Ffoulkes)

This is quite fascinating since manganese is much more abundant in nature in Germany and Tuscany then most European countries. Even if they didn't discover this connection

it is possible iron ore containing manganese could have contributed to the extra hardness of German metal.

Quenching and Tempering Steel

The two step process of quenching and tempering were used to maximize the potential of steel. Quenching was the process of cooling red hot steel quickly in a cooler medium such as water. Water was the medium that cooled the metal the fastest and this rapid cooling produced a very hard, yet brittle steel. Other mediums that were used to cool the steel at lower speeds were oil, molten lead, and air. If steel was quenched and left extremely brittle it would be of less use than steel that was tempered in an attempt to reduce the internal stresses of steel created by quenching. The combination of quenching and tempering was a difficult skill and became a guarded trade secret of this time period. It is known that the armorers in Germany used the full two-step process of quenching and tempering through a recipe book, dated 1532, that gives an explanation of the two-step quenching, tempering process. Unlike the Germans, the Milanese armorers used a one step process called slack-quenching that compromised the process. Although this process was easier and less time consuming it did not produce the superior steel that the full two-step process used produced. This difference in the production of steel could be a reason the German metal was superior.

General Design

The design of plate of armor was very complex and had many factors that determined the outcome of the products. Armorers sometimes spent countless hours hammering and heating their armor to create a unique masterpiece. The shops that these men used were filled with tools and devices used for different types of armor. These tools were then used to heat and shape armor to their desire. This was the base for the production of armor which became a very detailed process of metalworking and craftsmanship.

Cutting and Shaping

The first thing done to armor was to cut out its initial shape. This cutting was done with a huge pair of shears fixed in a large, heavy block of wood. These shears were also used for trimming armor in the later stages of production. Shaping was the next aspect of armor that was very important to the quality of the product. The metal quality

Figure 12: Painting of a workshop by Guillaume Vreland. 1460

and the thickness of the armor in certain areas were two very important features to the quality of an armor. The shaping of metal was done cold in most situations unless major alterations, such as curved edges, were being made to the piece of armor. This is assumed from pictures that depict armorer's hammering armor and holding the armor with a bare hand. The armor was hammered by the smiths into desired shapes and thicknesses. The thickness was a crucial part in the production of armor since the wearer of the armor

would want more protection over the vulnerable parts of his body. An example of thickness varying is the helm that tends to have thicker metal in the front then the back. Also the left side of armor tends to be thicker due to the fact that most blows would be coming from a right handed attacker and would hit the left side of the body.

Tools for Cutting and Shaping

The shears, hammers and anvils were the primary tools used for cutting and shaping. A normal anvil weighed two hundred pounds and was made of wrought iron faced with steel. The anvil lengthwise is straight and level but has a crowned surface going across it. The crown is there so the smith will not mark the iron that is being worked and also to keep his hand from being stung with every strike of the hammer (Hibben p.191). The pointed part of the anvil is called the horn. This section of the anvil is used for shaping curves, rings, and rounded parts of metal. There are also two holes in the anvil. One is called the hardy hole which is a square hole which is meant to hold the shank
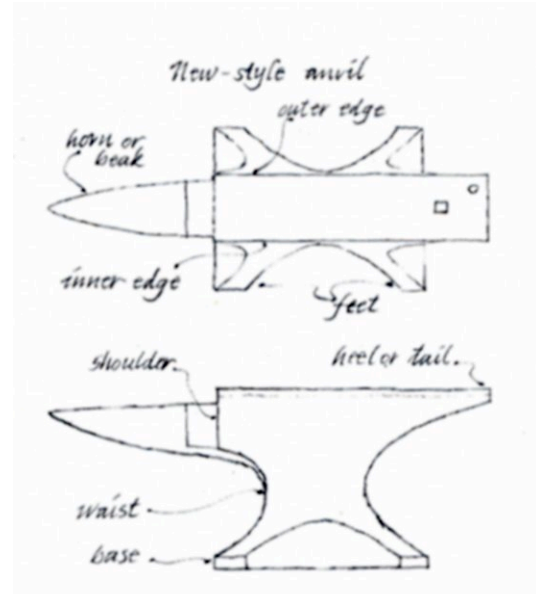
Figure 13: Anvil labeled by Jack Andrews in Edge of the Anvil

of tools in place firmly. The other hole is called the pritchel hole. This hole is round and is used for punching holes in armor. Different kinds of anvils exist but the one described is the most common.

An inventory from the Greenwich court workshop in 1514 gives a list of anvils they used at the time.

Pype Stake – round horned anvil for making tubes

Creste Stake – for beating up a helmet crest

Vysure Stake – for visors

Curace Stake – for the cuirass

A stake for hedde pecys

Armorers used hammers to shape their armor. Hibben describes a set of hammers as a set of three pieces: hand hammer used by the master smiths which was about sixteen inches long and weighed around two pounds, a hand sledge used by a helper, which was around 36 inches long weighing around six to eight pounds and swung from shoulder height, and a swing sledge, also wielded by the helper, with its length longer than the hand sledge and a weight up to twenty pounds. The swing sledge was also swung from shoulder height with two hands. Another account of hammers exists from the same Greenwich court workshop inventory.

Platynge hamer – heavy hammer, maybe a sledge hammer

Small Hammers

A Hamer for the hedde pecys

Creste hamer

Greve hamer

Rewetting hamer for rivets

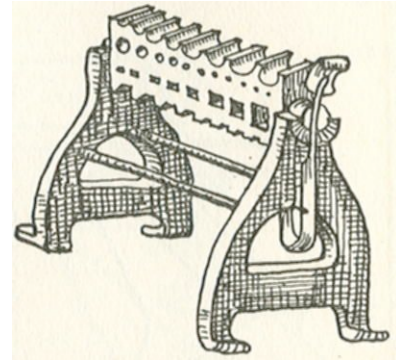Boos hamer for embossing of stell and iron

(Pfaffenbichler p.62)

Many smiths also used a bending device called a swage to bend pieces of metal into certain shapes. The swage was a bench like device with many a variety of holes in it of

different shapes and sizes so many unique bends and

alterations could be made to the metal from it.

Heat Treatment

Figure 14: Swage for bending

The initial heat treatment of armor was done

before it was shaped and the metal was melted in bars of

iron and steel for the use of the armorer. Although the

metal was being molded into armor and worked cold

there were processes to harden and strengthen the metal. A process called annealing was

used to strengthen armor and make it less brittle. Annealing was done by heating the

piece of metal to a red heat and then leaving it out to cool slowly. This process is closely

related to quenching and tempering. Quenching and tempering were a two step process

intended to harden the steel initially and then make it stronger and less brittle after the

hardening. Many different combinations of the processes of quenching, tempering and

annealing were used and these secrets were of much value to the armor smiths and the

trade. Different uses of heat included the making of turned edges. This was done by

heating metal and bending it around a wire to make a clean edge. Welding is the last

process I will explain that involves heat. Welding is done when a smith needs to attach

two separate pieces or metal. This process is difficult and not recommended by many

armor smiths. If iron is heated too much and it reaches a high enough temperature it will

burn and will be of no use to the smith. Even though welding is not preferred the process

of welding is as follows. Heat the two ends of metal that are intended to be welded. Once

they are of sufficient temperature take them to the anvil and prepare the ends for joining.

Taping the ends on the anvil and sprinkling dry sand with get rid of the soot and grease

on the metal. Lightly hammer the ends together. The smith continues to hammer until the joint is no longer visible. Some times you can't avoid using less desirable techniques and that is why the process of welding existed.

Tools used for Heat Treatment

The forge was the main source of heat for the armorer in his workshop. The forges had open hearths with a hood overhead to lead off the smoke and
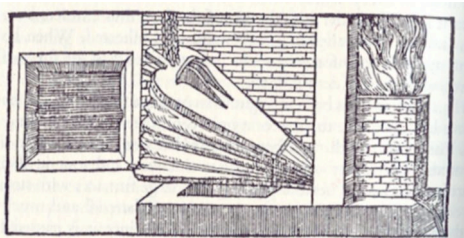
Figure 15: Blasting Forge for smelting Iron.

fumes that the fire produced. Other tools used with relation to heat treatment were the blower, shovel, rake, hook, poker, tongs, and sprinkling can plus a large trough of water for quick cooling. Without the trough of water quenching would not be possible. Another kind of tool used was the tongs. These existed in numerous shapes for gripping hot metal of various shapes and sizes. The jaws were the part that varied the most since the handle just varied in length and size. There were jaws for holding rivets, tongs for bolts, pincer tongs, link tongs, pipe tongs and pliers. Each different kind of
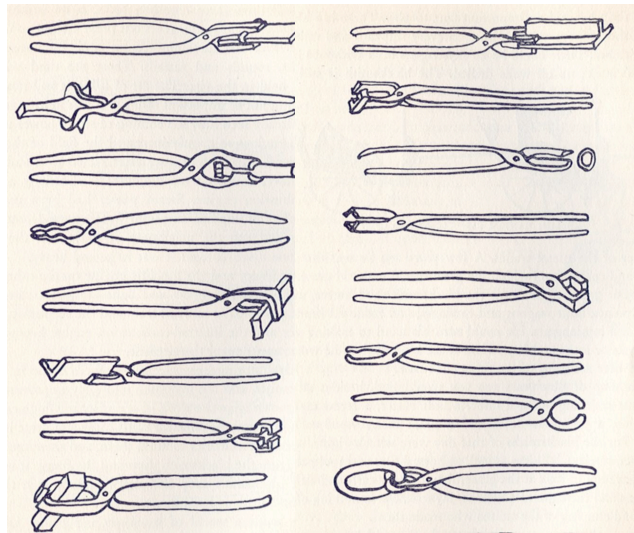
Figure 16: A variety of tongs

tong had its specific use and since armor has many different shapes it is easy to assume they needed many different tongs for each shape.

Connections and Joints

For armor to be worn it was necessary to have moving parts to allow the move with the wearer, as well as to make it possible to put on the plate metal garments. Hinges, rivets, and straps were devices used to grant movement and comfort to armor.

Hinges

Hinges were used on pieces of armor that needed to swing open and closed. The connection between the breastplate and back plate was one area that used hinges. Since the front and back piece of chest armor could not be one solid piece of armor (because the wearer had to get into it), the armor was made as separate pieces connected with either hinges or straps. Hinges were put on the side of the armor and connected either on one side or both. If the armor connected on both sides with hinges the back plate was two separate plates that swung together and latched. If the armor connected on one side with a hinge it was most likely a two one piece chest and a one piece back that latched on the opposite side with buckles. Hinges were also used on some helms that had a hinged face plate to have a moveable face protector. Ear flaps were also known to be hinged on helms such as the burgonet.

Rivets

Rivets were a type of connection that was very popular and very useful. Rivets were used to connect plates together and attach devices to the armor. Since the body is very flexible the armor requires the ability to move with the movement of the wearer. Sliding rivets are the most ingenious tool used in

making armor (Ffoulkes p.54). The slots in the lames were about _ inch thick and
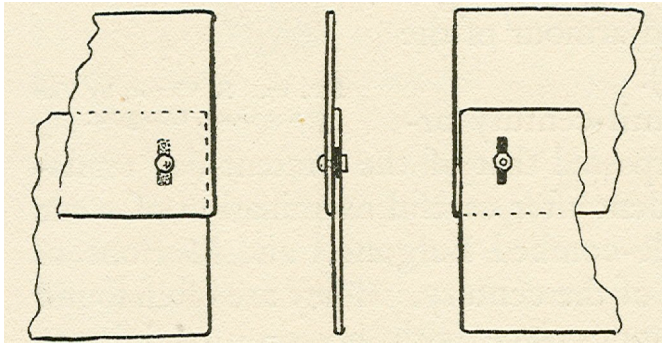
Figure 17: Slidng Rivets

allowed the sections of armor to become longer and shorter quickly and easily. Some pieces of armor that used the sliding rivet included the two-piece breastplate, pauldrons made of lames, the rerebrace and the vambrace.

The sliding rivet may have been the most successful type of rivet but the rivet was also used to attach lance rests, plackarts, stop ribs, and other accessories to armor. Helmets often used a loose rivet as a pivot for a visor. Rivets were the primary method of connecting armor to itself.

Straps

Figure 18: Leather Strap

Leather straps were an extremely common way to attach armor to the wearer. For armor used in the field and tournament the straps were hidden since the revealing of these straps would make for easy disassembly by an attacker. The armor had in it strap covers for the leather to attach to on the underside to hide it from weapon blows. Straps were used on almost every piece of armor. The ease that straps could be adjusted made them very popular in the making of armor.
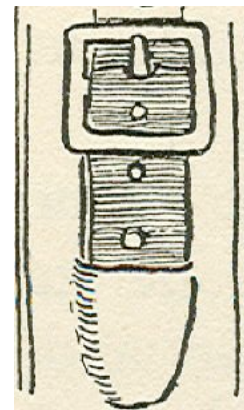
Decoration

Decoration of armor has been evident from the earliest times of defensive armor. Decoration and ornamentation of elaborate detail became evident as the "armorer became skilled in his craft and as the patron indulged in vanity or caprice." (Ffoulkes) It should be kept in mind that that the practical focus of armor was sometimes forgotten in the later years. The "glancing surface," a very important characteristic of armor, was set aside to make way for decoration. Jewels, favored by nobility, can be seen in the inventory of Piers Gaveston on the "ailettes 'frettez de perles.'" In this collection there are also plates ornamented with gold and silver. In 1385 the King of Castile wore a helmet at the battle of Aljubertota thought to be worth 20,000 francs due to the gold the helmet is enriched with. From the beginning of the 15th century up to the period when armor was discarded armor was engraved with a burin or with acid. In some cases engraving was the first step in niello-work. The lines and spaces created by engraving were filled with a black compound. By doing this neither the engraving nor the niello-work interfered or jeopardized the utility of the armor since the surface was still capable of polishing and could deflect a weapon. Other popular decoration methods were gilding and gold inlay . Many of these armors were blackened or oxidized so that the contrast of armor and embossing could be fully appreciated.

The decoration of armor did not stop with the use of valuable metals and gems but became an art where the armorer tried to suggest his suit was of a different material, and the armor became a place to show his artistic talent. The grotesque helmet of the 16th century from Nuremberg is an example of how armor was turned

Figure 19: Grotesque Helm of Nuremberg

into art. The features of this helm in no way increase its defensive properties but actually give it non-desirable characteristics for the battlefield.

It is impossible to ignore the fact that the practicality of armor decayed with the

Figure 20: Puffed and slashed style suit of armor

increase in decoration. The puffed suit of armor made in the 16th century in Vienna is decadence at its greatest. This is an example of armor used for special events. Armor was becoming more and more for pageant, joust, and parade use and less and less used for war (Ffoulkes). The embossing of suits can be seen as the one aspect of decoration that truly kills the original character of armor. Hollows and projections make the armor impractical but show to the public the dexterity of the craftsman. The casque after Negroli is an example of an embossed helm. This helm shows how the practicality of armor was ignored and they let their

artistic talents flow by creating and beautiful piece of work The reason that this helm is

so ridiculous and would never be used in battle is because of the "lodgments for the

sword or spear which would most certainly help detach the helmet from its wearer."

(Ffoulkes)

Physical Properties of Armor

The properties of armor can be explained using key measurements. Since many suits were made to fit it is understandable that a suit could be unique in dimensions. I will describe characteristics of suits of armor from 1400 to 1630 to generate an idea of the properties of armor.

Measurements

a	*Height of Breastplate* from the upper edge to the waist, measured outside; but in the case of articulated breastplates, from the upper edge to the point of placate, and then from the point of the placate to the waist indicated thus a….12 + 30.

a'	*Height of Backplate* from the upper edge to the waist, measured outside; and in the case of articulated backplates the same way as with the breast.

b	*Breadth of Breastplate* measured outside round the waist from edge to edge.

b'	*Breadth of Backplate* measured outside round the waist from edge to edge.

c	Length from the waist to the lowest point of the skirt or the tassets (where such exist), measured outside at the side.

d	Length of the arm, measured outside from the upper edge of the pauldron to the bottom edge of the vambrace, passing over the elbow-cop with the arm bent. (In the case of laminated "espaliers" from the edge of the gorget.)

e	Length from the upper edge of the cuisse in front to the bottom edge of the greave, passing over the knee.

f	Length of sabaton from the bottom edge of the greave down the middle to the end of the toe.

h	*Height of Helmet* measured inside, from the crown to the bottom of the side (comb not reckoned).

(Oswald Graf Trapp)
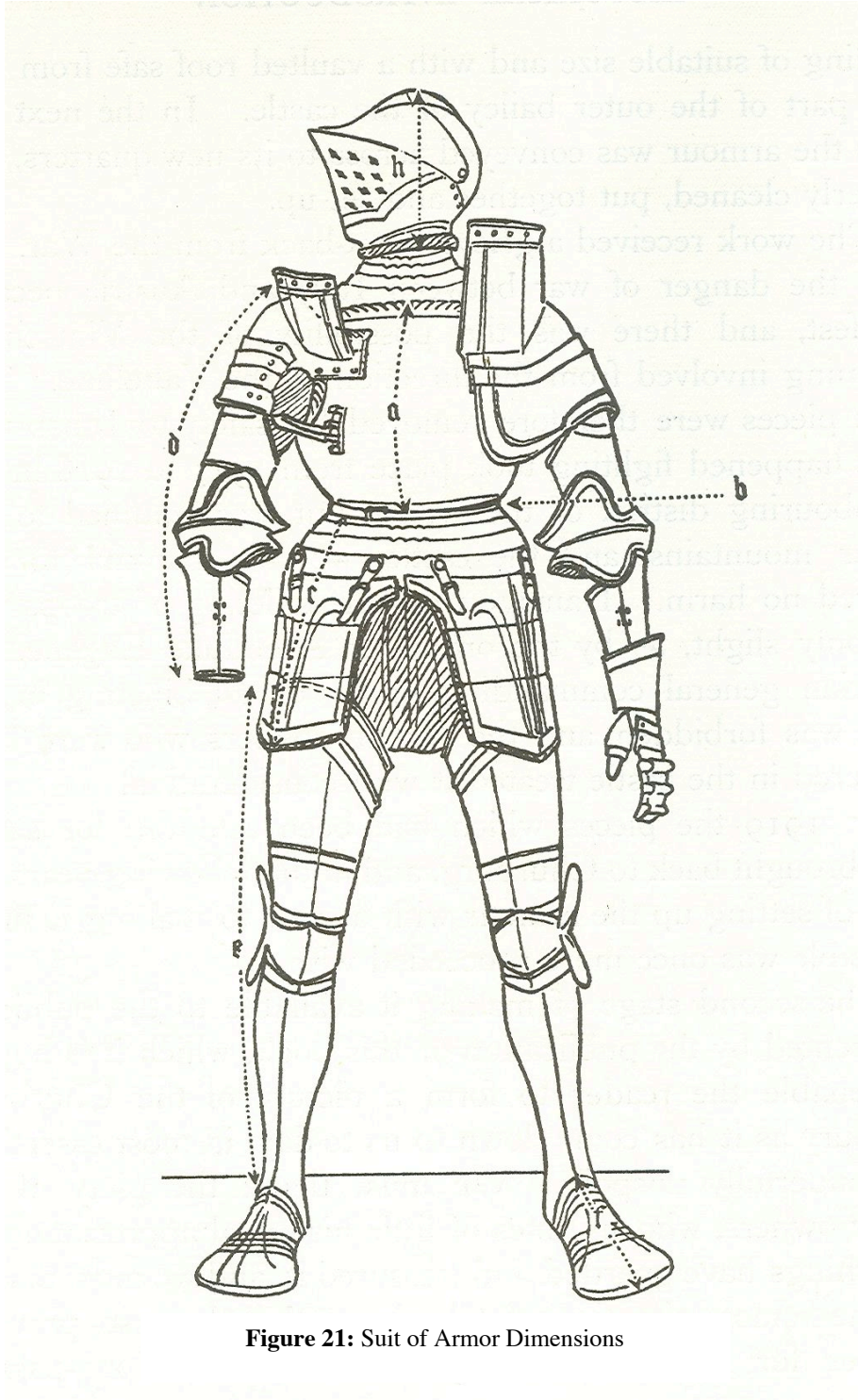
Figure 21: Suit of Armor Dimensions

Armor of Vogt Ulrich of Matsh, Count of Kirchberg   Milanese, c. 1450

This is special suit of jousting armor since it was made by one of the greatest armorers in history and the suit was also of 'gigantic size.' Both the breastplate and the backplate are articulating making a division in each piece. The breastplate and backplate are also hinged on the left under the armpit and buckled on the right.

The *Upper Breastplate* spans from the neck to the naval ending in a straight line. All the edges are turned over and flattened. Four staples are fixed on the right side of the armor for a short-lance rest. The rest is held in place with a removable bolt.

The *Upper Backplate*, similar to the breastplate with straight edges but the metal is thinner. It is composed of four articulated plates cusped into three points. Edges on both sides are turned over.

The *Lower Breastplate* is a five point cusp on the upper edge. The point in the middle of the breastplate extends to the height of the lance rest. A six lame skirt is attached to plate. The lowest lame on the left side has a short tasset, or "tuile," attached to it. The tasset on the left is missing.

The *Lower Backplate* is pointed and overlaps the upper plate. The connection is made with a strap, most likely leather. A culet of five lames has the remains of straps riveted on the lowest lame. These straps used to hold a rump-guard and show where it would have been carried. From the skirt hangs 10cm of mail. The rings were made of iron and riveted with iron except that last five rows are made of brass rings riveted with iron.

The *Right Pauldron* is made of five lames and is larger on the backside. The bottom two lames are curved edges. A reinforcing plate is riveted on in front and is curving forward at the top.

The *Left Pauldron* covers a massive area in the front and behind. Made of five lames, again the bottom two being curves, has a large reinforcing plate stapled and pinned in the center and is bent outwards at the top. There are turned edges on the upper and lower sections.

The *Arms* are protected by the *rerebracse* and the *vambraces*. Rerebraces connect to the *Elbow-cops* by a single lame, are open on the inside, and are articulated at the elbow-cops. The Vambracers are riveted with two lames to the elbow-cops and opens on two hinges.

The *Gauntlets* have two parts. The first is the area covering the wrist which is a funnel-shaped cuff that has no underside protection. The second part of the gauntlets is the metacarpal plate covering the fingers. The sections protecting the thumbs are missing along with the lining.

The *Cuisses* have plates hinged to the sides. At the top a single plate is with a turned over upper edge is riveted to each side. The upper edges of the cuisses are turned over to form square flanges as well. On each side there is the punched name ULDARICUS between simple ornaments.

The *Knee-cops* have large wings on them. They are articulated one time on the top and three times on the bottom. The bottom lame overlaps the greaves.

The *Greaves* have a pair of hinges on the outside and buckles on the inside. There is a place for the straps from the knee-cops to connect on the top. There is a row of holes for mail to be attached to cover the instep but the mail is missing.

The *Helm* is of the same time and workshop but not the original piece to the suit. It is also known that the straps used were faced with dark red velvet and the eyelet holes buttonholed with red silk.

Measurements

a	.	.	.	19+32 cm.
a'	.	.	.	32+18 cm.
b	.	.	.	57 cm.
b'	.	.	.	60 cm.
c	.	.	.	49 cm.
d	.	.	.	c. 78 cm.
e	.	.	.	c. 88cm.

Rings of mail-

Outer Diameter	7 mm.
Inner Diameter	5.5 mm.

Weights

Upper breast and back together
.   .   6.78 kg
Lower breast and back with skirt and
cutlet   .   .   11.80 kg
Tasset .   .   0.78 kg
Right Pauldron   2.37 kg
Left pauldron and reinforcing plate
.   .   3.39 kg
Right arm   .   1.68 kg
Left arm and reinforcing plate
.   .   2.17 kg
Gauntlets   .   1.20 kg
Cuisses together   5.61 kg
Greaves together   3.35 kg
Total = 39.13

(Measurements and Weights are from
The Armory of the Castle of Churburg)

Research on Harnesses and Evolution of Armor:

By Alexander Knight and John Prudente

Cavalry

A Brief History of the Knight

In the beginning of the plate armor era much of Europe was under the feudal system. Feudalism took shape in the vacuum of authority after the collapse of the Roman Empire. During Rome's heyday Rome had provided Europe with a political and economical infrastructure. The weakness of government authority, in Rome's wake, and a need for defense from outside invaders made the warrior class crucial. (Singman, 3) The main factors of feudalism became land and military power. In the 11th and 12th centuries the mounted knights were the predominant forces on the battlefield. The mounted knight's dominance had divided the Germanic warrior class. Mounted knights, became part of the aristocracy while those who could not afford horses lost status. As military technology advanced and became more expensive the gap widened. (Singman, 2) Since mounted knights were enormously expensive to train, maintain, and equip, kings gave knights a fief, often land, for their military service. The knights would rent out some of their land for the services of serfs, which would free the knight to hone their skills. The relationship formed between the kings, knights and serfs is the basis of the feudal system.

The mounted knight's military power stems from his ability to respond to danger quickly, being well armored and armed, and having extensive training, which starts at childhood. When a child, or his parents, decides he is going to become a knight he becomes a squire to a knight. A squire is a young aristocrat learning the military profession under a knight's tutelage, and providing services in exchange for his

instruction. The squire's main responsibilities were to assist the knight with his armor and his horse. (Singman, 123) For a squire to become a knight he must be have the skill and strength to compensate for the cumbrous armor and still use his weapons. The knight's most powerful weapon was his lance. The wooden spear would range from nine to eleven feet in length and be capped with a steel point. Medieval battle tactics typically began with a concentrated charge by the knights with their lances. This powerful charge defined the mounted knight as shock troops. Once in close quarters, knights would discard their lances and use their secondary weapons. The most popular secondary weapon was the sword, weighing between 2.5 to 3.5 pounds. Some knights relied on a mace, a wooden or iron club with a heavy, weighted end. (Singman, 122)

Mounted Knight's Training and Tactics

A mounted knight did not just train and wait for wars, however. Battles with dozens or hundreds of mounted cavalry were rare. Knights, also worked as command staff for the garrisons of castles. Military leadership was considered the aristocrat's natural prerogative, and the knight's combat experience, social authority and training made them perfect for the job. (Singman, 122)

Knights Job in the Castle

15th Century Mounted Knight Plate Armor

The military importance of the mounted knight in the 15th century cannot be ignored. They served tactically as the shock troops, charging into the heart of the battle with lances down. They would create gaps in enemy lines, riding through, wheeling about to get into position for another devastating charge (Edge and Paddock, 50). During the 15th century, the most common armor worn by the mounted knight was the full suit of armor. The full suit consisted of a full helmet

15th Century Mounted Knight Armor

with slits cut out for vision and ventilation, a gorget to protect the neck, breast and back plates to protect the torso, pauldrons to protect the shoulders, couters for elbow protection, gauntlets to protect the hands, and vambraces and rerebraces to protect the remaining areas of the arms. For protection of the legs there were two options. Some suits used tassets, cuisses, greaves and a curved plate to cover the knee and other suits, mostly later styles, simply had tassets that ran down to the knee and greaves to cover the lower leg. Suits of armor could be fitted with a fauld for added protection of the upper leg.

Figure 1:
Milanese Cavalry
Armor

Analyzing a conventional mounted knight's suit of armor of the mid-1400s in Figure 3 documents how a suit fits together and explains why it is not symmetrical. The head was protected by a barbute. There was a centrally running leather strap, which was used to support the lower half of the breastplate. The left pauldron is thicker and covers a portion of the breast and back plates because a mounted knight's left hand was used to hold the reins and therefore was exposed to attacks. (Edge and Paddock, 111) The right pauldron, however, has smaller specially designed plates in order to provide a greater range of motion for more effective hand-to-hand combat. Additionally the right pauldron was designed to absorb the lance's recoil when in the couching position. Similar to the left pauldron, the left arm has a larger couter to provide adequate protection. The breast and back plates are hinged together, with leather straps on the unhinged side to keep the pieces together. While, the suit of armor in figure 3 does not have any tassets attached,

the straps attached to the five-lame fauld suggest that there was a set of tassets originally with the suit. The leg harness on the suit has guttered cuisses, with articulated poleyns. On the outer knee, one of the lames extended out and in to provide additional protection. The back of the greaves had to be buckled into place. Also located on the lower leg guard were studs to attach the foot protection.

In the mid 15th century, armor for the heavy cavalry began to change in response to a new fighting tactic with newer, lighter lances (Oakeshott, 198). In Italy and Germany there were two different styles of changes. The Italian style focused on the addition of larger pieces of plate connected by smaller pieces for protection, thus decreasing the points that a lance could penetrate. The Italian armor smiths also enlarged the pauldrons to the point that they covered a section of the **Heavy Cavalry Armor Evolving** breastplate and the armpit area, eventually stretching across the upper back and causing later problems. The right pauldron was cut to allow the cavalryman to couch his lance across the body and over the head of the horse, aiming for his opponents left side. Subsequently the left side of the armor was usually covered with an additional piece of plate. By the end of the 15th century, stop ribs were being placed in a v-shape across the breastplate (Oakeshott, 202). The function of the stop ribs was to channel the lance tip away from vital points on the body and weak points in the armor.

The German style used larger, flatter pieces, which would often meet with projecting ridges down the center of the breast and back plates. The **German Style** concept of using the ridges, or keels, was to drive the lance tip to either the

left or the right. Furthermore the German smiths would ripple the pieces of the plate, making them even stronger. The concept behind the rippling is similar to that of corrugated cardboard. The flutes, as the ripples were often called, served as stop ribs.

Decline of Mounted Horsemen

Toward the end of the 13th century many aristocratic knights had accumulated such wealth and power from previous generations of military success they had become mercenaries accepting only the best jobs and were unreliable when summoned to battle. Therefore, the kings of the 14th century concluded that land based payment **New Payment System** was difficult to enforce because land removal from the knights who refused to go to battle when summoned was difficult. Therefore new forms of payment were devised, a retainer. The kings decided to divide their territory between barons and rich noblemen. These large landowners received annual payments to equip and train a certain number of troops. These annual payments shifted the role the knights had in the government. Knights were no longer the main source military power. New types of warriors emerged like the caballeros villanos from Spain, who were non-noble knights. (Ellis, 60) Non-noble knights would fight for less money and were not as expensive to equip. By the end of the 15th century cavalry began to become less important on the battlefield and their services ceased to be one of the mainsprings of economic and political power.

English history provides several reasons for the increasingly ineffectiveness of the mounted knight. First, it was partially due to the rise of sergeants and non- **Cavalry Decline** knightly men-at-arms fighting for prestige in order to earn as much money as possible. (Ellis, 61) The second reason emerged when the English faced the Scot's fast

and skilled light cavalry (called hobelars) who wore relatively little armor and rode ponies (called hobins). The English's heavy cavalry could not catch them when they retreated. This enabled the hobelars to do raid attacks, where they attacked and retreated before the opponents could counterattack. (Ellis, 62) A third reason was many knights preferred to fight on foot. It became common for mounted knights to dismount when they got to the front lines. The disadvantage to attempting to stay mounted can be seen in the English defeat by the Welsh in 15th century, where a duke told his knights to only fight on horseback, but they kept getting knocked off. Once a heavily armored knight was knocked off his feet he was extremely vulnerable because he could not get up quickly. Another reason cavalry was losing popularity was horses cannot go everywhere. In the mountains of Switzerland the Austrian cavalry was forced through mountain passes and were ambushed by the Swiss pikemen. A final and highly substantial reason was the development of the English long bow. The six-foot bow could shoot farther than any other bow or crossbow in existence and was powerful enough to pierce plate mail in close combat. The English dealt three major defeats to the French at Crécy (1346), Poitiers (1356), and Agincourt (1415) through the use of their longbowmen. The longbowmen would shoot continual volleys over the heads of their heavy infantry who had long pikes that defended them from the French cavalry attacks. The French who survived the charge through the raining arrows were too panicked and disorganized to break the English lines. Many horses struck with arrows would run wildly into the advancing French second and third lines, effectively breaking the French lines giving the English more time to regroup after each charge. (Ellis, 62-65) The use of cavalry showed a general decline throughout the second half of the Middle Ages. A rough average for the major European powers

shows that cavalry represented 40 percent of the total force c. 1500, 33 percent during the 30 Years War, 30 percent between 1648-1715 and 25 percent for the rest of the 1700s. (Ellis, 78)

Light Cavalry

The light cavalry were mounted soldiers, often equipped with shirts of chain mail or a cuirass with a helm and a sword or spear for weaponry. Few western units of light cavalry were equipped with crossbows or bows, due to the chivalric culture of the lesser knights. Tactically the light cavalry served as the reconnaissance unit of the army as well as running down the retreating infantry, as opposed to the **Light Cavalry Uses** shock tactics used by the heavy cavalry (Edge and Paddock, 50-52). In formation the light cavalry would typically be placed on the flanks, allowing for good speed and maneuverability. They were quite good at attacking the supply trains of the opposing force. When cannons were being used, the light cavalry would be used to take out those positions as well as attack the rear of the enemy.

From the period of c. 1450 to roughly 1525, the light cavalry wore a three-quarter suit of plate for their protection. The suit did not **Light Cavalry Armor** include certain elements found in heavy cavalry suits, such as the pauldrons and the heavy gauntlets. Instead the riders wore more flexible gauntlets made up of segmented plate. The piece in Figure 1 is an Italian-made suit of light cavalry armor.

Figure 2: Italian Style Cavalry Armor ca. 1510, Metropolitan Museum of Art. Item # 14.25.716

The suit in Figure 2 is a light cavalry suit from Innsbruck. The smith who crafted this suit is Christian Schreiner the Younger. The suit shows the elements typical of the Maximilian period armors. The breastplate (A) is fluted in the Italian style. The lack of pauldrons identifies this as a suit used for mobility in the shoulder joints. The wearer probably used a weapon that required increased flexibility in the shoulders, like a horse bow. (Ellis, 75) The upper arm pieces (B) consist of four or

Figure 3: Diagram of Light Cavalry Armor, ca. 1560, Image courtesy of the Metropolitan Museum of Art

fives lames each in an articulated arrangement. The lower arm pieces, made of a two-pieces of plate joined with a hinge, join the upper arm pieces at a slightly enlarged couter (C), leaving the inner elbow unguarded. The segmented gauntlet (D) extends well into the forearm, possibly limiting use in the wrist. The fauld consists of six lames, possibly slide-riveted or articulated, later giving away to the five lames tassets, also articulated. Helmets used by the light cavalry varied by time period but were most often close-faced sallets. (LaBonte)

The Age of Firearms

The introduction of firearms in the 15th century further changed the way the cavalry was used in the military. The fast evolving war technology nearly pushed cavalry out of the military. There are two main reasons the cavalry remained in the military. The

first reason is the inertia of tradition kept cavalry in the military because there was still a "stronghold of aristocratic vested interest." (Ellis, 78) The second reason is from a military point of view even though the arquebus was devastating **How Cavalry Stayed Useful** when a large volley was shot, it was still in the early stage of development and it was unreliable and took a long time to reload, leaving ample time for the cavalry to strike an effective attack. (Ellis, 78) Waiting for the right moment combined with a return volley from friendly arquebusier fire could break the lines of pikemen defending the arquebusiers as they reloaded. This strategy of combining cavalry with musket squadrons was the basis of all military strategy through the end of plate armor era.

One of the greatest military strategists of the 17th century was Gustavus Adlophus (1611-1632). The introduction of the wheellock enabled cavalry to use guns easily, allowing Gustavus to base his strategy on being on the offensive, making it important to strike first. He broke up the enemy formations with artillery as a prelude to attacks either by infantry or cavalry. If the attack was from the cavalry, the cavalry, with pistols, was broken up into three ranks, but only the first rank was allowed to fire one gun, while the second and third ranks were to save their shot for emergencies. The **Gustavus Adolphus Tactics** cavalry was to depend mostly on their swords. The pistols were more to break into the lines in order to create close combat conditions where cavalry dominates. The cavalry coordinated with groups of musketeers who were used to disorganize the enemy infantry just before the charge. The musketeers gave cover fire for the cavalry's retreat if they failed to break the lines. Adolphus's strategy was not perfect, however. First off the horsemen did not have enough space or time to get to a gallop between shots

and ended up trotting into the enemy lines, which takes from the cavalry shock action. Secondly horsemen could not ride more than a hundred yards or so without losing contact with their defense, the musketeers. Gustavus's strategy may not have been perfect but it took his enemy generals many years and several big battles to discover its shortcomings.

In the second half of the 16th century, the most common armor worn by the heavy cavalry was the three-quarter suit of armor. The three-quarter suits **Three-Quarter Suits** consisted of many of the same components as the full suit of armor. The only dramatic change was the lack of solid plate protection for the lower legs. In place of the greaves and sabatons, thick leather boots were used.

However, in the mid 17th century half suits of armor begin to replace the increasingly rare and expensive three-quarter suits (Oakeshott, 198). The half suit consisted of a close helmet with an umbral ridge and comb, breastplate and tassets. The gorget remained a part of the suit to cover the gap left by the helmet and the **Half Suits** breastplate. By the end of the 17th century, the use of heavy armor for cavalry was restricted to helmets and cuirasses, these units becoming the aptly named cuirassiers. The thought behind this was quite simple. Firearms, such as the flintlock musket, were able to pierce the thick plate armor worn by the heavy cavalry (Oakeshott, 197). The heavy cavalry began to change their protection accordingly.

Figure 4: French Heavy Cavalry Armor ca. 1600 Metropolitan Museum

The officers of the unit shed most of their armor, going to a simple breastplate and open face helm. The remaining lancers continued to wear the half or three-quarter suits.

(LaBonte)

Sources:
  Ellis (60, 62-65, 78)
  Edge and Paddock (50-52)
  Oakeshott (198,202,197)
  Gregory LaBonte (A Classic Suit of Armor 04-05)

Infantry

Infantry Tactics

From the 15th to the 17th century the majority of an army was comprised of infantry. Exact percentages vary by country and armament but numbers ranged from 50% to 80%. The infantry's function in the army remained the same as it had been for ages, but with the progression of time and the addition of firearms, additional responsibilities surfaced. Historically, the infantry force was broken into heavy and light versions. The different types of light infantry were **Infantry Introduction** culverineers, musketeers, longbowmen, and crossbowmen. The different types of heavy infantry were pikemen, Landsknechts, and halberdiers. (Contamine, 232) The light infantry was typically unarmored or lightly armored and equipped with bows or crossbows, however, after 1550 during the rise of firearms, guns became more popular and culverineers, who used the culverin, an early musket, and musketeers began to comprise large percentages of the infantry. The heavy infantry was armored with varying levels of armor, depending upon their weaponry and purpose. A typical heavy infantryman would be equipped with a gambeson and a breastplate with tassets, with a spear or pike. Heavy infantry would also be afforded a helmet and other pieces depending on the period.

In the 13th century spanning into early 14th century to be infantry meant being poor. Often the infantry units were composed of archer serfs, who had **Long Bowmen** little hand-to-hand combat training or soldiers that did not have the means to support themselves and a horse. Infantry did not begin to gain respect until English longbow evolved into the unrivaled, non-artillery range weapon of Europe. The

English longbow continued to be a dominating battle weapon until the rise of firearms in the 16th century.

Early firearms were difficult to use until the invention of the matchlock. The matchlock was a welcome improvement in the mid 15th century and remained in use until early in the 18th century. The matchlock secured a lit slow match in a moveable arm. When the trigger was depressed the arm brought the match cord to the

Matchlock

flash pan to ignite the powder. This allowed the musketeer to keep both

hands on the gun, improving his aim drastically. The gun had its weaknesses, however. It took time to ignite the end of the match leaving the musketeer useless against a surprise attack. Also, it was difficult to keep the match burning in damp weather. The one real advantage the musketeers possessed, like mounted knights, was the intimidation factor. For the most part, however, longbowmen were more effective in battle than the musketeers.

The power of the longbow can be seen at the battles of Crécy (1346), Poitiers (1356) and Agincourt (1415). The battle at Agincourt was one of the best-recorded battles of the Middle Ages and therefore will be the focus of this section. In August of 1415 Henry V left England with eight thousand longbowmen and two

Agincourt

thousand men-at-arms. He landed in France and set up a base of action

with little resistance. Henry V's troops entered the battle of Agincourt with five to six thousand longbowmen and one thousand men-at-arms and defeated a French army of twenty five thousand men-at-arms, though the third line of French cavalry never entered battle.(Keegan, 80 and 88)

The English tactics were simple: exploit the overconfidence of the French and get them to charge in order to defeat them from the defensive position. The English provoked a charge by shooting several volleys of arrows at the enemy. These initial volleys were not crippling but the loud noise from the simultaneous clank and bang of five thousand arrows combined with the screams of any animals that get hit rattles troops. At Agincourt the French responded with a twelve hundred-horse cavalry charge. The **Cavalry versus Infantry** English longbowmen would continue lobbing volleys as the French charged, secure in their knowledge that among the English troops were concealed stakes stuck in the ground at the proper angle to repel a cavalry charge. The French failed to break the English lines and were forced to make a hasty retreat. Arrows would hit the retreating horses causing the French cavalry to charge uncontrollably into the advancing infantry. (Keegan 95-97)

The French men-at-arms advanced in a trident formation eight thousand strong. French infantry sustained fairly high casualties against the longbowmen due to the prolonged exposure to direct archery fire. At sixty yards the longbow can penetrate plate armor making the last fifty yards very dangerous. Once the enemy infantry is within ten to twenty yards they will begin to charge at full speed. The front line of English infantry have one of two tactical options, which will be chosen based on who has more men. If the defending infantry have more men than the charging infantry, the front line will charge at the enemy to stop them from getting to full speed and to offset their **Infantry versus Infantry** footing. If the defending army is at a disadvantage it is up to each individual man-at-arms in the front line to time trotting backward from the charge to offset the footing of the charging infantry. The desired outcome is to throw the enemy

off-balance enough that they fall. Once a heavily armored infantryman falls he is highly vulnerable to attack and an obstacle for his fellow men-at-arms to trip on. The French army had superior numbers and better equipped soldiers giving them a false confidence, which caused the French who could not see the front lines to eagerly push forward. When the English used the step-back method the Frenchmen would loose their footing and fall in the mud, get killed and have hundreds of other eager Frenchmen being pushed from behind trip over them and become an easy kill for the English. The overconfidence of the French caused their generals to continually throw reinforcements at the English when they should have retreated and collected themselves. (Keegan 97-102)

Crécy, Poitiers and Agincourt marked a change in military strategy away from shock tactics and individual ability to strategies dependent on patience and long-range attacks. There are several reasons for this change other than the apparent military advantage it gave on the battlefield. First, archers needed less armor than **Switch to Range Weapons** the heavy infantry. At Agincourt most of the French troops were heavy infantry with full plate armor, which was expensive, cumbrous and quickly becoming ineffective. Even though the French outnumbered and out-armored the English they could not break their enemy's lines. This change in military superiority from the heavy infantry and cavalry who used hand-to-hand combat, to light infantry who used range weapons marked the beginning of the transition to guns and artillery.

Infantry Armor

In the beginning of the 14th century infantry defenses were made of various materials: latten (a brass-like copper alloy), baleen, cuir bouilli (leather), **Mail Era** iron, but by the end of this century the suit of armor was almost completely composed of steel. (Paddock, 115) Accompanying the steel harness was the hauberk, a long-sleeved shirt of mail that extended to the lower thigh, with mufflers or mail mittens for hand protection. The hauberk was the most common form of body defense. Mail is not a rigid defense and provides nearly no protection from piercing weapons, arrows or crossbow bolts, blunt trauma, broken bones and hemorrhaging. To protect against these potentially life-threatening blows armorers developed additional defenses. By the end of the 14th century breastplates and back plates had became common and could be made of leather, bronze or steel. The evolution into plate ended the mail era and began a transition era.

In the beginning of the 15th century mail armor was not abandoned, it was worn under plate armor to protect from blows that landed in between the **Transition** armor plates. The first popular type of plate armor was the coat of
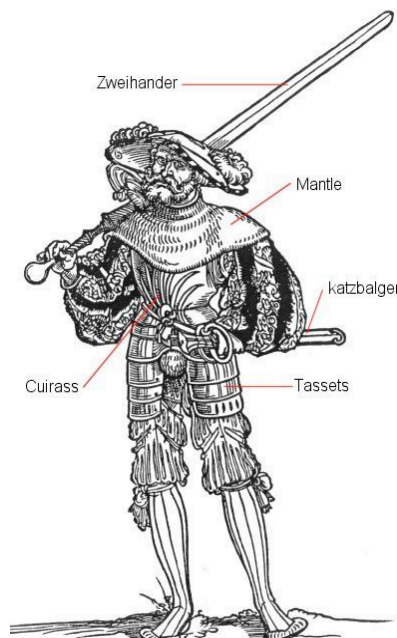

Figure 1:
Brigandine

brigandine. The coat of brigandine was composed of layers of leather with metal plates between, typically connected with large rivets to give a studded armor look (Figure 1). The infantry who wore studded armor were known as brigands because they were mercenaries who after a battle looted the dead for better armor and extra funds. Often all a brigand would find was a kettle hat, open-faced sallet or skullcap. If a brigand was lucky he could find armor of a noble or rich knight. The richest infantrymen had

corslets, which consisted of breast and back plate, tassets, vambraces, gauntlets and an open-faced helm.

By the end of the 15th century firearms were beginning to change the face of plate armor. The technological peak of plate armor was in the early 1500s during the Maximilian era. During this time period the German gothic armor and rounded Italian armor styles can be seen in new harnesses. Some harnesses, such as Henry VIII's field plate, were crafted so well they were said to be impenetrable to even pins. Every joint was fitted and layered perfectly. The plate armor made during this period **Plate Era** allowed for maximum protection and movement, though plate armor never became mobile enough for archers to wear. During the 1500s, specialized tournament armors became more common. Plate was part of every facet of European life: entertainment, military action and celebratory dress.

Figure 2: German Landsknecht ca. 1510, Image courtesy of www.St-Mikes.org

Labels: Zweihander, Mantle, katzbalger, Cuirass, Tassets

The Gunpowder Age

The second half of the 15th century brought major changes in military theory. Studying the German Landsknechts (Figure 2) can illustrate the changes in military strategies. The Landsknechts were formed to counter the superior fighting techniques **German** of the Swiss Pikemen. (Oakeshott, 195) These pikemen used their skills with the long pike combined with choice strategic battlefield selection. The Landsknechts were trained to use several weapons,

from a two-handed sword called a zweihander to an arquebus. They wore a breast and back plate with tassets to the knees (Edge and Paddock, 140). They protected their lower legs with leather boots and used wide brimmed hats for head protection. The Germans even developed new battle formations for the Landsknechts to combat the growing use of arquebusiers. Their new strategy was known as gevierte Ordnung. (Miller, 7)

In the gevierte Ordnung formation the pikemen and the halberdiers formed a solid square in the center with the two-handed swordsmen, Doppelsöldner, at the front and rear. Behind the front two ranks of Doppelsöldner stood the ensigns in the center of the three Fähnlein (companies). Next came the forest of pikes with four center companies in the middle. At the rear were three ensigns with the most experienced troops. Around this block stood a wall of arquebusiers. They were protected by the pikemen **Gevierte** and occupied the most effective position in the attack. (Miller, 7) It became **Ordnung.** customary for a regiment in the gevierte Ordnung formation to have four wings of arquebusiers who were trained to advance, fire and retreat to reload while the pikemen continually advanced. Since the gevierte Ordnung is a defensive formation the artillery was placed in the front in order to allow the commanders to see the field of battle. (Miller, 8)

When the gevierte Ordnung needed to advance a line of foot were put in the front of the formation called the verlorene Haufe (forlorn hope). The verlorene Haufe were composed of volunteers, prisoners trying to redeem themselves, and unfortunates who were picked by lottery. The verlorene Haufe jobs were to stop oncoming **Igel and** **Verlorene** enemies and to create gaps in enemy lines for their cavalry to penetrate. **Hauge** If the Landsknechts were being charged they formed into the Igel (hedgehog) formation.

In the Igel formation the arquebusiers moved to the third rank while the pikemen moved to the front and prepared for the cavalry charge. The Doppelsöldner (with halberds and

Figure 3: Munition plate 1500s, Edge and Paddock pg.139

two-handed swords) plugged the gaps in the front and second ranks at the same time allowing space for arquebusiers to fire. (Miller, 8) Toward the middle of the 16th century daring ploys began to disappear as movement became restricted by firepower. Pikemen also began to become less effective on the battlefield as firepower increased.

Early in the 16th century, it was not uncommon for the heavy infantrymen to wear "munition plate." Munition armors (Figure 3) were suits that were made of poorer quality metals and were of a low quality due to the speed of manufacture (Edge and Paddock, 139). It typically consisted of a simple, reinforced breastplate, a back plate, small fauld and tassets, and a helmet (Oakeshott, 195). The inclusion of arm **Munition Plate Armor** harnesses varied amongst the army. During the second half of the 16th century, the breastplate was thickened as an attempt to bulletproof the heavy infantry. The tassets decreased in size as did the gorget and the gauntlets, save for the finger lames.

During the 17th and 18th century the use of plate armor began to decline. Guns became too powerful for steel to stop the bullets without being extremely heavy and cumbrous. Armor had a relatively short life, but it dominated military technology for almost its entire life span.

Tournament

Tournaments and jousts first emerged in Europe in the 11th century. Technically the difference between a tournament and a joust is a tournament is a battle between groups of horsemen and a joust is a battle between two horsemen. Initially tourneys were established as a way to show and practice ones military expertise off the battlefield. Therefore armor used in tournaments was the same armor employed in wars. These early tourneys often lasted all day and had no clear 'winner'. There were virtually no rules, and injury or death was common. (Edge and Paddock, 154) The first **The Beginning** tournaments differed little from battle. The brutality often witnessed in early tournaments caused Pope Innocent II to ban the 'sinful sport' in 1130, though tournaments were still practiced throughout Europe during the ban. Tournaments did not regain complete respectability until Pope John XXII lifted the ban in 1316. (Edge and Paddock, 154) The European reintroduction of the tournament brought many changes in the armor used and the rules observed.

By the 13th century increased importance was attached to safety to reduce the drain on the nation's reserves of trained warriors caused by their death or injury during tournaments. The first specialized tournament armor wasn't developed until this time. From the middle of the 13th century the use of rebated lances, introduced sometime before 1200, became more common and marked the difference between the joust à **Safety Features** plaisance, joust of peace, and the joust à l'outrance, the joust of war. The jousts of peace were fought with rebated lances, where the object was to splinter lances or unhorse opponents. The jousts of war were fought with real arms until one contestant was

disabled or killed. The jousts of war were linked with medieval trial by combat. (Blair, 156) For additional safety some forms of the joust adopted the 'tilt barrier,' which was
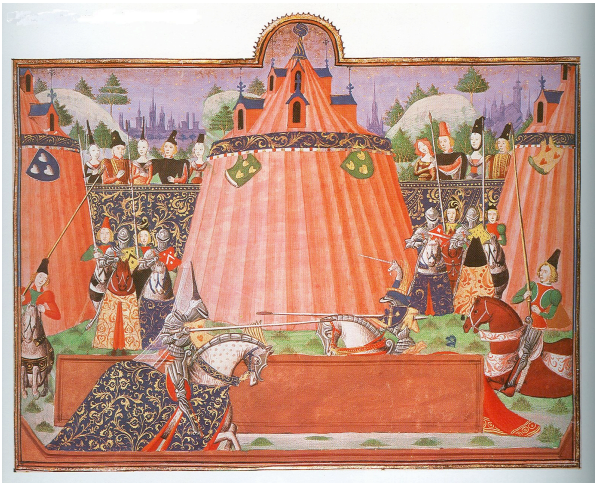
Figure 1: Edge and Paddock, 158-A medieval knight and his armor. Picture of a tilt.

introduced around 1420 in Italy. The tilt barrier separated the contestants with initially a cloth, but later on a wooden fence that could be five to six feet tall and capable of withstanding a glancing collision from a charging horse. Any joust that made use of the safety barrier was known as a tilt. (Edge and Paddock, 158) These new rules combined with armors specially designed for the joust greatly reduced tournament deaths.

The earliest reference to specialty armor made for the joust was from the royal

Figure 2: Edge and Paddock, 163-Frog-Mouthed Helm.

tournament held in the park at Windsor on July 9th, 1278. All armors in this tournament were made of leather, including the helms, and all **Specialty Armors** weapons were made of whalebone, or as it may be called today, baleen. (Blair, 157) The first piece of armor designed exclusively for the joust was the frog-mouthed helm, introduced in the end of the 14th century. By the beginning of the 16th century each form of joust had special versions of field plate armor. (Blair, 157-158) In general the plates became heavier and stronger with

reinforcing plates in all vulnerable places.

There were several types of tournament courses, either foot or mounted combat. Each form of jousting had its own set of rules. Most of the types of joust differed little from one another but there were at least twelve types that fit **Joust Forms** into one of two groups, the Gestech or Rennen. Mentioned within this section are several of the German variants, with both typical armament and rules described. For the foot tournament, the rules and weaponry varied nation by nation. Most of the variant jousts were German and many of them gained popularity when Maximilian devised them during his rule c. 1515-1530. (Blair, 163)

Foot Combat

Throughout the middle ages the joust was the most popular form of tournament and therefore the best known form today. However as long as there has been the joust there have been foot combat tournaments. The earliest foot tournaments were known as Freiturnier. Often ordinary field armor was used with a great basinet **Freiturniers** strapped or screwed to the cuirass. The great basinet retained its globular shape of hounskull visor until the end of the 1400s when it was superseded by two new shapes; one hemispherical with small piercings and the other of the bellows form. Many Freiturniers were fought with swords, spears, daggers, pole-axes and pole-hammers and by the 15th century a special form of the Freiturniers developed where combatants fought over barriers. (Blair, 164)

The Kolbenturnier was a tourney where only clubs and rebated swords were used. A large, rounded helmet with bars protecting the face was worn for the fight. Field armor was worn to protect the rest of the body, usually a full suit of plate. The helm would be

screwed down to the breastplate to keep it from being knocked off. (Edge and Paddock,

Kolbenturnier   174) The popularity of the Kolbenturnier in the early 16th century

caused the new generation of field armors to be

fitted with spare helmets and reinforcing plates for the bevor,

breastplate, left couter and the left gauntlet in order to be able to be

used in foot combat. (Blair, 164)

Gestech

Initially the term Gestech was applied to all ordinary jousts

fought with rebated lances. In the 14th century, however, a special

form of the Gestech appeared, called the Hohenzeuggestech. The

object of this form of joust was to splinter lances. The

Hohenzeuggestech differed from the Gestech in the saddle used. The

Hohenzeuggestech saddle is raised ten inches above the horse's back

Figure 3: Edge and Paddock, 170-Henry the VIII foot combat armor in the Royal Armories, shown with a contemporary poleaxe.

forcing the contestants to ride in a standing posture. The front of the saddle was shaped to

form a large wooden shield, forked over the horse's back, which protected the rider from

his feet to just above his waist. Two bars extended backward

Hohenzeuggestech

wrapping around the rider's thigh to prevent him from being

thrown. As could be imagined there were most likely many back injuries and broken legs.

(Blair, 160) The armor used in the Hohenzeuggestech was field armor without leg

harness, a frog-mouthed helm, and a small shield suspended over left side of the rider's

body. The Hohenzeuggestech lasted until c. 1450 when the Gestech Proper (Deutsches

Gestech) replaced it.

The Gestech proper returned to the normal height saddle without the bars around the thighs allowing riders to fall off if hit hard enough. The object of the Gestech proper was both splintering lances and unhorsing riders. In c. 1480 the shields for the legs were replaced by the stechsack, a thickly padded bumper for the horse's chest, which hung around the neck in such a way that it protected the rider's legs.

Gestech Proper

A comparatively large number of Gestech armors have survived from the late 15th and early 16th century. The Gestech armor consisted of a helm of frog-mouthed form, called the stechhelm, which was screwed down to the cuirass. The breastplate went down to the waist, and was very heavy. It was boxed and flattened on the right for a large lance rest and a queue. A queue is a combination known as the rest of advantage, developed in England. The Gestech armors had rasthaken, which was a horizontal bar projecting backward under the arm and stopping at back in a hook, under which the butt-end of the heavy lance could be lodged. A broad fishtail-shape central plate was usually riveted under the lower edge of the breastplate; it arched over the crotch and extended down to rest on the top of the thighs, which provided additional support for the armor. Broad strips of leather were riveted along the outer edges of plate, which could be laced to corresponding strips on the culet and around the thighs. The plate was covered by a low, pointed plackart, usually attached to bottom of the breast by a central screw. A fauld and tasset was of normal form. The back plate joined to the breastplate by hinged metal hasps at the

Gestech Armor

Figure 4: Blair, 152- Armor (Stechzeug) for the German Gestech, by Valentin Siebenburger of Nuremberg, c. 1530. Displayed at the Germanisches National-Museum, Nuremberg.
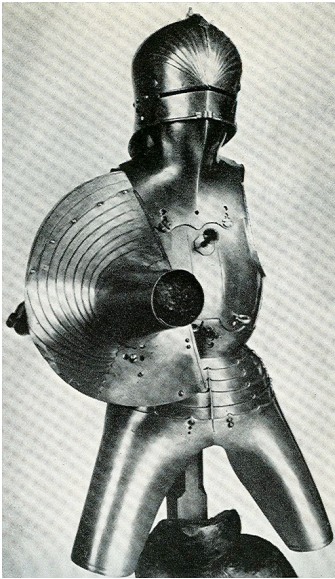
shoulders and the sides. Usually the breastplate was small and light, sometimes little more than an x-shaped frame with a small fishtail culet. (Oakeshott, 264) The Gestech armor also had small laminated pauldrons, cut away over the front of the armpits and both, but sometimes just the right, carried large circular besagews. Each pauldron extended in a series of laminations down the outside of the arm almost to the elbow and are occasionally fitted with a short, vertical peg on the point of the shoulder. The peg was designed to enable the lance to be carried over the shoulder without rolling off. Also, there were short gutter-shaped upper cannons linked, on the right, by small couters to the polder-mitten and, on the left, the manifer. The polder-mitten was often arranged so that its upper end could be locked to the upper cannon by a screw, which fixed the arm in the proper couching position. The manifer was like a lower cannon continued as a solid plate over the back and sides of the hand, occasionally there was a single lamination across the middle joints of the fingers. The right hand was either bare or covered with a large, padded glove, being otherwise protected by the large steel vamplate on the lance. The pear-shaped and rectangular wooden shield, known as the stechtarsche, was suspended by cards that passed through holes in the left side of the breastplate. (Blair, 161-162)

The final form of the Gestech was not adopted until the 1520s when the Italian tilt was introduced. This form of the Gestech is known as the

Plankengestech

Plankengestech and the usual Gestech armor was used with additional

leg harnesses in case a rider's horse collided with the barrier. Also a higher type of shield was used but it did not have the queue.

The Scharfrennen (Rennen)

The earliest reference by name to the Rennen was in 1436. (Blair, 162) The difference between the Gestech and the Rennen was the Rennen placed more importance on unhorsing and it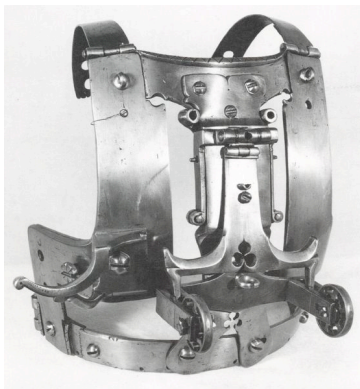 placed less importance on splintering lances. The armor most commonly used in the Scharfrennen from the last quarter of the 14th century through the 1470s was a light half-armor or brigadine with a sallet, bevor and a rectangular shield suspended off the left side. By the 1480s a special armor had been developed for the Scharfrennen; a good number have survived to present day. The Rennen armor usually came without leg harnesses, vambraces, pauldrons or gauntlets. The large renntartsche, described below, and the vamplate was used for protection of the hand and arms. The Rennen cuirass was usually similar in form to the Gestech, except the plackart, fauld and tassets were heavier. The tassets for the Rennen extended past the knees and were shaped to the thighs. The helm usually used was a one-piece sallet with the visor-slit cut in it, known as the rennhut. The helm was accompanied by a deep bevor attached by screws to the breastplate. Two wing-shaped plates are usually fastened over the brow by means of pins or pivoted bars designed to fall off when struck. The whole bevor and the front of the body are covered by the renntartsche. The renntarsche was made of wood and leather with steel reinforcements attached by a central screw to the breastplate and by a bolt attached to a wing nut on the bevor. The renntarsche was shaped

Figure 5: Blair, 152-Armor (Rennzeug) for the German Scharfrennen, by Christian Treytz of Innsbruck, c. 1490.

Scharfrennen Armor

to the bevor and breastplate stretching down to just above the waist where it curved out to clear the saddlebow and cover the bridle-hand. Special heavy boots were worn with plates that covered thighs and knees called dilgons, which hung off the saddle. (Blair, 162-163) This type of armor remained popular until the 1550s, though by the 1530s new types were emerging.

In the early 16th century, during the Maximilian era, many forms of Scharfrennen emerged making it far more varied than the Gestech, however many of the variations were very similar. One of the main joust forms devised by Maximilian was the Mecanischesrennen where the breastplate was fitted with a spring-operated mechanism covered by a metal shield made of separated segments; when struck the mechanism caused a segment to be flung in the air. The object of the Mecanischesrennen was to unhorse one's opponents.

Mecanisches Rennen

Figure 6: Edge and Paddock, 168-Armor for the Mecanishesrennen with spring loaded breastplate. (Blair, 163)

Another specialized form of the Scharfrennen was the Welschrennen, introduced in the early 16th century from Italy. In the Welschrennen an ordinary field plate armor was worn fitted with a large reinforcing-piece over the left pauldron and either an armet and wrapper or a closed helmet shaped like an armet, but extended downward to be screwed into the cuirass. The Welschrennen style used a different type of lance. (Blair, 163)

Welschrennen

General

By 1520 there was a general tendency, outside Germany, for the field plate talked about above to be used in all forms of tournaments with the addition of several pieces; tilt helmet, grandgaurd, pasguard, manifer and the tilting targe. The tilt helmet had a heavier visor with a single visor-slit and piercing on the right side only. It had interchangeable tilt and field visor instead of two different helmets. The grandguard had **15th Century Armor** reinforcing plates that covered the left and part of the right side of the breastplate attached with a central staple or peg. It was made in one with the bevor or separate with reinforcing left tasset. The pasguard was derived from the vambrace and had a large wing-like reinforcement for the left elbow attached by a staple or haute-piece. The manifer was a large mitten gauntlet for the left hand either strapped over the ordinary gauntlet or attached by means of a staple and pivot-hook. (Blair, 166-167)

From the 1570s to the end of the tournaments an ordinary three-quarter field plate with symmetrical pauldrons and mitten-gauntlets with flanges along the **16th Century Armor** inner edges to protect opponents weapon from sliding down the hand. After 1610 the reinforcing pieces for the joust consisted of the grandguard or targetta, manifer and pasguard. (Blair, 166-167)

Tournaments lost most of their popularity as full plate armor lost its popularity. However, in some areas of Europe tournaments lasted until the beginning of the 18th century. Tournaments were replaced by the carousel, which involved riding **Carousel** at a suspended ring and trying to catch the ring on the end of a lance, attempting to hit a wooden or papier-mâché of a Moors head with various weapons, riding at a quintain (a pivoted demi figure, usually of a Moor, with a shield and sword)

with the object of hitting the quintain in the center so the quintain does not spin around and hit you, or to win a battle royal where the object is to smash opponent's crest with a blunt sword or a padded club. (Blair, 168)

Parade Armors

Figure 1: Norman 59, The armor of the Elector Otto Heinrich, Count Palatine of the Rhine, attributed to Koloman Helmschmied, c. 1520.

In the 14th and early 15th century plate armor evolved primarily as a military technology. Toward the end of the 15th century specialized plate armors were beginning to be designed as costumes for parades and celebrations and as sports equipment for the joust, as well as continuing to evolve militarily. After devastation from the black plague had ravished the countryside, Europeans tried to start their lives over again. The serfs and working class suffered the most from the plague, forced to live in close proximity to the dead and dying, which allowed the black plague to claim millions of lives. When the population surged after the black plague ended, Europeans found a shortage of bankers, merchants and trades-people. The skills that were once common had become rare and extremely desirable. Merchants and tradesmen, for the first time, were able to choose their prices without worry of their fellow lower classmen working for less. The surge in income allowed them to work less and focus more on luxuries of life, such as art and a better education. Consequently, a new, and larger, middle class was formed. The middle class, like the nobles of the feudal system, wanted to convey their wealth and newly afforded education. During the middle ages plate armor was a popular way to flaunt ones wealth. Increased demand for plate armor caused hundreds of armorers to gather together in cities to learn from one another and compare their skills. After 1500 demand for etchers

increased sufficiently for hundreds of them to join the cities of armorers. Cities like Nuremberg, Augsburg and Milan became hubs of armor production and design. (Ashdown, 354-355) Cooperation and competition drove the skills of armorers and etchers to new levels. Plate armor, more than ever, was a representation of the owner's wealth and power and was worn with great pride. Kings, wealthy noblemen and the forming middle class sought after the most renowned teams of armorers and etchers to forge their beautiful, custom armors.

Figure 2: Edge and Paddock 171, Italian parade sallet of steel, encased in gilt to resemble the head of a lion, 1460.

Armors worn in parades or given as ceremonial presents were decorated through several techniques. The most common were embossing, etching, fluting, pointillé and

Figure 3: Blackmore 26, Helmet and crest from the effigy in the Beauchamp Chapel, St. Mary's Church Warwick.

engraving. (Norman, 63) Initially the main form of decoration was fluting. In general, Italian armors have smooth surfaces and German armors were decorated with numerous flutes, as seen in the Koloman Helmschmied armor, c. 1520, displayed in figure 1. However, Italians from a heavily German influenced city called Venetia fluted as well. Fluted armors went out of style early in the armor decoration era, going out of style in Italy c. 1520 and going out of style in Germany c. 1530. (Norman 62)

As armor decoration evolve beyond fluting, themes began to develop. One of the earliest themes to develop was to imitate animals.

Figure 4: Edge and Paddock 138, Maximilian I presented a grotesque parade armor to Henry VIII in 1514, only this helmet survived.

Throughout the age of man societies have revered animals as symbols of power and personality traits. In ancient Egypt gods were half animal, half human. In Christianity the snake convinces Adam and Eve to eat the apple from the tree of knowledge. The Chinese zodiac associates animals with human personality traits. During the plate armor era helmets were made to imitate the head of animals as does the parade sallet embossed to look like the head of a lion in Figure 2. Figure 3 is a frog-mouthed helmet made to imitate a goose coming out of the wearer's head. Armors also used animals in decorations, however most animal bodies are very different from human bodies, therefore animals were etched or embossed onto breastplates, couters or pauldrons, as seen in figure 10.

Animals represented a lot for the late 15th century and 16th century armorer, but human face and expression never lost its meaning and power for many armorers drawn to the grotesque look. Grotesque armors and helmets consist of interweaving human and animal forms with foliage and flowers. The interweaving of human and animal traits can be seen in Henry VIII's helmet in figure 4. Helmets were often embossed to represent the face of a man with an aquiline nose and a long moustache. (Norman 63) The helmet in figure 4 crosses

Figure 5: Laking 105, Burgonet decorated with a grotesque mask, acanthus leaves, scrolls, and conventional flowers.

71

animal horns with a seemingly insane expression on a man's face generating a demonic image in the eyes of the observer.

Figure 6: Laking 108, Burgonet of a grotesque mask of a man's face with acanthus-leaf ornament from bow strings over head.

Another grotesque helmet is the burgonet in figure 5. It is decorated with plant motifs, which is a third theme that developed in during the evolution of armor decoration. The extensive use of flowers and foliage in armor decorations reflects the development of the middle class. As the middle class grew and their economic status improved they had more leisure time to spend on education and entertainment. The middle class's new found fondness for art created an appreciation for nature, which can be seen on plate armor in the form of plant motifs. The burgonet is made of embossed steel, the surface is russeted and partly gilt, the skull is highly ridged, and decorated with a grotesque mask, acanthus leaves, scrolls, and flowers. The left hinged ear-piece with the mask is a rough restoration, varying in design and of inferior workmenship to the right and without guilding. The helmet has crest-holes in the ridge, one on either side, and two pairs of twin-holes at the back for a plume-holder. At the base a row of rivets for attachments of lining, and two rivets on the band, with a rope edge, has been applied. (Laking-105)

The burgonet displayed in figure 6 combines the use of facial and plant motifs. The helmet is made of embossed steel entirely wrought in one piece and the surface is russeted. The skull is vigorously embossed with a grotesque mask of a man's face showing a moustache, a strongly hooked nose, and small receding eyes beneath heavy

eyebrows. From the brow strings an acanthus-leaf ornament, in some places embossed to a depth of two and a quarter inches, which continues to the back of the skull and forms the comb. The ears are forged in grotesque leaf-form, with cornucopias at the back

Figure 7: Laking 482, 483, embossed half-armor, probably made by Lucio Piccinino, c. 1570.

supported by acanthus leaves. In the front is a movable plate embossed in the form of teeth and at the back is a neck guard turned outwards in a leaf pattern. There are two holes in the comb for a crest and the neck-guard is pierced with a large hole as well. A brass shield-shaped plume-holder is applied at the back; the border is decorated with brass rosette-headed rivets (or rivets over wasers) for the attachment of the lining. (Laking 108)

An example of an embossed half-armor can be seen in figure 7. The entire surface of this elaborate piece of craftsmanship is treated with radiating bands containing symbolical and classical figures, masks and festoons of fruit. On the intervening spaces are strap work and arabesques damascened in silver and gold on a blackened background. The figures have a great variety of design and the modeling is bold and carefully finished. The arabesques are unsurpassed for delicacy and skill in working-they remain in perfect condition after three hundred and fifty years of wear and tear. The interior surface of the half-armor has also been blackened. The suit bears no armorer's mark or signature, but is attributed to Lucio Piccinino, the son of Antonio Piccinino, the Milanese sword-smith, because of its resemblance to work commonly attributed to him. (Laking 482-3)
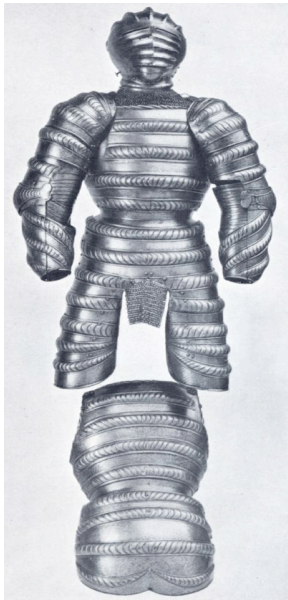
Figure 8: Laking 379, 380, 381, German puffed and slashed armor, c. 1520, with a German closed helmet, c. 1530.

Another major theme that evolved in the 16th century was to puff and slash suits of armor, forging armors to resemble clothing. In figure 8 the three-quarter puffed and slashed armor is decorated with broad horizontal hands embossed, which represent the puffed and slashed costume in fashion. The pullings-out were portions of the lining drawn through the slash. The puffs are etched with invected borders and the slashings are decorated with leaves or cross-hatching and gilt. (Laking 379-381)

The armor in figure 8 was forged when etching with a hatched ground was most popular, c. 1520-1530. The process for etching was to first cover metal in a protective coat through which designs were scratched with a fine point, then acid was added to make the scratches permanent. Hatched backgrounds went out of style in Germany in the 1520s, but stayed popular until the third quarter of the 1500s in England and much longer in Italy and France. (Norman 63) In figure 8 are alternating puffed bands with plain surfaces decorated with mermaids, masks, and conventional leaves and flowers. It is suggested by Meyrick that the latter were designed to imitate the pattern of the damask cloths of the period. The armor has been roughly connected together with modern brass round-headed rivets. The closed helmet has a low skull deeply embossed with five combs decorated with slashing. The alternating flat surfaces are etched with conventional flowers and scrolls. There are twin holes at the back and a single hole at the base, for the crest, with four countersunk holes on either side—possibly for hearing purposes. The visor and bevor were wrought in one

Figure 9: Blair, 1982, 208, targe and burgonet belonging to Prince Alessandro Farnese of Parma, Made in Italy c. 1563-5.

piece, of bellows form, with two narrow apertures for the sight and sixteen slits of double keyhole form, for ventilation. On the right side is a spring-catch for fastening, and the left lower edge is doubly notched, presumably for the purpose of engaging. When raised, the visor fork, which is a hole for pivoting located in the chin-piece below is hinged on the left side and wrought in the skull, is slashed and hollowed to fit over the gorget. The borders are decorated with conventional flowers, strap work, and round-headed rivets for the lining straps. (Laking 379-81)

The final major theme can be seen throughout the age of armor and is known as alla anticha or Roman esque in style. Alla anticha can be seen across Europe because during the renaissance the European societies revered great civilization. The Roman Empire had at one point stretched from Africa, across Europe and into Asia and was one of the first civilizations to see the virtue in education and science, like the renaissance. There are few armors and helmets that are exclusively alla anticha, but there are many armors and helmets, which an armorer decided to use a classic look as can be seen in figure 5 or 9. The helmets in figure 5 and 9 are burgonets of ancient Roman form and the shield in figure 9 is of Roman form.

Figure 10: Norman 73, cuirass in the antique style made by Bartolommeo Campi of Pesaro, c. 1540, probably for Guidibaldo II of Urbino.

In reality the fact that a small shield was forged with the helmet in figure 9 proves that armorer wanted a classical look because shields were not used during the plate armor era. Figure 10 is a cuirass alla anticha, made to resemble classical Roman leather armor. The effects of Roman influences and the middle class's new found appreciation natural entities shifted the focus of armorers from technical utility to out-of-the-ordinary technical curiousity.

Figure 11: Blair, 1982, 209, Half armor from a small garniture belonging to Duke Alessandro Farnese of Parma, made by Lucio Piccinino, Milan c. 1578-79.

Many armors made in the 16th century were not built for battle or tournaments, but for aesthetic pleasure. Therefore, armors as in figure 11 were not practical for battle of any kind. There are two reasons for the armor's impractical nature. First, embossing, puffing and slashing, etching and engraving all weakened armor and made it more cumbrous. Second, if someone had a highly decorated armor, like the armor figure 11, they would not risk having a weapon destroy the expensive and time consuming decorations. Many armors that were heavily decorated would have interchangeable parts; one for show and one for battle or tournaments. In closing, armor decoration was driven by growth of the middle class's desire to flaunt their new found wealth and to express their developing appreciation for art and nature to the rest of the world. The increased demand gave armorers enough to do that they could work together in large numbers and hone their skills in armor making to their maximum.

Evolution of Armor

The political and economical performance of 14th century Europe was the culmination of several major events from the previous millennium. First, the decline of the Roman Empire left Europe with no centralized government, forcing all of Europe to detach from one another to govern and defend alone. Second, most of Europe shared the unifying dogma of the Roman Catholic Church. Catholicism was the only remaining vestige of the Roman Empire. The church's centralized administration, comprised of its intricate network of bishops, was the foundation that enabled the church to endure the Middle Ages. Third, the Migration Period brought a new political and social infrastructure based on powerful regional noble families. Consequently new kingdoms were established: the Ostrogoths in Italy, Visigoths in Spain and Portugal, Franks and Burgundians in Gaul and western Germany, and the Saxons in England. (en.wikipedia.org/wiki/Middle_Ages) The interaction between the cultures of the new kingdoms, the culture of old Rome, and the Christian influences brought forth a new form of society.

The feudal system was a hierarchal class-based government, which formed in the vacuum of centralized government after the decline of the Roman Empire. The aristocrats held all the power, but only comprised one percent of the population. Lack of a centralized government coupled with a need to defend against barbarians and civil strife prompted kings to divide their land among feudal lords, who in turn offered fiefs to knights for military service. A fief is a fee for military service, often a piece of land. Once the knight agrees he becomes a vassal, who is part of the aristocracy. A knight can then rent out his land to commoners in exchange for labor.

The High Middle Ages, 1000-1400, brought the end of the barbarian attacks, which increased political organization, and a population boom, which urbanized Europe and brought many different forms of intellectual, spiritual and artistic works to life. (en.wikipedia.org/wiki/High_Middle_Ages) A major area of development during this time was in military matters. By the end of the High Middle Ages the plate armor era had begun. As armor and weapons progressed technologically they became more expensive. Increased cost combined with generations of aristocrats passing on knighthood to their next of kin created a larger economic class separation. Knights were trained from childhood and cost a lot to equip, maintain and train, but their military dominance in the battlefield could not be denied.

At the beginning of the plate armor era, c.1350, most battles were fought in small groups of knights or defending castles: often a knight would never see battles on the scale of hundreds. Before the High Middle Ages large groups of knights were hard to gather because a vassal would own hundreds of acres and only produce one or two knights. To remedy this problem kings and lords would build forts and castles to house, train and equip knights. Castles would also act as homes for the kings or lords and as a base of action. Since outside attack from beyond Europe was minimal during this period many battles took place at forts and castles. Trebuchets and battering-rams were used to break walls and then knights would attack. The main form of defense on many castle walls was the use of crossbows because of their power and distance. If the battle was on the scale of hundreds of solders it would be fought in open fields. The development of the crossbow and the longbow created a serious threat to the charge attack. Plate armor was developed to counter these threats.

In the beginning of the plate armor era, armor was simple and would cover the torso, hands, head and feet. Covering the most vulnerable parts of the body helped to resist range weapons, but they were cumbrous when fighting hand-to-hand. As the decades progressed the armors began to gather at the castles and garrisons to sell their armors to the aristocracy. Guilds of armorers formed and their skills progressed to heights of near perfection.

During the final years of the High Middle Ages, c. 1350, plate armor development was halted before it had to really develop, when the Black Death decimated the population of Europe, killing nearly a third of the population. The primary culprits in transmitting the disease were the oriental rats' fleas carried on the back of the black rats. Major European cities were devastated by the Black Death creating widespread hysteria, which caused Europeans to flee to the countryside to avoid death. People turned to the church for answers. The clergy promised cures, treatment and an explanation, but did not produce what they promised. They said it was God's will, but the reason for the punishment was unknown. The church lost prestige, spiritual authority, and leadership over the people. The clergy abandoned their Christian duties and fled. After the plague, angry and frustrated villagers started to revolt against the church because of their broken promises. The new realization that the church did not really understand God's will caused Europeans to seek out their own answers.

After seeing so much death the poor class looked to better understand life. Commoners left their land and did not plant their crops. The unattended crops and stray animals died in consequence. Other professions were abandoned by the lower class creating a lack of sufficient law enforcement, which promoted lawlessness. People called "Bechini", dressed in red robes with red masks and only their eyes showing, pillaged

homes, murdered and raped people. The high rate of death and abandonment in the lower class cause the economy to change. One of the biggest problems was the loss of valuable artisan skill. Therefore, those who had the skills became even more valuable, allowing them to demand higher wages. The economic growth allowed commoners to participate in commerce on a higher level than ever before.

Over the early fifteenth century armor went from covering vulnerable parts of the body to being full suits of armor. As the Renaissance began many areas in Europe, starting in Florence, Italy, began to develop greater appreciation for nature, art and science. The increased appreciation for the arts can be seen on the armors that have incredible attention to detail and on many early parade armors. Later on, during the sixteenth century, many embossed parade armors have acanthus leaves, scrolls, and/or conventional flowers. However, the effects of this growing appreciation of one's surroundings affected more than just armor decoration: it affected trade, political power and economical growth.

Starting with the first full harnesses made in Germany a new product for trade emerged. Harnesses are very difficult to make and even harder to make well. The economical advantage to being a renowned armorer is of great importance, which is the reason guilds were so selective with their apprentices. The great expense of a full harness made it an aesthetic and status object instead of just being a military weapon. Most of the armors that survived to present day originated from Germany. From the Wallace collection, thirteen out of sixteen cap-a-pie suits are German, all eight armors forged in 1460 to 1560 are German, all the three-quarter suits are German, and eight out of nine half suits are German. (Ashdown, 350) Since Italy and Germany were the center of

almost all armor development, we will focus will be on their naturalistic, artistic and scientific development.

In the fifteenth century two main forms of harnesses developed: the German Gothic armor and the Italian rounded armor. This century was focused mainly on the finding the best design for armor. Armor was so coveted, however, merchants would trade their spoils of war, mostly armors from fallen soldiers, across Europe. (Ashdown, 352) In combination with merchants trading armor, newly opened trade routes from the voyages of Marco Polo, Columbus, Magellan, Vespucci and many others brought new wonders to Europe from all around the world. (Kenseth, 28) Seeing all these wonders from different parts of the world caused the people of Europe to reflect on their own beliefs and sciences and began to study nature as machine. (Kenseth, 29)

Italy and Germany led Europe in its quest to acquire wonders. In the 16th century courts were the center of the intellectual community because the courts were not constraining like universities. However, the court's interest and personally based system of patronage influenced universities' curricula and projects of scientific organizations. The courts gained all their power because during the beginning of the renaissance many princes of Northern Europe supported projects that emphasized technical expertise or encouraged an empirical approach to nature. (Moran, 169) German princes were often collectors who gathered natural objects, curious objects and scientific instruments. (Moran, 170) By the early 16th century princes changed focus from nature to practical mathematics and mechanical arts, which increased their desire for works of art such as plate armor. The scientific developments of the courts of Northern Europe further increased the trade across Europe, which had developed to a point where almost all armor

from Europe was of the same form, a combination of the German Gothic armor and the Italian round armor. (Ashdown, 355)

Many European armors were composites of different restored armors resulting in each armor style to lose its uniqueness, and since Europeans were acknowledging nature, the age of mannerism began. In the armoring world this period was known as the decoration period. Mannerism focuses on out-of-the-ordinary technical curiosity rather than technical utility. (Moran, 172) This desire for beauty over utility can be seen in the vast amount of parade armors made in the age of decoration. The decoration of armor weakens and thins it, creating a weaker suit, which could not be used in battle. The aesthetically pleasing suits of armors would become part of a wunderkammer, cabinet of curiosity, which is an organized collection of items where diversity and anomalies of nature is emphasized. The result of these collections was a group of empirically gathered references cataloguing discontinuities within an assumed natural order. (Moran, 173) Many rulers had various reasons for creating a cabinet of curiosity: some collected for show, some to display their political power, some to keep a historical representation of the past, and others for future scientific advance. Regardless of their reasons, the desire to collect helped preserve the survival of harnesses to present day and allowed harnesses to remain more popular than their utility would have allowed. During the age of plate, armor followed the path of human development.

Research on Evolution of Pieces of Armor:
By Angela Leo

Helms

Open Faced Helms

Circa 1350 – 1650

Open faced helms were the first helmets on record and remained widely popular throughout the evolution of armor. Since the helmet was open, it did not obstruct the wearer's vision, mobility, or breathing. Furthermore, the open faced helms had a low production cost and could be made with ease. The main attraction of the helms was protection of the head with an increased field of vision. Below is a summary of the main open faced helmets used with emphasis placed on style and structure.

Barbut (aka. Barbute, Barbuta) (1430-1520)

Barbut, Milan, 1450, WCL (75)
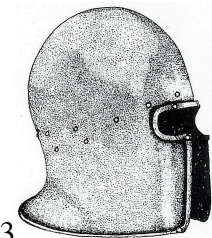
Barbut Milan, 1470, Blair, 73

Milanese Barbuta, 1445, Edge and Paddock, 107

Italian Barbuta, 1445, Edge and Paddock, 107

<u>Historical Orientation</u>: The barbuta, similar in style to the sallet or the bascinet, was mainly produced in Italy and then exported. Although the barbuta allowed for increased visibility, it left a portion of the face vulnerable. Moreover, since it was not attached to the chest armor, the barbuta was easily knocked off during battle.

<u>Structure</u>: The one-piece helmet had a rounded skull with a keel-shaped comb. In order to allow for rotational mobility, the helmet was not usually attached to the chest armor. It was fitted to the nape of the neck with an everted edge at the rear and almost reached to the shoulders at the back and sides. Often, the facial opening was T-shaped, but sometimes it was just a large opening in the front that left the face uncovered. A series of small holes was sometimes punched in the helm to which a helmet lining was attached.

<u>Style</u>: The helmet was often worn by knights and accompanied by a coif and breastplate. Since the barbuta already covered the face, it was rarely supplemented with a visor like other open faced helms.

<u>Sources</u>:
        Blair, 1972, pg 85
        Blair, 1982, pg. 73
        Edge and Paddock, pg. 106-107
        Stone, pg. 93

Bascinets (1220-1460)
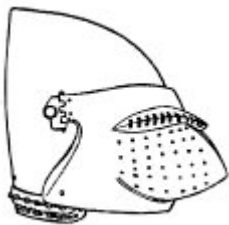
Hounskull Bascinet, Milan, 1400, Churburg (16)
(Blair, 1972, pg. 194)

North Italian Basinet, 1390, Edge and Paddock, 70

Historical Orientation: The bascinet was the most popular of the lighter helmets. Since the bascinet did not go down far in the back, the neck was left exposed. Thus, after 1330, an aventail was fitted to the helm to protect the back of the neck. By the late 1300s, the visor typically worn with the bascinet developed a conical snout that projected outwards in order to deflect a hitting lance. The basinets containing the visor were called "dog-faced" for the profound snout.

Structure: The bascinet consisted of a hemispherical skull usually constructed out of one piece and was often accompanied by a visor.

Style: It was typically worn with a visor that pivoted at the temples so that it could be raised or swung out. It was sometimes pierced with small holes for ventilation and had horizonal slits or a series of vertical piercings for vision.

Sources:
Blair, 1972, pg. 68
Blair, 1982, pg. 76-77
Edge and Paddock, pg. 70, 72-73
Stone, pg. 102-105

Burgonet (early 16th century – 1675)

Burgonet and buffe of Sir Henry Lee, Greenwich England, 1585 (Blair, pg. 204)

Burgonet, Nuremberg Germany, 1575, HAM 603

Historical Orientation: The burgonet was a light helmet worn by the infantry and light cavalry throughout its era. It was very similar to a sallet but its origin is very obsure.

Structure: The burgonet is an open helmet with a brim projecting out over the eyes. Sometimes ear flaps were hinged to the sides of the skull and an upstanding comb ran down the center. The burgonet was rarely accompanied by a visor, but might have the falling buffe, so named because it could be lowered when not in use.

Style: Because of its classical look, the burgonet was sometimes elaborately decorated and used in many parades of the time.

Parade Burgonet, Milanese,
1500s, Stone, 157

Sources:
    Blair, 1972, pg. 136
    Blair, 1982, pg. 107
    Stone, pg. 156, 157

Cabasset and Morion (1500-1600)

Comb Morion, Northern Italy, late
16th century, WCL (705)
(Blair, 1972, pg.198)

German Morion, Late 16th
Century, Stone 455
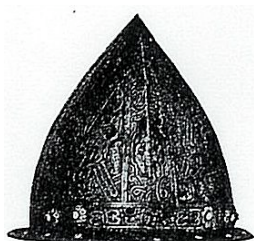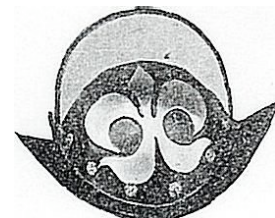
Italian Cabasset, 1585,

Stone, 159

Historical Orientation: The cabasset and the morion were very similar in structure and style. The helmets were very common among archers, musketeers and infantry as they did not impede aim. The downside of these helmets is the limited protection they provided.

Structure: The morion's skull was commonly made from two plates joined by riveting and hammering, but better made morions were constructed out of one piece. The skull had a high comb and a brim with high peaks front and back, and turned down at the sides. The cabasset, although similar to the morion, had a flatter brim and a less emphasized fin. The smaller fin of the cabasset resembled a stem, so the helmet was named "cabasset," which means pear in Italian.

Style: The helmet was usually worn alone. Towards the end of the 1500s, the morion was sometimes highly decorative for ceremonial use.

Sources:
    Blair, 1972, pg. 110
    Blair, 1982, pg. 346
    Edge and Paddock, pg. 140
    Stone, pgs. 157-159, 455, 457

Kettle Hat (1180-1480)

khanda - 296

Kettle Hat, traditionally that of Ulrich Zwingli, South Germany, early 16th century, SLM (KZ5633) (Blair, 1972, pg.198)

Kettle Hat, Germany, 1440, Blair, 296

Kettle hat, Germany, c. 1440. Museo Civico L. Marzoli, Brescia.
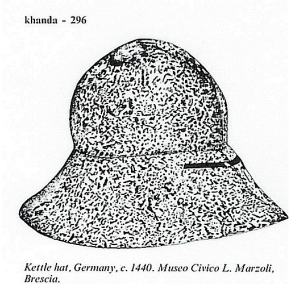
Historical Orientation: The kettle hat was not only popular with soldiers, but was also worn by the upper class and nobility. It was relatively cheap and easy to produce, and

provided all-round vision. In order to protect from falling objects coming from city walls, the skull was made of one piece, thickened, and had a low comb added to it. Eventually, however, the kettle hat evolved into the morion and the cabasset, which were very similar in construction.

Structure: The skull had a bowl shape and a broad brim was usually riveted to it. The skull itself was segmented with the segments connected by a plate bent to conform to the head. The segments were then riveted to the plate. Sometimes a leather strap was attached and placed around the chin to hold the helmet in place. After around 1320, the conical skull was made up of one piece and was slightly taller in the center.

Style: When worn by upper class people and nobility, the helmet was accompanied by a coif. On the other hand, most soldiers wore the helmet plain. The broad brim provided coverage from archers and falling objects, yet still allowed for movement and good vision.

Sources:
   Blair, 1972, pg. 32
   Blair, 1982, pg.295-296
   Edge and Paddock, pg. 73
   Stone, pg. 350

Sallet (1430-1520)

Italian Sallet with a deep skull and bellows visor, 1500, Edge and Paddock 108
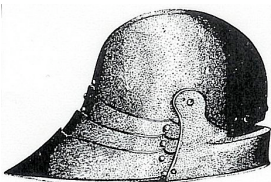
Sallet with pivoted visor and a laminated tail, Vienna, 1490, Blair, 1982, 413

Historical Orientation: The sallet, primarily used by soldiers, had two different versions depending on geography. The Italian version was very similar to the barbuta, whereas the German version of this helm usually covered the entire face with a mobile visor and had a long tail that sloped downwards at the back.

Structure: The Italian version is a "single piece almost to the shoulders at the back and sides. The skull is rounded usually with a keel-shaped comb and curves into the shape at the nape of the neck, then out to form a small tail. The face opening is an open arch narrowing slightly toward the bottom." (Blair, 1972, 85) The German version of this helm usually covered the entire face with a mobile visor. It was generally larger and deeper than the Italian version. It also had a long tail that sloped downwards at the back.

Style: Because the helmet did not provide a lot of facial covering, it was often worn with a visor, but not typically accompanied by a coif.

Sources:
   Blair, 1972, pg. 85
   Blair, 1982, pg. 413
   Edge and Paddock, pg. 99-100, 108
   Stone, pg. 536

Zischaegge (late 16th – 17th century)
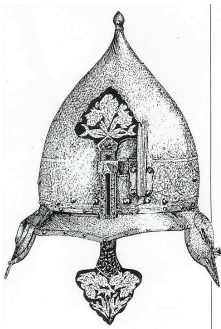
Zischaegge, Turkey, 17th Century, Blair, 424

Zischaegge, Austrian, 17th Century, HAM 190

Historical Orientation: The Zischaegge has Turkic origin but was commonly seen as far away as Central Europe. It was also known as a "shishak."

Structure: The skull was either spherical or pointed with a fixed peak. There was also a segmented tail to provide protection for the back of the neck. Earlaps were attached to the skull in addition to a nasal bar to shield the face (as shown in the above picture).

Style: Although the Zischaegge was worn in Turkey and surrounding areas, it was also common in Europe, influencing European armor. The nasal bar used to shield the face was later adapted into some styles of the burgonet.

Sources:
    Blair, 1972, pg. 137
    Blair, 1982, pg. 424, 531

Closed Helms

During the 16th century, a different kind of helm appeared in order to satisfy different needs in armor. The closed helms were not meant as a replacement for the open helms, but rather a partner. Obviously a fully armored knight would be highly vulnerable if he rode into battle with a kettle hat. Although the closed helm restricted movement and decreased visibility, the extra protection and covering it provided was a worthy exchange.

Armet (15th century – 1510)

Italian Armet, Milanese,
1500, Edge and Paddock, 105
←Visor Closed
Visor Open →
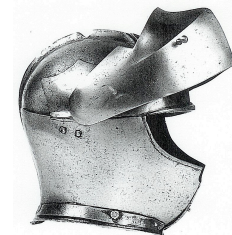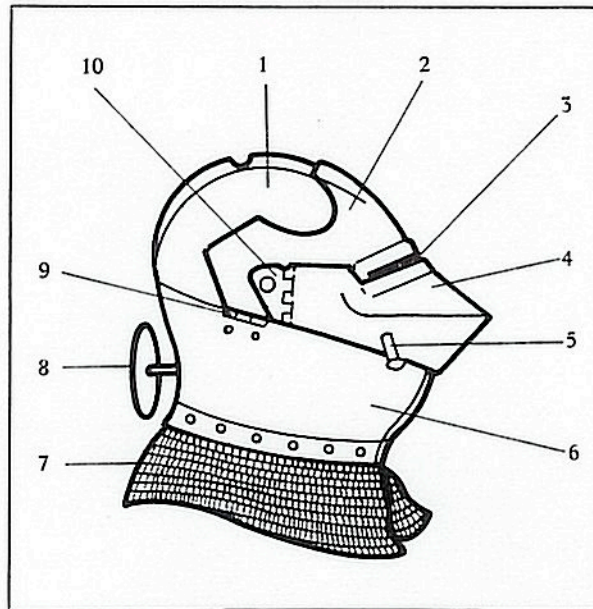
Armet: *1. skull; 2. brow reinforce; 3. sight; 4. visor;*
5. Lifting peg; 6. cheek piece; 7. mail fringe; 8. rondel;
9. cheek piece hinge; 10. visor hinge and pivot. From the
Glossarium Armorum.

Historical Orientation: The armet was a closed helm that provided immense protection

for the face but limited vision. The early Italian version had cheek pieces hinged by the

upper edge. However, around 1505, a German version surfaced that had cheek pieces

hinged at the back. After the appearance of the bevor armet in the early 1500s, the armet

evolved into the closed helm of the 1500s.

Structure: The armet was a closed helm with a "one-piece hemispherical skull… and a

narrow tail of steel shaped to the head extending as far as the nape of the neck." (Edge

and Paddock, 105) The helm was accompanied by a pivoting sparrow beak visor that

covered the face opening. A disk or roundel can be seen in the above picture on the back

of the skull. This was intended to protect the joint so that the weight of the helmet was

supported by the shoulders instead of the head.

Style: The armet, since it provided greater protection, was worn with full suits of armor.

Typically, a gorget around the neck was used to further move the weight to the shoulders.

Although the German style of the helm had more sharp edges, the basic structure of the
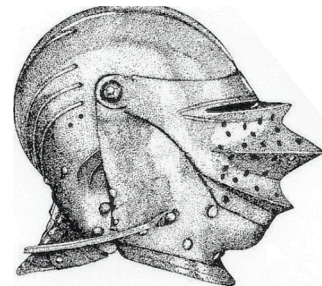
two helms was nearly the same.

Sources:
    Blair, 1972, pg. 133
    Blair, 1982, pg. 22
    Edge and Paddock, pg. 99, 105-106
    Glossarium Armorum, pg. 38
    Stone, pg. 17

Close Helm (1510 – post 1650)

Probably French, 1550,
HAM 208.1.a

Close Helmet, S. Germany,
1510, Blair, 1982, 257
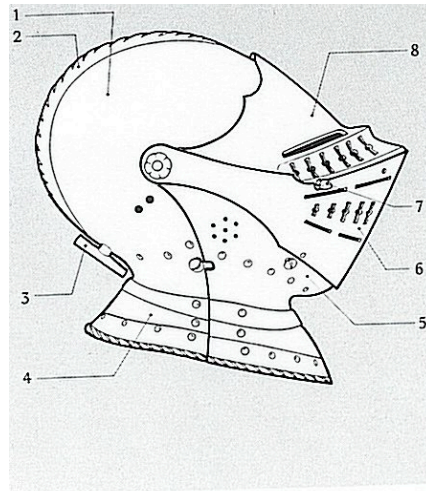
Blair 120

Close helmet. 1. skull; 2. comb; 3. plume holder; 4. gorget plates; 5. bevor; 6. upper bevor; 7. lifting peg; 8. visor.

Historical Orientation: The close helm was another type of closed helmet that appeared in the 1500s and was similar to the sallet in skull shape. After 1510, the armet and closed helm only differed by the cheek pieces versus the full facial covering. The face was covered by a visor that was attached to the skull. The sparrow's beak visor was commonly seen outside of Germany until about 1530. However, a new visor, divided into a visor proper and an upper bevor, was introduced in the late 1520s. There were ventilation slits that could be covered by an additional visor when extra protection was needed. The new visor was also less profound and flatter than the sparrow's beak.

Structure: The skull was more closely shaped to the head. A visor, along with a close fitting bevor that overlapped the skull on both sides, pivoted from the same point on each side of the helmet. The visor contained eye slits for vision.

Style: The Italian version of the closed helm used a sparrow's beak visor with a less concave lower portion than the German one. The German style also had interchangeable

visors in order to eliminate the need to own multiple helmets. The German helms were

constructed with interchangeable visors for different situations such as jousting, fighting

in the field, ceremonies, and so on. Italian-style closed helms were not as versatile.

Sources:
      Blair, 1972 pg. 134-135
      Blair, 1982 pg. 120, 136
      Edge and Paddock, pg. 141
      Glossarium Armorum, pg. 43
   Stone, pg. 257

Tournament Helms

Tournaments consisted of mock combats used as a "form of sport and also as a

means of practicing one's skill at arms." (Edge and Paddock, 154) Over time, the main

attraction of tournaments shifted from war preparation to a sport. Jousting became a

"vehicle for personal glory and profit" (Edge and Paddock, 154) From the late 1300s to

the 1600s, jousting was one of the most popular spectator sports and incorporated parade,

dance, and music as well. As the popularity of jousting rose, new armor was developed to

increase protection of the jousters. In fact, tournament armor was usually heavier and

reinforced more than that for war. Eventually, exchange pieces were made to convert

field armor for the tournaments. The simplest of helms consisted of a normal armet with a

frog-mouthed visor. However, modifications to the basinet gave rise to the great basinet,

another popular jousting helm. The frog-mouthed jousting helm was designed

specifically for jousting needs and remained a common form of headpiece through the

1520s.

Great Bascinet (1350 – late 16th Century)

Great Bascinet found at Athens,
South German, 1435, M.M.
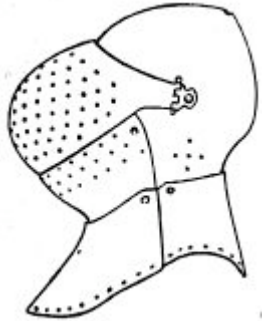
English Great Basinet, 1515,
Edge and Paddock, 173
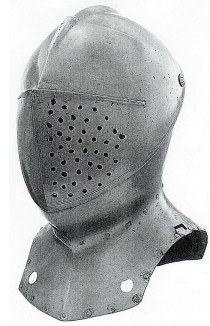
Historical Orientation: The great bascinet was primarily constructed in Italy for export. After its discontinuation in other countries, it was used in Germany until the 1420s when its purpose shifted to tournaments. Then, the great basinet was used mainly in foot combat.

Structure: Unlike the original bascinet, the skull of the great basinet fit more tightly to the head and often extended to the shoulders, or at the least below the cheeks. Originally strapped, and later screwed, to the breastplate, the helm shifted its weight from the head to the shoulders.

Style: Besides extending to the cheeks or even the shoulders, the great bascinet differed from the original since it had a more rounded visor that contoured to the face. When used for jousting, a single slit (sometimes with vertical bars) was placed in the visor to add extra sight and circular holes provided ventilation.

Sources:
    Blair, 1972, Pgs. 109,194
    Edge and Paddock, Pgs. 168-169, 173

**Frog-Mouthed Jousting Helm (Mid 15th century – Early 17th century)**
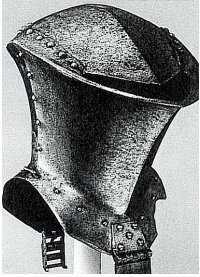
 South German, 1480, Edge and Paddock, 163

Historical Orientation: The frog-mouthed helm is "the earliest identifiable piece of armor apparently designed exclusively for the joust." (Blair, 157) Although it provided great protection during the joust, the frog-mouthed helm provided limited sight capabilities to the wearer. There was little variation in this helm until around 1520. There were several versions that surfaced around this time. One version, the "swung," had a pronounced forward curve. (Below, left) The shorter, squatter "pillbox" form originated in Italy. (Below, right) A cross between the two was used in Flanders, France, and England.

 Strechhelm Jousting Helm by Lorenz Helmschmied of Ausburg, 1490, Philadelphia Museum (Blair, pg.196)

Jousting-helm, Milanese, 1490, Blair, 1972, 197
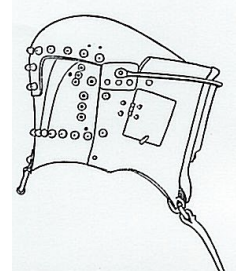
Structure: The helm was constructed in one of two forms; the first consisted of two halves fastened together by hasps and pins, whereas the second was a closed helm modified with a removable visor. Heavier than war helmets of the era, the helm had a low skull and curved upwards and outwards at the front in order to create a flattened point along the line of vision. The helm contained piercings that acted as ventilation holes, and

occasionally there was a door on the left side that could be opened for breathing while not

competing. Using hasps at the front and rear, the helm was fastened firmly to the cuirass.

Also, an inner hood (see picture below) provided comfort as well as extra protection.

Quilted arming cap for a German jousting helm, 1484, Edge and Paddock, 182

Style: The left side of the helm was eventually reinforced with an extra plate of steel.

Sources:
> Blackmore Pgs. 25-27
> Blair, 1972, Pgs. 73, 157-158, 195-197
> Edge and Paddock, Pgs. 154-158, 163, 182

Foot Combat Helm

Tourney Helm for Combat with Mace or Sword, possibly English (Edge and Paddock, pg.173)

Historical Orientation: The helm pictured was pumpkin shaped, however, there are many

others designed for the foot combat of tournaments. The faceguard provided maximum

vision yet still provided adequate protection for the wearer.

<u>Structure</u>: The large, globose helmet contained a multi-barred faceguard similar to a wire fence. The fence extends from the forehead to the chin and from ear to ear. The structure is designed for full protection of the head and shielding for the eyes. The helm was attached to the breastplate and the head swiveled freely inside.

<u>Style</u>: This type of helm was primarily used in jousts with maces, clubs, or swords. The multi-barred faceguard provided maximum vision since it eliminated the need for a visor.

<u>Sources</u>:
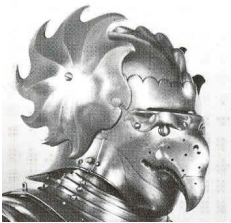Edge and Paddock, pg 173

Decorative Helms

Parade/Ceremonial Helm

Lion's Head cover on a Sallet, Venice, 1460
(Edge and Paddock, pg. 171)

Parade Armor built for Margrave Albrecht von Brandenburg, 1525
(Edge and Paddock, pg. 172)

<u>Historical Orientation</u>: Since purely ornate helms were not capable of being functional, removable decorative pieces were commonly used to modify helms. Thus, they were usually based on an existing helm.

Structure: Above is a sallet with a removable lion's head cover. It is believed that the lion's head used is reference to the myth of Hercules and the Nemean Lion. (Blackmore, 25)

Style: Because of the almost complete covering of the body with armor, a need for identifying features emerged. There is no specific style to a decorative helm. The only specific is that the decorations complete the purpose they were designed for. Some examples of decoration methods include engraving, attachment of additional pieces, and embossing. A helm produced by the latter method is pictured below. Generally anything that had been embossed had a compromised structural integrity and was therefore no longer useful for combat. The removable pieces allowed the helm to still provide protection.

Maxmilian parade armor,
Edge and Paddock, 138

Embossed Helmet, 1530,
Blackmore, 97

Sources:
    Blackmore, pg. 25, 97
   Edge and Paddock, pgs. 171-172

Torso Armor

__Breastplate:__

Plate protection for the torso began in the 1100s with the introduction of the coat of plates. Gradually, the coat of plates was replaced by more developed forms of plate armor, but its lighter version, the brigandine, remained in use until the beginning of the 1600s. Breastplates were originally made of two overlapping plates, but eventually consisted of only one plate. The plate was rounded, ridged, or squared. 1500 brought about a change in the amount of time and energy that was given to the style of armor. Up until 1450, the focus of armor manufacturing was on producing functional breastplates with little regard to style. However, in the second half of the 15th century, two quite different styles emerged out of Italy and Germany. The two contrasting styles fused together after 1500 and formed the Maximilian style. However, with the rise of firearms by 1600, the style became less sophisticated once again.

Coat of Plates (1100s-1400s)
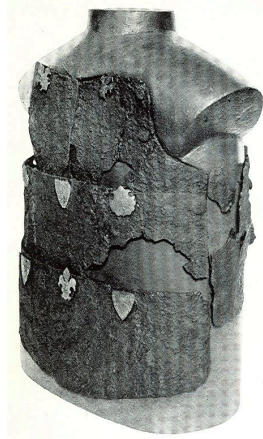
Coat of plates, 1361, Battle of Wisby, Blair, 1972, 50

Historical Orientation: The coat of plates was armor for the trunk that was introduced in the 1100s. Also called the "pair of plates," the coat of plates was gradually replaced by more developed forms of plate armor in the early 1400s, although its lighter version, the brigandine, remained in use until the beginning of the 1600s.
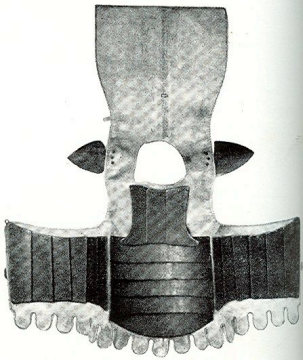
Modern reconstruction of a coat of plates, Blair, 1972, 50
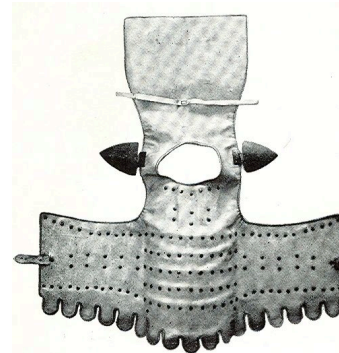
Structure: The basic form consisted of rectangular overlapping plates set vertically or horizontally and riveted to a strong fabric. Parts of the coat of plates were joined with laces or straps or buckles.

Style: The coat of plates came in many versions that had different plate orientations combined together. For example, short upper breastplates and side plates were placed vertically but the main part of the breast was protected by large horizontal plates that were concave to the body.

Sources:
      Blair, 1972, pg. 50
      Blair, 1982, pg. 136

Brigandine (1400s-1650)

Historical Orientation: Basically a light version of the coat of plates, the brigandine added protection for the breast and back and sometimes even the arms and legs.

Brigandine with arms, Spanish, 1500s, Stone, 150

It was initially used as light armor for men not expected to go into battle or traveling through dangerous territory and moreover, as a replacement for a cuirass for soldiers who could not afford a full suit of armor. In 1450, the brigandine was worn by all classes of soldiers; however, by the 16th century, it was mainly used by infantry and light cavalry. Initially the plates were 3 or 4 X 8 to 10 inches in size, but later were usually no larger than 1 X 2 inches in size.

Structure: The brigandine was made of plates of iron or steel that overlapped upwards and were riveted to a canvas or cloth garment sometimes covered with silk or velvet. The armor sometimes also consisted of legs and arms.

Style: There were two primary types:

Type 1: Opened down the front

Type 2: Included a small globular breastplate made in two L-shaped halves, used to protect the chest and lungs, joined by straps and buckles down the center. Sometimes a simple, but rough backplate was included. The backplate was shaped like an oblong with a truncated triangular extension at the bottom.

The plates were tinned to prevent rusting and ruining of the cloth. The outer fabric of the brigandine was typically expensive material for the wealthy and canvas or leather for the normal soldier. Bare rivets were sometimes made in a decorative fashion either in horizontal lines or groups of three or four. Modeled after civilian fashions of the time, the brigandine was quite fashionable in the 16th century.
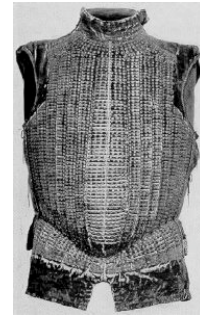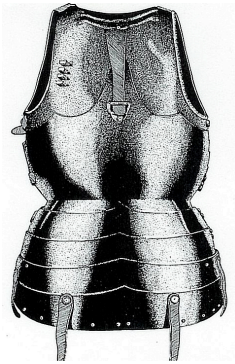

Brigandine, Italian, early 1500s, Stone, 150

Brigandine, Italian, 1580

Sources:
Blair, 1972, pg. 58-59
Blair, 1982, pg. 104-105
Edge and Paddock, pg. 77, 118, 120
Morrison, pg. 167
Stone, pg. 149-150

Two-plate Breastplates

Breastplate, with lower breastplate and skirt, Italy, 1450s, Blair, 103

Historical Orientation: Since, next to the head, the upper body is the most vital part of the body, much attention was given to the construction of armor for this region of the body.

Milanese Armor, 1450, Italy, Blackmore, pg.34

103

Structure: The breastplate was made of two overlapping steel plates that covered the front of the body from the neck to a little below the waist. The lower plate overlapped the upper plate and was connected by straps or sliding rivets
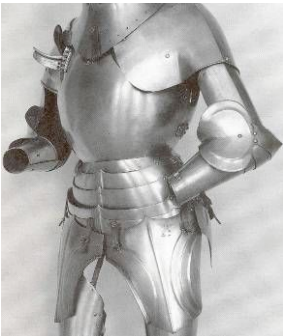

Gothic Armor, Germany, 1480, Blackmore, 44

One-plate Breastplates

The one-piece breastplates came in three different forms, rounded, ridged, or squared. The ridged breastplates eventually evolved into the popular peascod form.

Rounded one-piece Breastplates

Breastplate with fauld, 1450, Italy, Edge and Paddock, pg. 97

Historical Orientation: Italians favored using large pieces of plate armor to cover significant portions of the body all at once. As early as the 1500s, the northern reaches of Italy began borrowing aspects of German gothic style for their breastplates. Therefore,

from 1500-1520, the breastplate, usually flat and of a v-section, was fluted in a gothic style. Also, around 1500, German armor became more globular in form like the Italian style. All along, armor from Innsbruck had been partially Italian looking because of its close proximity to Italy. Eventually the traditional gothic towns like Augsburg swayed towards the rounder and less decoratively elaborate Italian style (Blair, 95-96).

Field armor of Kunz Schott von Hellingen, Germany, 1500, Blackmore, 31

Germany, 1510, Edge and Paddock, 142

From 1500-1530, there was a fusion of German and Italian styles termed the Maximilian style.

Maximilian style armor, Germany, 1530

Maximilian armor, 1520, Edge and Paddock, 142

Structure: The Italian breastplate was either globular or flattened and did not have many embossments. The German breastplate was slenderized and elongated with ripple-like fluting and lamination at the joints for increased mobility. The Maximilian breastplate was globular with moveable gussets and a narrow waist plate.

Style: The Italian breastplate was rounded and cut straight off at the waist. Its globular shape favored simple lines for decoration without many embossments or protrusions. The style of the Italian breastplate typically followed civilian dress of the period. Therefore, Italian armorers incorporated styles of armors from other countries, like Germany or Spain, in order to stay in fashion.

Maximilian armor, 1520, Blackmore, 53

The Maximilian breastplate had a high waistline and a low, straight neck edge. The fluting on the breastplate, skirt, and all other body armor was vertical and parallel like the German style while it maintained the rounded forms of the Italian style.

Ridged one-piece Breastplates

Armor of the Archduke Sigmund of Tyrol by Lorenze Helmschmied, Germany, 1480, Blair, 104

Historical Orientation: The Italian breastplate developed a ridged form that was popular through the 1500s and into the 1600s. Sometimes, around 1520, there were other ridges that ran outward from the medial ridge of the breastplate like ribs.

Breastplate, Northern Italy, 1560
Higgins Armory Museum
HAM 798
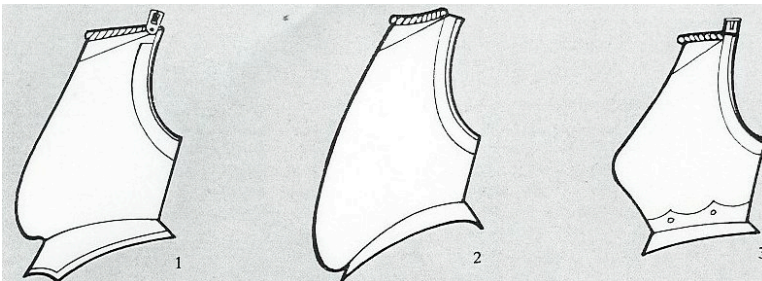
Blair, 1982, 103

Around 1530, the universal globular form developed a low medial ridge and an incipient projection in the center. During the 1540s, two other forms of breastplate developed. In the first, the ridge line became larger and the waistline became dipped in the center (1. in above picture). By the 1560s, the dip had become a more prominent point (3. in above picture). The second type was very similar to the Italian style. The breastplate became flatter and longer and a shallow curve formed from the neck to the waist. In the 1570s, the pointed breastplate turned into the peascod form that was the most widely used until the 1580s (2. in above picture, and pictures below).

Peascod breastplate for foot service, 1575-1600, Milan, Italy
Higgins Armory Museum, HAM 1136.a

Peascod Breastplate with articulated gussets & narrow basal flange without fauld, 1585-1590, Northern Italy
Higgins Armory Museum, HAM 2961.2

Suit of armor with peascod breastplate, Germany, 1590-1600, Blair, 141

It was necessary for the most vital parts of the body to be heavily fortified. Thus, once common fluting almost entirely disappeared, the breastplate was made thicker. Around 1600, the peascod breastplate gave way to a breastplate with a sharp medial ridge and flat surfaces along with a small flange both at the cusped waistline and at the neck. The Jacobean form of the breastplate lasted from 1600-1650.

Armor for a boy, Milan, Italy, 1610, Blair, 142

Breastplate with lance rest, 1500-1510, Italy
Higgins Armory Museum, HAM 803

Structure: The Italian breastplate was either globular or flattened, did not have a waist lame, and also had a slight ridge running along the midsection. The German breastplate was slenderized and elongated with ripple-like fluting and lamination at the joints for increased mobility. For some ridged breastplates, a v-shaped stop rib was riveted just below the neck and a lance rest was attached to the right side of the breastplate. The fauld, tassets, and backplate were all attached to the breastplate as well.

Breastplate with lance rest, Germany, 1490, Blackmore, 49

Engraved breastplate, made by an Italian craftsmen,
Edge and Paddock, 145

Style: The Italian breastplate was sometimes decorated with engravings and

embossments. The German breastplate was often stamped in many places with fleur-de-

lis and had lots of spikes which served both stylistic and functional purposes. There were

constructed to prevent arrow pieces and decorative fluting deflected a missile or weapon

attack from vital areas.

Armor of Kaspar von Montani, Germany, 1555,
Blackmore, 94
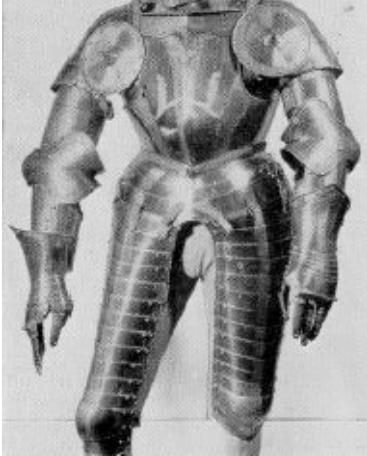
Light field armor of Heinrich von Rantzau, Germany,

1550-1560, Blair, 1972, 131

After 1600, there was not much effort placed upon gracefulness or beauty of breastplates

in general, only on extensive protection for the torso.

Cuirassier armor, South Germany, 1641, Blair, 151

Sources:

Ashdown, pg. 313
Blackmore, pg. 31, 34, 40, 44, 49, 53, 94
Blair, 1972, pg. 80, 91, 94-96, 117-120, 142, 147, 151
Blair, 1982, pg. 102-104
Edge and Paddock, pg. 97, 142, 145
Higgins Armory, Artifact Catalogue
Stone, pg. 143-145

Backplate

Italy and Germany: 1450-1600

<u>Historical Orientation:</u> The backplate was used in both Italy and Germany. The Italian style had a high neck flange between the shoulder straps and slightly rounded, slanting underarm gussets. The backplate tended to narrow at the waist and had a riveted waist lame or a raised lower edge of plate to prevent the waist belt from slipping.
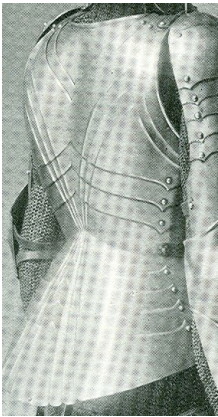
Backplate, Italian, 1470, Laking, Armor 340
Notice the narrowing at the waist
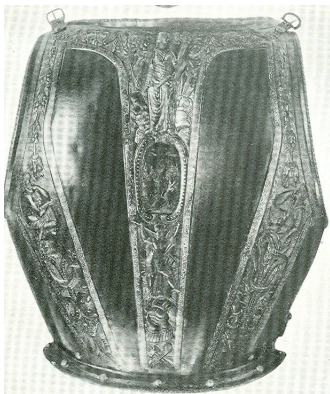
Backplate, Italian, 1560, Laking, Armor 340
Note the buckles at the top in order to attach to the breastplate and the raised lower edge

The German style had a low, straight neckline without shoulder prongs and the backplate was slightly globular in contour towards the waist. Around 1460, the backplate consisted of an upper plate and a plate to cover the join of the neck and shoulders, riveted to the inside of the upper plate. During the 1470s, the breastplate and plackart were riveted

together instead of attached by a strap and buckle (Blair, 91). In Innsbruck, from 1490-1510, the backplate was made of 3 pieces instead of one solid piece. It consisted of one central plate which was a lower half of truncated triangular shape with the other two pieces being hinged plates on either side.
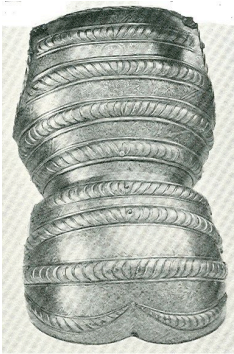
Backplate, German, 1520, Laking, Armor 379-380. The culet is riveted to the flanged plate at the base
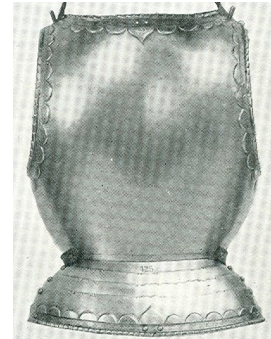
Backplate, German, 1540, Laking, Armor 425

Structure: The backplate was made of one piece of steel, however around 1460, it consisted of an upper and a lower plate that overlapped. Later, in Innsbruck, the backplate was made of a central plate and two hinged plates on either side. The neck flange was reinforced and overlapping rear lames of the skirt were added to protect the loins. The culet was sometimes riveted to the bottom edge of the backplate.

Style: The backplate sometimes had extensive decoration and engraving. These backplates were usually part of parade or ceremonial armor.

Backplate of an armor belonging to Duke Francesco I de' Medici, Italy, 1574, Blair, 71

Jacobian Period 1600-1650

Historical Orientation: The backplate during the Jacobian period was a mirrored

reflection of the breastplate.

Structure: The backplate was a shaped plate with a neck flange, and underarm gussets

were barely apparent. It was sometimes equipped with a hook from which the helmet was

hung when not in use.

Style: It was shorter with a narrow flange as opposed to a culet.

Sources:
 Blackmore, pg. 43
 Blair, 1972, pg. 91, 123
 Blair, 1982, pg. 71-72
 Edge and Paddock, pg. 101

Tassets (1400s-1650)

Historical Orientation: The tassets provided protection for the upper part of the thigh.

There was widespread use of tassets in Europe but mainly in Italy and Germany. One-

piece tassets were used in Germany till 1530 and in the Italian joust until 1575. In

Germany, from 1500-1510, one piece square tassets were commonly seen. After 1510,

laminated tassets appeared which were rectangular with rounded corners and shaped to

the thigh. The 1560s marked a time where the tassets became wider with a marked spring

at the waist to be worn with a large truck hose. In Italy, after 1550, short tassets became

wider at the bottom and were rounded over the fork.

Structure: The tassets consisted of either a single plate or a set of smaller horizontal plates held together by straps and rivets which increased flexibility. Initially hung from the fauld, the tassets became directly riveted to the breastplate as the fauld disappeared. After 1600 till 1650, the tassets extended down to the knees and joined there to the poleyns in infantry and cuirassier armor.
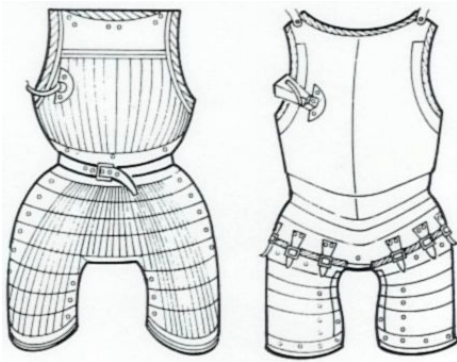
Laminated tassets riveted to skirt (left) and short tassets attached by straps and buckles (right). Blair, 482

Style: Some second-quality Italian armors made during 1550 to 1600 had one-piece tassets with lames simulated by embossing, which became widely used after 1600.

Maximillian style breastplate and tassets, 1523, Edge and Paddock, 145

Sources:
    Blair, 1972, pg. 123
    Blair, 1982, pg. 482-483
    Edge and Paddock, pg. 145

Stone, pg. 606

Rump-Guard (Hind-tasse) (1450-1500)

Rump-guard on backplate, 1490, Blair, 1972, 221

Historical Orientation: The rump-guard was a small defense for the rear. It started in 1450 but by 1500, it had become incorporated into the culet and ceased being its own entity. The rump-guard was worn in both foot and mounted combat.

Structure: The rump-guard was a simple long oblong plate that was hung across the lower edge of the culet. It was attached to the culet by rivets.

Style: It had only one style. It existed after 1500 as an additional lame on the bottom of the culet.

Sources:
    Blair, 1972, pg. 81, 221
   Blair, 1982, pg. 407

Culet (1450-1600)

Culet, Wallace Collection, Laking, Armor 379-380

Historical Orientation: The culet was typically used in foot and mounted combat to protect the buttocks. It was the accessory of choice by the cavalry if their saddle did not have a rump protector. Around 1460, in Germany, the culet was made up of three lames and sloped to form a tail like projection. After 1510, it had a straight or slightly curved edge. Later, during the Maximilian era, a deep, laminated culet was popular. The culet became increasingly shallow around 1540, and by 1560 was only made up of a single lame. As armor became heavier and in decline, the culet was disposed of for weight reasons.
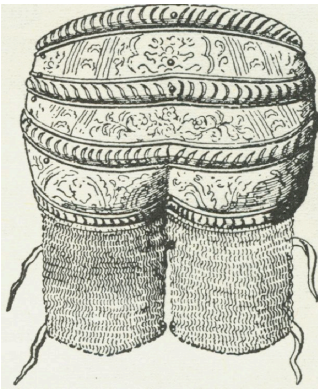
Atypical culet, 1520, Wallace Collection, Ashdown, 291

Structure: The culet was made of overlapping lames like the fauld and tassets. It was initially made up of three lames loosely riveted together and sloped to form a tail like projection. The culet eventually developed into a single shallow lame projecting from the lower edge of the backplate. The culet ran along the waist edge of the backplate and curved around the lower back of the wearer. It fastened at the sides with hinges on the left and buckles on the right,

Style: Since the culet was mainly used in battle by the cavalry, it was rarely seen with decoration.
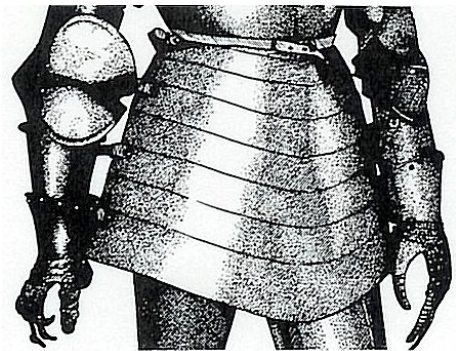
Sources:
 Blair, 1972, pg. 123

Edge and Paddock, pg. 101
Stone, pg. 198

Tonlet/Tonnlet (first half of 16th century)

Historical Orientation: The tonlet, from the French word tonnelet meaning "little barrel," was used mainly for fighting on foot in order to protect against blows from offensive weapons. It sometimes replaced leg armor when jousting in a tournament.

Tonlet for foot combat armor, 1500-1508, Italy, Blair, 485

Structure: The tonlet was either a solid, single plate that was elaborately fluted, or made of horizontal lames connected by sliding rivets. The tonlet enclosed the wearer's body from the waist to just about the knees and was hinged on one side and fastened with buckles and straps on the other like the culet.
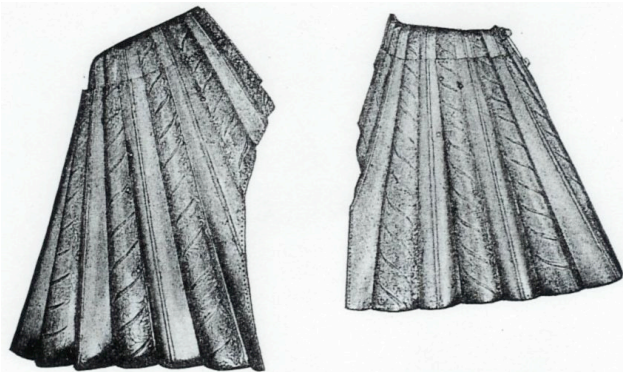
Tonlet, attributed to Henry VIII, early 1500s, Stone, 622

Style: The sliding rivets allowed the tonlet to be pulled up or down when needed. The tonlet became a requisite part of certain tournament armors in later years.

Parade armor for Emperor Charles V, Germany, 1512-1514, Blair, 122

Sources:
      Blair, 1972, pg. 122
      Blair, 1982, pg. 485
      Stone, pg. 622

Fauld (1400s-1600s)

Historical Orientation: The fauld was used in Italy and Germany, mainly. Over the period of its use, the number of lames decreased from about 5 to nonexistent.

Structure: A short skirt made of lames. It is attached to the breastplate and if present, the tassets were connected to the fauld.
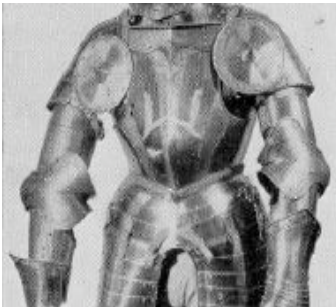
Breastplate and fauld, German, 1550-1560, Blair, 131

Sources:
      Blair, 1972, pg. 131
      Blair, 1982, pg. 180

Lance Rest (early 1300s-1600s)

Historical Orientation: The lance rest, often seen on jousting armors, had widespread use across Europe. In the beginning of its time, the lance rest did not support the lance but helped to distribute the blow over the whole breastplate. Later, it actually supported the lance and became much more elaborate.

Structure: The lance rest was a piece of steel attached to the right side of the breastplate. It was connected to the breastplate in two ways, either riveted to the breastplate or connected with studs. The lance rest was first lined with felt, but later wood or lead was used.
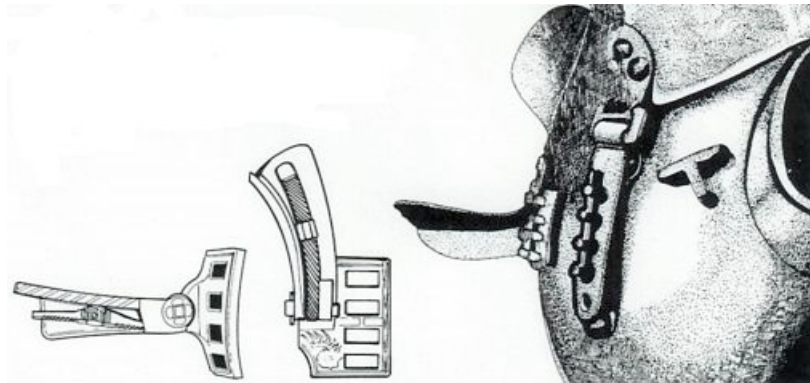
Detail of a rest in a jousting armor, Italy, 1560, Blair, 405. Side (left) and front (right) views.

Style: There were two forms of the lance rest, a simple hook and a reversed L.
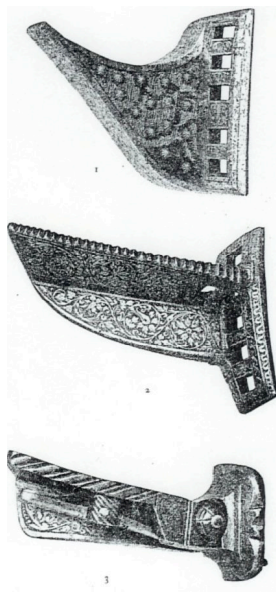
Lance rest, German, 1530 (top),
German, 1554 (middle),
German, 1560 (bottom), Stone, 410

Hook lance rest, Blackmore, 49

Sources:
    Blair, 1982, pg. 404-405
    Edge and Paddock, pg. 75
    Stone, pg. 410

Queue (1500s)

Historical Orientation: The queue was seen mainly in Germany and was very good for

jousting. The queue helped hold down the butt of the lance and thus served as a

supplement to the lance rest.
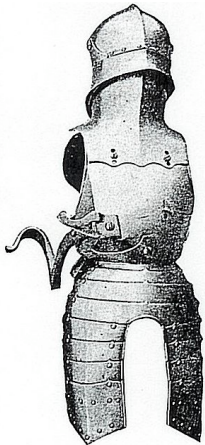
Queue attached to a jousting armor, German, 1500, Stone, 35

Structure: The queue was a long bracket of steel usually around a foot or more in length.

It projected from the backplate on the right side of the suit of armor.

Style: It was positioned symmetrically to the lance rest for maximum effectiveness.

Sources:
    Blair, 1982, pg. 398
    Stone, pg. 520

Plackart / Placart / Placard / Placate/ Plaquet

Historical Orientation: The plackart can refer to either the lower part of the Gothic

breastplate or the extra plate placed on top of the breastplate for extra protection in

tournaments. It became very common with the increased power of firearms.

Structure: The plackart, extending up from the waist, doubled the thickness of the breastplate when attached. It usually screwed and buckled to the breastplate; however, sometimes the plackart was riveted instead.

Sources:
  Blair, 1982, pg. 381
  Stone, pg. 510

Stop Rib

Historical Orientation: The stop rib, an accessory to the breastplate, prevented the point of the weapon from sliding into the joint or an opening.

Stop rib is riveted to top of breastplate, Germany, 1490, Blackmore, 49

Structure: It was a small v-shaped iron bar that was usually riveted to plate armor. The stop rib was either square or round in section and sometimes was hammered directly into the metal as a built in accessory instead.

Style: The stop rib was not only fitted on the breastplate but also below the pauldrons, vambraces, and cuisses sometimes.

Sources:

  Blair, 1982, pg. 453
  Edge and Paddock, pg. 76

Attachment Methods

There were four main ways of attaching different pieces of armor to the breastplate and backplate.

Indian breastplate with straps for attachment to backplate, 1600s, Stone, 145

The strap and buckle was most common for attaching loose pieces over time, while later on, rivets, hinges and key-hole slots and studs became widely popular. Leather straps with buckles were common for attaching accessories under the armor since they could be easily slashed. Hinges of brass were on the outside when necessary, but lateral steel hinges were used on the inside because they were likely to be damaged. The hinges were locked shut with spring pins and sometimes with a sneck for extra security.
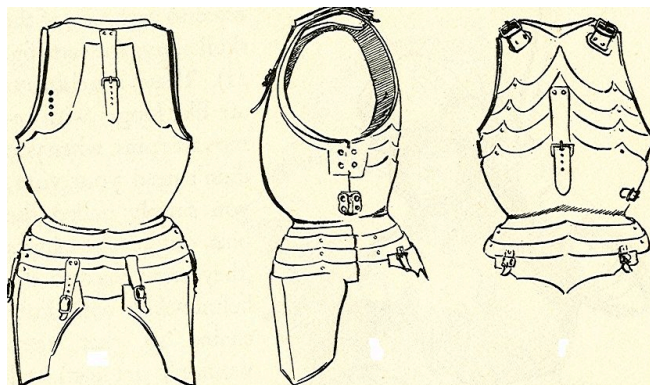
Cuirass, Milan, 1460, Oakeshott, 44

Front view shows straps used to connect parts of breastplate and tassets. The four holes are for the bolts to attach a lance rest (left). Side view shows the hinges to attach backplate and breastplate (center). Back view shows straps for backplate and culet (right).

The plackart was attached with three vertical straps and buckles. Tassets were commonly attached to the bottom of the breastplate by hinges or leather straps and

buckles, but also sometimes by catches so they could be easily removed if not needed. During the 1600s three new forms of attaching tassets became common.

1. Attachment via wing nut bolts permanently fixed to the breastplate

2. The upper edge of the tasset had a horizontal key hole slot that fit over a corresponding stud on the lower rim of the breastplate

3. Attachment to the culet at the sides with hinges with detachable pins. The whole thing could be put on like a belt and buckled together.

Method of sliding rivets, Ffoulkes, 59
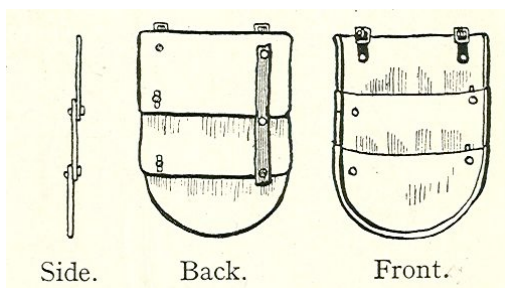
Side.   Back.   Front.
Turning lock pins, Ffoulkes, 59
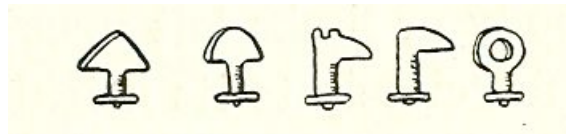
Sources:
    Blackmore
    Blair, 1972, pg. 80, 145
    Ffoulkes, 1909, pg. 58-59
    Oakeshott, 1982, pg. 44
    Stone, pg. 145

Anime (1530-end of 1500s)

Historical Orientation: The anime was a type of laminated cuirass invented in Italy in 1530. Although very flexible, the anime was not good as a defense and therefore was out of fashion in Western Europe at the end of the 1500s.

Structure: The anime consisted of overlapping horizontal lames pinned together by internal leathers and sliding rivets.

Anime, Venetian, second half of 16th century, Stone, 10

Sources:
    Blair, 1972, pg. 124
    Blair, 1982, pg. 20
    Stone, pg. 10

Waistcoat Cuirass
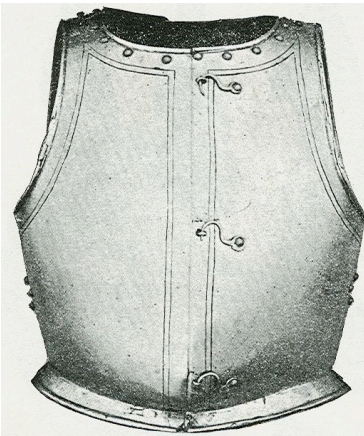
European Waistcoat Armor, second half of 1600s, Italian, Stone, 656

Historical Orientation: The waistcoat cuirass was extra protection for the torso.

Structure: It was usually made of two or more shells hinged to either side of a strip up the center of the back, and fastened up the front like a waistcoat with studs locked in by pivot hooks.

Style: Made in the form of a peascod civilian doublet, often with imitation steel buttons down the front.

Sources:
    Blair, 1972, pg. 124

Miscellaneous Armor

<u>Shoulder Armor (1400-1630)</u>

Besagew (1400 - 1570)

Plain Besagew, 1500, Germany, HAM 828.8

<u>Historical Orientation:</u> Before pauldrons came into popularity, the besagew closed the gap between the spaudler and the rerebrace in order to protect the armpit. During 1450-1530, a segment of the besagew was cut away to make room for the lance. As the pauldron's use increased, there was less of a need for besagews. By the 1550s, the besagew was gone from Italy and around 1570 was no longer seen in Germany or Greenwich either.

<u>Structure:</u> The besagew was a small iron disc tied on with leather straps to the arming doublet that was worn underneath. The disc was circular, oval, square, or cross-shaped.

Armor with besagews, 1549, Nuremberg, Blair, 1972, 131

<u>Style:</u> The besagew underwent relatively minor stylistic changes in its time. Sometimes, the simple disc was fluted, primarily with the Gothic and Maximillian styles of armor.

Fluted Besagew, HAM 2607
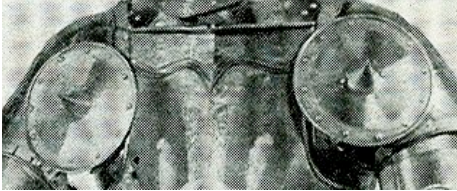
Light field armor with besagews, 1550-1600, Blair, 1972, 131

<u>Sources:</u>
    Blair, 1972, pg. 45, 53, 97, 108, 126, 131
    Blair, 1982, pg. 82
    Stone, pg. 111

Spaudler (1300 - 1560)
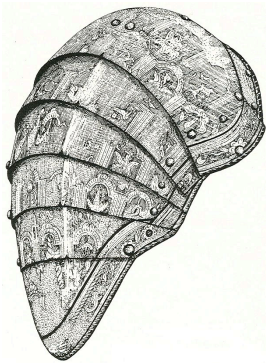
Spaudler, 1600, North Italy, Blair, 1982, 445

<u>Historical Orientation:</u> The spaudler, used to protect the point of the shoulder, was seen in its basic form as early as the 1300s. Mostly used in Germany, it took the form of a simple disc on the shoulder from the early 1400s to around 1460. After that, the spaudler was constructed out of many small overlapping plates till the 1500s. In 1470, it was enlarged in the front and the back and had a space cut out for the armpit. Like the besagew, the spaudler went out of style as the appearance of the pauldrons increased around 1560.
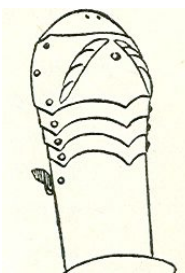
Spaudler, South German, 1500, Blair, 1972, 211

<u>Structure:</u> Originally, the spaudler consisted of a small disc tied onto the shoulder with laces to the arming doublet. Eventually however, articulated lames were attached with

laces or rivets to the collar. After 1460, sometimes the spaudler also attached to the rerebrace. In armor of both the foot soldier and the light cavalry, the spaulders were typically symmetrical in structure.

Spaudler, 1420, Edge and Paddock, 28

Style: Although there is no real distinction between German and Italian styles of the spaudler, one unique style did emerge around the mid 1400s. The version called munnions were simply elongated spaulders with articulated lames reaching from the top of the shoulder down to the elbow. The style was rare and only lasted a few decades. The Germans continued using spaulders later than the Italians but they too switched to the pauldron exclusively around the late 1500s.

Sources:
Blair, 1972, pg. 44-5, 64-6, 119, 126, 144
Blair, 1982, pg. 445
Edge and Paddock, pg. 28

Pauldron (1470- 1630)

Pauldron, 1500s, Western Europe, HAM 9

Historical Orientation: The pauldrons, a shoulder defense that replaced the combination of the besagew and the spaudler, actually evolved from the spaudler around 1470. By

1480, an asymmetrical shape took form as the regular shape of the pauldrons for the new century. On the left side, the pauldron was square shaped but had a small rounded rectangular shape on the right side. Around 1490, the Italians cut the back of the pauldrons so that they didn't overlap yet still provided a large area of protection. The 1500s marked the height of the pauldron's popularity and the designs for it were quite varied. However, by the 1600s, the pauldron began its decline. The traditional asymmetric defenses were abandoned for a symmetric design since there was no need to accommodate a lance. By 1630, the pauldrons fell out of use.

Interior view of arm harness, Edge and Paddock, 181

Structure: Protecting the point of the shoulder and the armpit, the pauldron acted as a combination of the besagew and spaudler. The pauldron, usually a single large plate or lames articulated on sliding rivets, was buckled to the collar and either overlapped or slotted into the rerebrace. Sometimes, the upper lame was reinforced by an haute-piece which protected the neck.
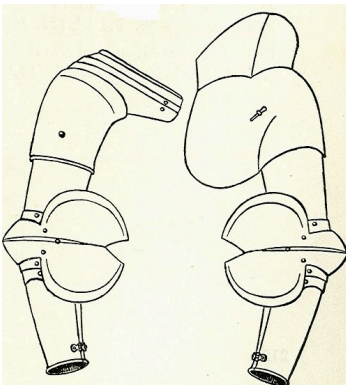
Pauldrons with haute-piece, 1500, Milanese,
Blair, 1972, 211

Style: During the early 1500s, there were distinctive changes to the pauldrons in different

geographic areas. German pauldrons were still rarely used yet they had extended down

the front to eliminate the need for a besagew.
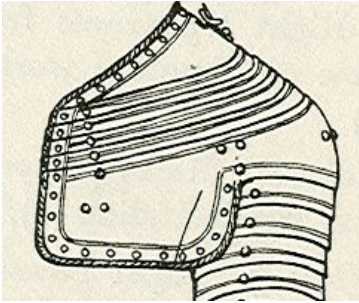
 Left pauldron, 1620, German, Blair, 1972, 213

Italians turned up the corners of the pauldrons to deflect lance blows away from the neck

(see haute-piece picture above). Lastly, the Greenwich pauldrons had a strange rounded

shoulder design that gave the wearer a humped look.

Sources:
      Blair, 1972, pg. 85-87, 90-91, 95-98
      Blair, 1982, pg. 361-362
      Stone, pg. 563

Arm Harness (1350-1650)

Couter (Cowter) (1350 - 1600)

 Couter, 1530, Greenwich, Blair, 213

Historical Orientation: The couter was a defense for the elbow. What started as a simple

plate fastened to the mail armor later evolved into articulated lames riveted to the plate

armor. In 1430, the couter's right side wing was drawn out to cover the tendon and the inside of the elbow joint and a small reinforcing plate was attached to the upper half.
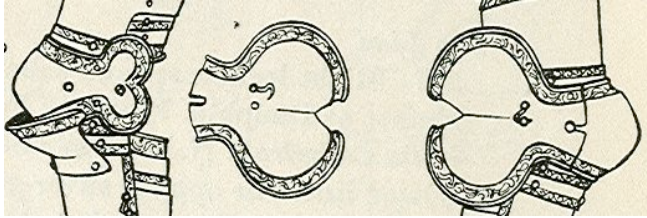
Couters with detachable wings, 1530, Greenwich, Blair, 1972, 213

Couters became more symmetrical and had large tendon guards around 1490. By 1560, the Italian construction reduced the size of the couter and it remained small until the early 1600s when it ceased to be a separate and distinctive entity.
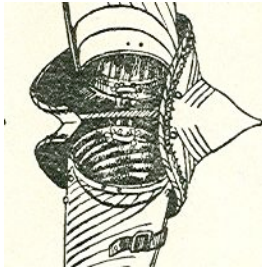
Underside of a couter, Blair, 1972, 211

Structure: Originally, the couter was a single plate attached to the outside of the elbow. It evolved in structure into a set of articulated cup-like lames riveted to the plate armor over the elbows. Eventually, the couter was enlarged to wrap around the entire elbow and acted as a joint between the rerebrace and the vambrace

Right couter for the foot tourney, 1550, Germany, Blair, 1982, 494

Style: Pre-1500s, shaped wings were put on the couter and this stylistic design, beginning in Germany, soon became popular across Europe.

 Bracelet couter, 1525, South Germany, Blair, 1972, 213

From 1515-1545, the bracelet type of couter emerged. It completely enclosed the elbow joint and was put on like a bracelet. The bracelet couter was seen mainly in Germany.

Sources:
      Blair, 1972, pg. 83, 98-99, 213
      Blair, 1982, pg. 142, 494-495
      Oakeshott, pg. 86

Rerebrace (Upper Cannon) (1450 – 1650)
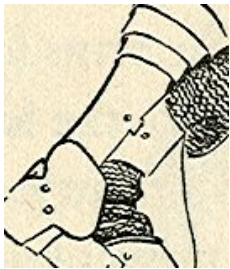
 Hinged rerebrace, 1360, Oakeshott, Knight and His Armor, 39

Historical Orientation: The rerebrace is a defense for the upper arm. Over time, it evolved from a gutter shape into a tubular design that was difficult to wear and thus gave way to the hinged version. In Italy, the short, open rerebrace became longer and almost totally enclosed over time. On the other hand, in Germany, gothic style required armor to become elongated and rippled. Also, the rerebrace was permanently attached to the spaudler and completely enclosed it.

Structure: The rerebrace was made of an iron plate that was fitted to the upper arm. It connected on top with the spaudler or pauldrons depending on the time period, and on the bottom with the couter. Traditionally, the rerebrace was secured with arming points or buckles but sometimes rivets were used instead.
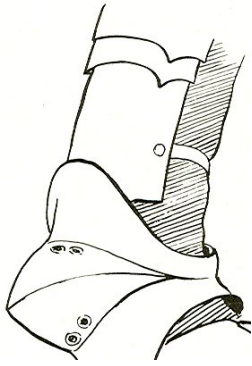
Gutter shaped rerebrace, 1350-1500, German, Oakeshott, Knight and His Armour, 86

Style: The three forms of the rerebrace are gutter shaped, tubular, and hinged. The gutter shaped protected the outside of the arm and was attached with belts around the arm. Since the belts could be easily cut in battle, the tubular shape emerged. It was popular for a while but was difficult to wear as it was put on like a large bracelet. The superior style was the hinged version which offered complete protection and was easy to put on and take off.

Rerebrace (tubular), 1550, Italy, HAM 1444.4

Sources:
      Blair, 1972, pg. 64-65
      Blair, 1982, pg. 404
      Oakeshott, European Weapons and Armor, pg. 39, 85-87
      Stone, pg. 526

Vambrace (Lower cannon) (1450-1650)

Vambrace (hinged), 1475-1525, Europe, HAM 3084.18

Historical Orientation: The vambrace was a defense for the lower arm. From 1400-1500, Italians had hinged vambraces that filled in the gap around the couter with many small laminations. At the same time, the Germans had a tubular vambrace that was riveted to the couter which in turn was riveted to the rerebrace creating a somewhat permanent arm harness. The 1500s saw few changes to the vambraces; however, in 1620, there was a limited trend in Germany to have the "tulip" shape vambraces.
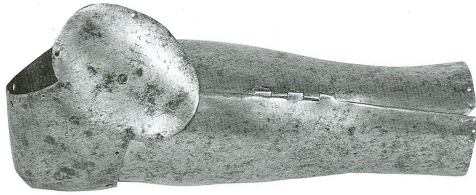
Tulip shaped vambrace, 1390, Chartres Cathedral, Edge and Paddock, 81

Structure: The vambrace was made of an iron plate that was fitted to the lower arm. Often, strips of metal running longitudinally down the vambraces were present to give strength to the metal frame. The vambrace was attached to the couter at the top and came down to the wrist at the bottom.
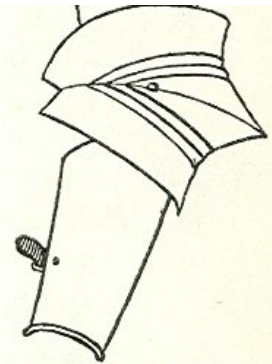
Gutter-shaped vambrace, South German, 1500, Blair, 1972, 211

Style: The vambrace, like the rerebrace, had three forms, the gutter-shaped, the tubular, and the hinged. The styles of the vambrace were fairly distinctive. In Italy, the vambrace was "tulip"-shaped for awhile, flaring out at the wrist to protect the gap of skin between the end of the vambrace and the start of the gauntlet. Gradually it became less "tulip"-shaped for aesthetic reasons. In Germany, the vambrace was used in conjunction with the

rerebrace to form a turning joint in the elbow area. The bottom edge of the rerebrace had

a flanged edge that rotated in the top of the vambrace.   The gothic styling also elongated

the vambrace and added ripples in the metal to give a look that was very different from

that of the Italian vambrace. The "tulip" shape experienced a short revival in 1620

Germany, right before the end of arm harnesses.

Sources:
      Blair, 1972, pg. 64-65
      Blair, 1982, pg. 494-495
      Oakeshott, pg. 85-87
      Stone, pg. 652

Hand and Foot Armor (1350-1625)

Gauntlet (1350- 1625)

The gauntlet was first mentioned around 1350 as a replacement for mail mittens.

It was designed to protect the hand and wrist during combat. From 1350-1430s, the

hourglass gauntlet was most popular. However, around 1430, the mitten form of the

gauntlet appeared. In the 1500s, four variations of the mitten gauntlet were seen across

Western Europe, the finger, the elbow, the locking, and the tilt gauntlet. By 1625, though,

the gauntlet had disappeared from practical use.

Hourglass Gauntlet (1350-1430s)
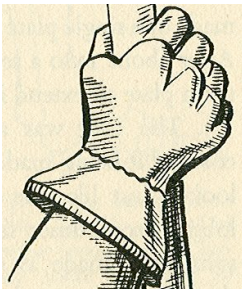
Hourglass gauntlet, 1360, Oakeshott, 40

Hourglass Gauntlet, 1376, English,
Blair, 1972, 207

Historical Orientation: The late 1300s brought a distinctive shape to the gauntlet: the hourglass shape. In Italy, the gauntlet cuff was pointed which was different from the German form which lacked the point but remained symmetrical. The use of the hourglass form ended in 1430 with the arrival of an evolved form of gauntlet, the mitten gauntlet.

Structure: The hourglass gauntlet was constructed of two to three laminations over the top of the hand and a plate connecting them to the flared out plate that covered the wrist. The plate stopped at the knuckle line and the fingers were protected by mail gloves worn underneath.

Style: The joint between the wrist plate and the hand plate was highly emphasized.

Mitten Gauntlet (1430-first half of the 1500s)
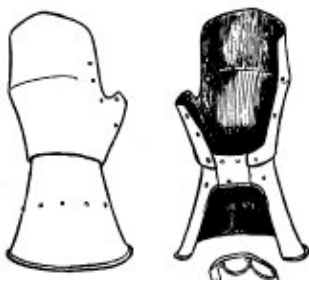
Mitten Gauntlet (Front and Back),
1440, South Germany,
Blair, 1972, 209

Mitten gauntlet, 1520,
Augsburg, Blair, 1982, 192
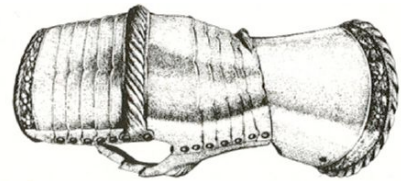
Historical Orientation: The mitten gauntlet was derived from the hourglass shape. In Italy, from 1500-1550, bell-shaped cuffs of moderate length were most common. The bell-shaped cuffs ensured that a lance could not travel along the gauntlet and strike the space between the gauntlet and the vambrace. On the other hand, the German design had shorter, more tubular cuffs that were often hinged. However, in 1530, they also followed the Italian style of longer pointed cuffs with a flare to protect the wearer.

Structure: Although derived from the hourglass shape, the mitten gauntlet had a slightly different structure. The back of the cuff was extended more up the forearm. It protected the sides and back of the hand and was held in place with a narrow strip across the inside of the wrist. A slight bend along the knuckle line was added and the main plate followed the thumb shape. The fingers, though still covered in mail, were also protected by small laminations.

Fingered Gauntlet (1500s-1625)
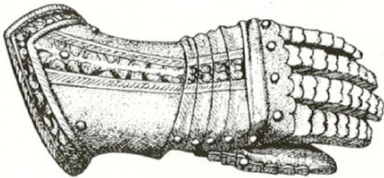
Fingered Gauntlet, 1570, Italy, Blair, 1982, 192

Fingered Gauntlet, 1480, Germany, Blair, 1972, 209

Historical Orientation: The fingered gauntlet was a variation of the mitten gauntlet.

Structure: Each individual finger was protected by many small laminations that completely enclosed the finger.

Style: The Italian version had pointed cuffs that flared out excessively and eventually deteriorated in use. The Germans had pointed cuffs as well but with only a slight flare.

Elbow Gauntlet (1500s – 1625)
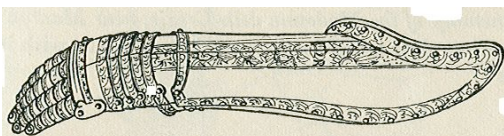
Elbow gauntlet, 1586, London, Blair, 1972, 209

Elbow gauntlet, 1560, South Germany, HAM 3455.a

Historical Orientation: The elbow, or bridle, gauntlet was a form of the mitten gauntlet that was popular in the 1500s. The elbow gauntlet was used by light cavalry and foot soldiers and sometimes replaced the vambrace. In 1620, the elbow gauntlet became shaped to the forearm but was only used on the left side. It was scarcely used in Italy and saw most use in Germany.

Structure: The cuff extended past the lower arm to the elbow and was fingered with laminations in the metacarpal area.

Locking Gauntlet (1500s – 1625)
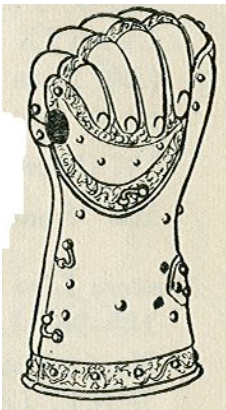
Locking gauntlet, 1530, Greenwich, Blair, 1972, 209

Locking gauntlet, 1500s, German, Stone, 418
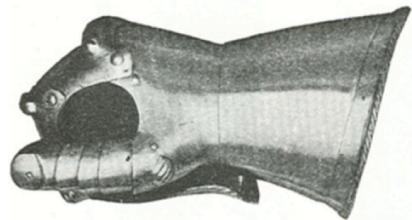
Historical Orientation: The locking gauntlet was a specialized type of mitten gauntlet for the right hand. It was used for foot combat and the tourney.

Structure: The lames on the fingers were articulated in line with the knuckles. The last lame was extended so that when the hand was closed, it could be fastened to the cuff by a turning pin or some other form of catch. The wearer's grip on his weapon, whether it was a sword, mace or poleax, was rendered almost unbreakable. Thus, the locking gauntlet was never used with a lance.

Tilt Gauntlet (1500s – 1625)
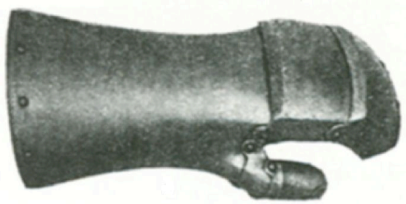
Tilt gauntlet, early 1500s, Germany, Stone, 244

Historical Orientation: The tilt gauntlet, another variation of the mitten gauntlet, was used for the left hand in the Italian and German joust.

Structure: The metacarpal and finger lames were each made in one embossed, rounded plate. Together with the thumb scales, the plate entirely covered the inside of the hand when the gauntlet was closed.

Sources:
> Blair, 1972, pg. 41-42, 66-67, 99-101, 208-209
> Blair, 1982, pg. 192-193
> Edge and Paddock, pg. 49-50, 84, 92
> Stone, pg. 227, 244, 245, 418

Gadlings (1350 – 1500)
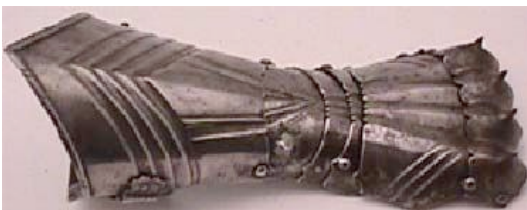
Gadlings, HAM 2440.2

Historical Orientation: The gadlings were decorative and offensive structures designed to hurt the opponent or at least intimidate them.

Structure: They were low spikes or jagged metal points that were mounted to the knuckles of the gauntlets.

Style: Although generally low spikes, the gadlings sometimes took on different forms. An example of this would be the leopard gadlings seen on the Black Prince's gauntlets. He replaced the spikes with the animal that was on his crest.

Sources:
     Blair, 1972, pg. 67
     Stone, pg. 242, 245

Sabatons (1350-1600)

Pointed Toe Sabatons, HAM 2607

Historical Orientation: The sabatons were a defense for the feet. First seen as plate metal shaped around the top of the foot around 1350, the sabatons enclosed all but the soles of the feet by the early 1400s. Some sabatons had long pointed toes that could be detached if necessary. By 1490, the pointed toe had been replaced by a broad round-toe style known as the bear-paw design. The bear-paw was narrowed down in 1530 and by 1550, the sabatons were mostly oblong with rounded toes. 1570 brought bluntly pointed toes to the

sabatons. By 1575, sabatons were no longer used in battle and were seldom seen after 1600.

Bear-Paw Sabatons, 1550, Glossarium Armorum

Structure: The sabatons were constructed out of a wide plate shaped to the instep and the front of the ankle and approximately four laminations that overlapped downwards to join the toe plate. The toe plate had holes in it through which the laces were tied to attach the sabaton to the shoe worn underneath.
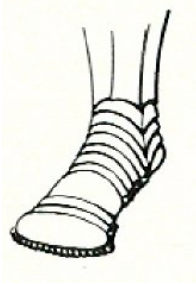
Broad Sabaton, Blair, 1982, 408

Style: The style of the sabatons was largely dictated by the fashion of regular shoes. The famous long pointed sabatons mimicked the fashion of civilian shoes in which the toes grew so long they had to be tied around the ankle to keep the wearer from tripping. The bear-paw design was believed to have been made to give the wearer more toe room as opposed to that of the previous style. It was easier to walk in although still unnatural. Rounded toes and bluntly pointed toes were the last forms of sabatons. These are the most similar to our shoes today and were usually seen on armor dating from the late 1500s to the early 1600s.

Blunted Toe Sabatons, HAM 428

Sources:
 Blair, 1972, pg. 85, 100-102, 215
 Blair, 1982, pg. 408
 Edge and Paddock, pg. 80-82, 85
 Stone, pg. 530, 569

Leg Harness (1400-1620)

Schynbalds (pre-1400 – 1500)

Schynbald, 1475, Italy, HAM 3084.28.a

Historical Orientation: The schynbald, or shin-guard, was used throughout the 14th century in place of a greave. Around 1475, Germans added roped detailing along the edges and everyone else soon followed their design. By the 1500s, it was replaced almost entirely by the greave.

Structure: It was made out of a plate of metal that covered only the front and partial sides of the lower leg. The schynbald terminated just above the anklebones. It was first strapped over the chausses, a padded undergarment for the legs, and then fastened in back with straps and buckles.

Stylistically, there was little that could be done to distinguish one maker from another. Occasionally more wealthy people had pictures and coats of arms etched into the metal but this was rare and didn't last.

Sources:
        Blair, 1972, pg. 42-43, 53, 63
        Blair, 1982, pg. 199

Greaves (Greves, Graves) (1400- 1575)

Greaves, 1450, Edge and Paddock, 34

Historical Orientation: The greave was a defense for the lower leg that replaced the schynbald. In the early 1400s, the extensions over the sabatons were cut off and the greaves ended about an inch from the tops of the sabatons. Around 1500, the back of the greave was extended to the ground and a slit was cut in it to make room for spurs. In 1545, German armorers started using three-quarter greaves, which went only three-quarters of the way around the leg. This trend was continued by those in Greenwich until 1570. By 1575, the greave was no longer used in battle although it continued to be used in fashion armor for many years.

Closed greave, 1325, Oakeshott, 35

Demi-greave, 1310, Oakeshott, 35

Structure: The greave was constructed of a front and rear plate hinged together on the outside, and fastened with straps or buckles on the inside. The lower part of the greave followed the shape of the ankle and curved down almost to the ground. It was attached to the poleyn and sabaton with pin-catches.

Style: Like the schynbald, the greave was made simply and efficiently, which didn't leave a lot of room for decoration or stylistic changes. It was generally two plates of metal with the occasional roping detail along the edges.

Sources:
        Blair, 1972, pg. 85, 101-102
        Blair, 1982, pg. 199
        Edge and Paddock, pg, 34
        Oakeshott, pg. 35
        Stone, pg. 253

Cuisse (1400-1600)

Cuisse, 1575, North German, HAM 2601.1

Historical Orientation: The cuisse was a defense for the upper leg. Originally, the cuisse was made of quilted cloth and referred to as a "gamboised" cuisse. Then, around 1400, the fabric was replaced by a metal sheet that covered the top of the thigh. In 1430, an articulated plate was added but was reduced to one narrow lame in 1450, and by 1490, the top of that lame resembled a flattened S-shape. By 1500, the lame and the main piece

became completely convex and 1510 brought hinged extension plates to the outside of the thighs, allowing more ease in putting them on. The cuisses grew shorter and flatter on the top in 1530. In Italy at this time, the cuisse was being made of horizontal laminations which Greenwich picked up in 1570. In Germany, the cuisse was formed into two halves that were joined horizontally and were used until 1600. After 1600, an occasional short cuisse was seen, but it was largely replaced by the knee-length tassets.

Structure: It consisted of a metal sheet that covered the top of the thigh and an articulated plate to fill in the gap between the top of the main plate and the groin. The cuisse was riveted to the poleyn.

Leg harness with an open cuisse, Edge and Paddock, 181

Style: There were both open and full cuisses. The cuisse made in Germany largely reflected the style of the overall harness at this time. With the exception of the horizontal joining of the cuisse in 1530, the shape remained the same throughout the years. In Italy, the cuisse was mainly the traditional metal plating that was seen on the rest of the armor. No specific styles emerged that were unique to the cuisse.

Sources:
    Blair, 1972, pg. 81, 84-85
    Blair, 1982, pg. 151
    Edge and Paddock, pg. 181

Poleyn (1430-1620)
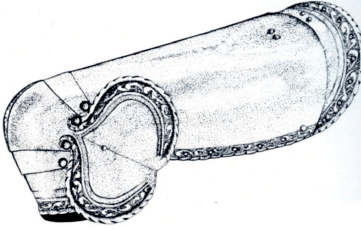
Poleyn, 1535, Nuremberg, Blair, 1982, 382

Historical Orientation: The poleyn was a defense for the knee. It started as an occasional rounded segment over the knee but did not develop into its own form until the mid-1400s. Around 1430, the poleyn consisted of a plate over the knee with articulated lames. In 1450, the bottom lame of the poleyn became pointed and a mail fringe was attached to it. From 1400 – 1500, small wings were built into the poleyn and by 1570, the wings were heart shaped to better protect the knee joints. After 1620, the poleyn was not widely used. It was occasionally included in the leg harness but it was not seen as a separate entity.

Poleyn, 1515, Greenwich, Blair, 1982, 199

Structure: The poleyn was a plate shaped over the knees with articulated lames riveted to the cuisse and the greave or schynbald. Small wings were added to protect the sides of the knees.
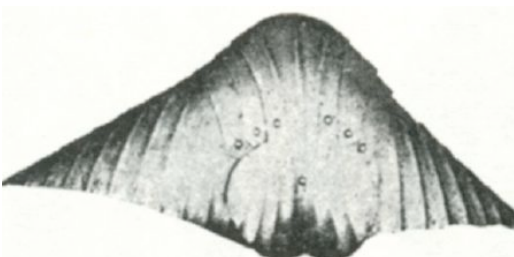
Poleyn, 1460, Italian, Stone, 364

Style: It had a basic form and the styles were reflected in the wings of the poleyn. The wings on the sides varied according to the style of the day. Italians favored rounded wings with decorative touches on them while the Germans preferred large fluted wing-shaped or heart-shaped wings.

Sources:

Blair, 1972, pg. 53, 81, 84
Blair, 1982, pg. 199, 382
Stone, pg. 364, 512

Miscellaneous Armor (1350-1625)

Almain Collars (1530-1600)

Almain collar, 1600, Switzerland, HAM 2961.4

Historical Orientation: The Almain collar appeared in 1530 in Germany and was mostly used until the early 1600s. It was cheap to make and was often used on munition armors.

Structure: It consisted of a collar that was attached permanently to the spaudler. To open the collar, the spaudler on the opening side was fixed to the rear main collar plate only. The collar itself was secured with a keyhole and stud design.
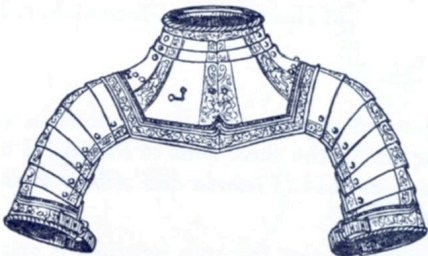
Almain collar, 1560, Saxon, Blair, 1972, 207

<u>Style:</u> There were two main designs of the almain collar. The first one had spaudlers that were meant to be worn with mail sleeves. The spaudlers were little more than caps on these and were attached to the mail with arming points and the occasional rivets. The second type had spaudlers that replaced the rerebraces and attached to the couters with rivets.

<u>Sources:</u>
    Blair, 1972, pg. 119, 127, 207
    Blair, 1982, pg. 198

Arming Doublet (Doubling Armet, Armor Doublet) (1450 – 1620)

Arming doublet made of padded and embroidered leather, 1580, French, Stone, 513

<u>Historical Orientation:</u> The arming doublet was a quilted undergarment worn underneath armor in order to cushion blows. It was known as an "aketon" earlier in history. In 1450, the arming doublet came to be separate from the aketon. The arming doublet had become less quilted overall by 1550. If more quilting or padding was needed, it was usually tied on separately. It remained in a similar construction until 1620 when it was replaced by the buff coat.

Arming doublet, 1400s, Germany, Blair, 1972, 89

<u>Structure:</u> It included a standing collar, gussets at the armpit and elbow, or complete sleeves that covered the armpits. Mail armor was attached to it by arming points and it protected places on the body that plate armor did not cover.

<u>Sources:</u>
Blair, 1972, pg. 77-78, 89
Edge and Paddock, pg. 108, 115
Stone, pg. 18, 513

Cod-Piece (Brayette) (1450-1570)

Solid plate cod-piece, HM Royal Armory

<u>Historical Orientation:</u> The cod-piece is a cup-like protection for the genitals. It was first seen in 1450 in Germany as a solid plate protecting the general area. The cod-piece was rarely seen in armor after 1570.
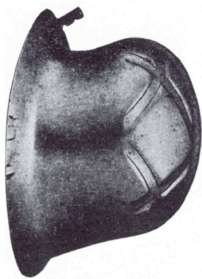
Cod-piece, 1546, German, Stone, 143

<u>Structure:</u> It was constructed from either a solid plate or from several articulations. The cod-piece was thickly padded inside and was attached to the bottom of the fauld with either a leather strap or a rivet.

Cod-piece, early 1500s, Edge and Paddock, 181

Style: The style of the cod-piece varied on the wearer's personal preference. It could be made of solid plate and point out horizontally; it could be articulated and hang down; or it could be made of plate and point upwards. Civilian fashion of the time also played a role in the styles of the cod-piece.

Sources:
Blair, 1972, pg, 123, 164
Blair, 1982, pg. 137
Edge and Paddock, pg. 181
Stone, pg. 143

Gorget (1300 – 1600)

Gorget, HAM 2384

Historical Orientation: The gorget was a plate defense for the neck. It protects the gap between the helmet and the rest of the body armor. It was seen as early as the 1300s as a hinged plate covering the neck area. In 1450, the back of the gorget was occasionally seen attached to the lower helmet in a sort of rotating joint while the front of the gorget was left separate. A laminated gorget was seen in 1520; it had separate laminations for the front and back with a pivot allowing the gorget to open and close. In the early 1600s,

gorgets were being worn less and less with full body armor; but continued to be worn alone as a status symbol through the America Revolution.
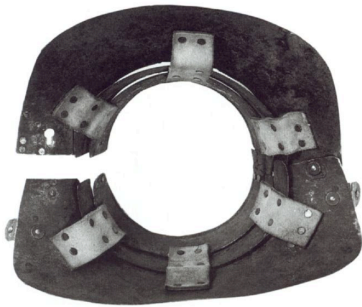
Interior view of the gorget, Edge and Paddock, 180

Structure: The gorget was comprised of two main plates, one at the front and one at the rear. They enclosed the neck and sometimes extended down over the top of the chest and back. The two halves were hinged together on one side and the other side was fastened by a peg engaging in a key hole slot.

Decorated gorget, Blair, 1982, 198

Style: The gorget was seen with one main style. A pointed front and back originated in the 1500s, and this style remained for many years. The variations on this design included different types of points, roping along the edges, and various shields and emblems painted or engraved on the front point. A plain, unpointed gorget was also seen occasionally.

Sources:
Blair, 1972, pg. 102, 105, 109
Blair, 1982, pg. 197-198
Edge and Paddock, pg. 100, 180
Stone, pg. 250-251

Mail (1100-1700)

Coat of mail, 1400s, German, Stone, 429

Historical Orientation: Mail was a protective metal fabric that was fashioned specifically for whichever part of the body it was intended to protect. Mail armor for the head included a coif and ventail, aventail, and a mail fringe. Torso armor consisted of a hauberk, skirt, and breeches. Mail armor for the extremities included sleeves and mittens for the upper limbs and chausses and sabatons for the lower limbs. By the 1300s, mail tended to have a more subordinate role in relation to plate armor. First, mail served as a linking element for various plates. Eventually, mail was used to protect the more vulnerable parts of the body such as the neck, elbow, and knee joints. In Western Europe by the 1500s, mail was used mainly as an accessory, such as the arming doublet. However, in Eastern Europe, mail often served as the main defense until the late 1600s.
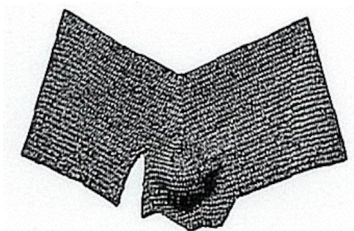
Brayette, 1400s, German, Stone, 429

Structure: Mail involved the linking of iron or steel rings, the ends of which were either riveted or pressed together.

Gussets of mail, 1500s, Stone, 429

Style: The protection for the thighs came in two forms. In Italy, a long skirt covered the thighs down to the knees. In Germany, instead of a skirt, mail breeches were worn. They were tight-fitting and shaped to cover the genitals.

Sources:
    Blair, 1982, pg. 341-342
    Stone, pg. 424-430

Haute-piece (1425 – 1585)

Haute-piece, Blair, 1972, 211

Historical Orientation: The haute-piece was a defense for the neck in field armor, foot combat, and tourney armor. Around 1425, the haute-piece began as edges of the pauldron were bent upwards to form flanges. From 1425 to 1475, the haute-piece grew rapidly in size until the left one reached the height of the ear, its maximum size in history. In the 1500s, the Italian style was to have low-rising, asymmetrical haute-pieces, whereas the German style was generally higher. Greenwich armor had symmetrical haute-pieces that were always detachable. Haute-pieces went out of style and use in Germany around 1560. The Italians used them up to the seventeenth century, however their use greatly declined by 1530. They remained in use the longest in Greenwich, where their appearance was still seen up to 1585.
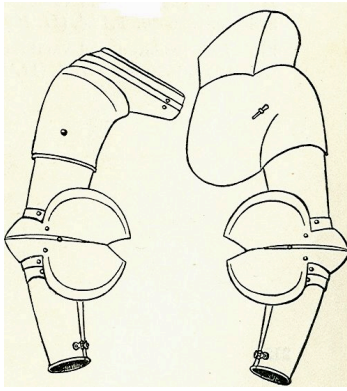
Pauldron with haute-piece, 1500, Milanese, Blair, 1972, 211

Structure: The haute-piece was constructed from a single piece of plate either riveted to

the pauldron or made detachable through the use of keyhole studs.

Style: The left haute piece was generally larger since that side required more protection.

Sources:
Blair, 1972, pg. 83, 97-98, 211
Blair, 1982, pg. 253-254

Website and Database

By John Prudente

The About the Project Page gives a brief background of armor evolution and an introduction to the group's project.
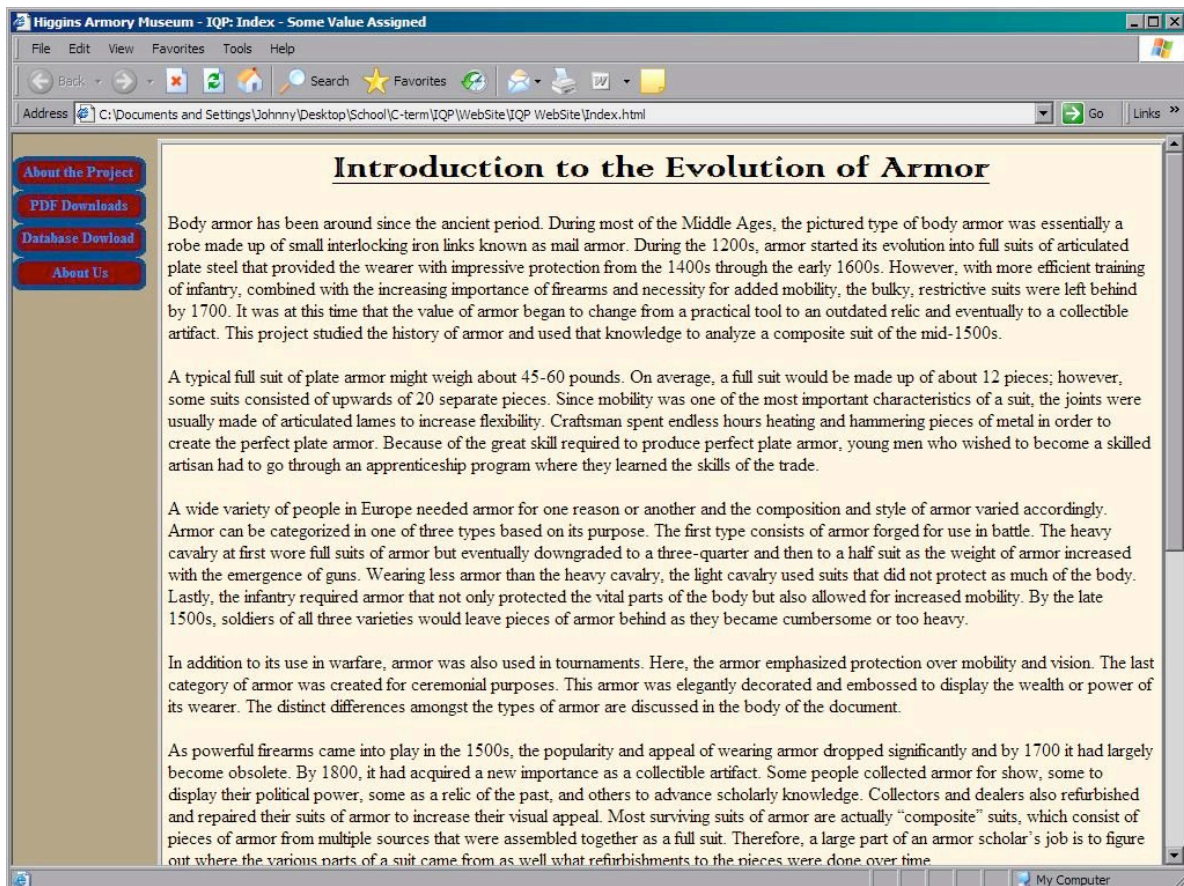
The PDF Downloads Page is the page one can download individual sections of the Project Paper. If desired the Project Paper in it's entirety can be downloaded here as well.

PDF Downloads

The following files are for use on information about the particular named piece of armor:

Helmet
Torso
Arm and Leg
Hand, Foot, and Misc.

The following files explain the evolution of four different types of armor:

Infantry Armor
Cavalry Armor
Tournament Armor
Unusual Armor

The following files explain the tools and metallurgy methods used in the manufacturing of armor:

Armor Production
Metallurgy
General Design and Production
Decoration

For Information on Harness 2879 Click the following link:

Suit 2879

Full Project Download

This is for you armor buffs out there or anyone looking for specific Information on Harness 2879. These are suggested uses for this material

The Database Download Page can be used for Armor Research.
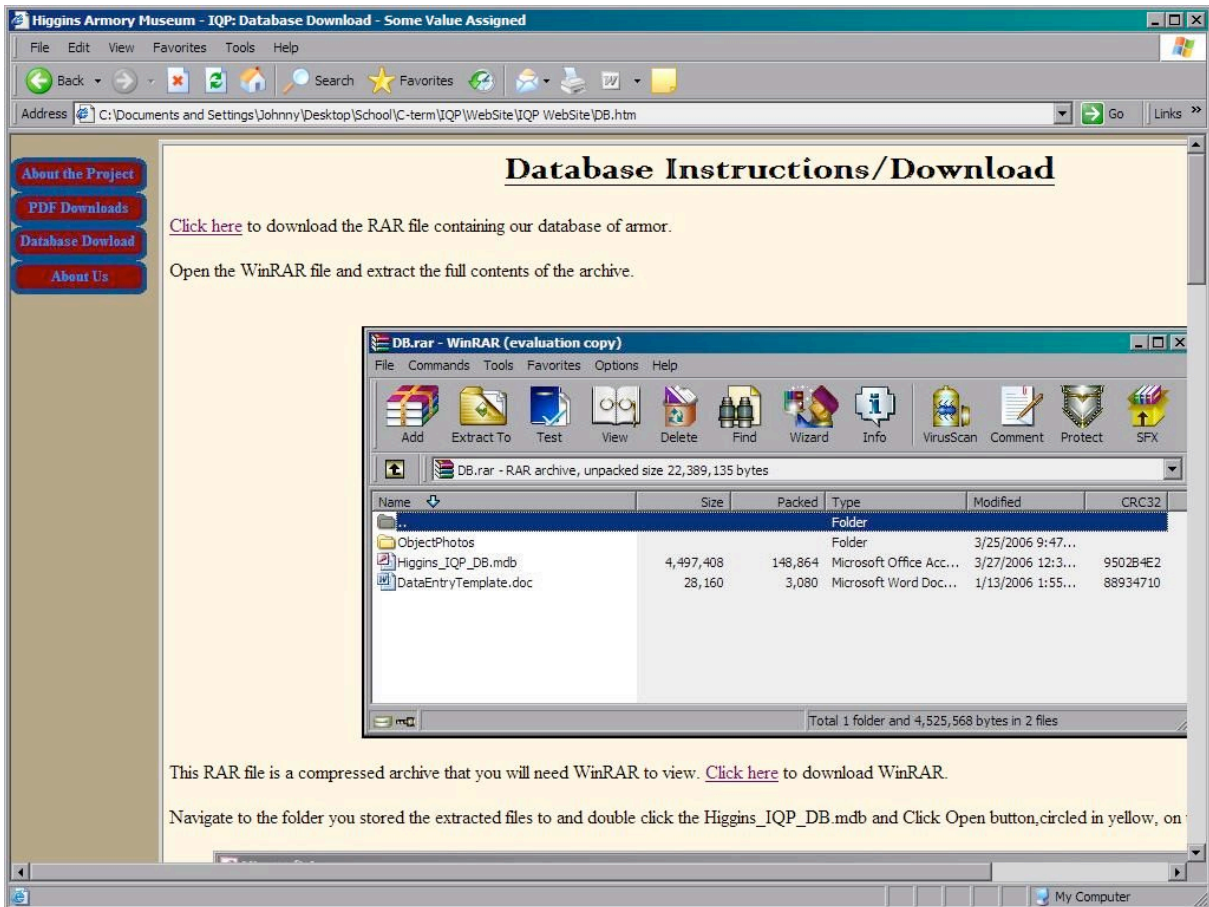
To begin using the Database one must download the RAR file containing a folder of pictures, the template used to fill in the database, and the mdb file that is the database. This RAR file is a compressed archive that you will need WinRAR to view. This program can be downloaded from our website. Open the DB.rar File.
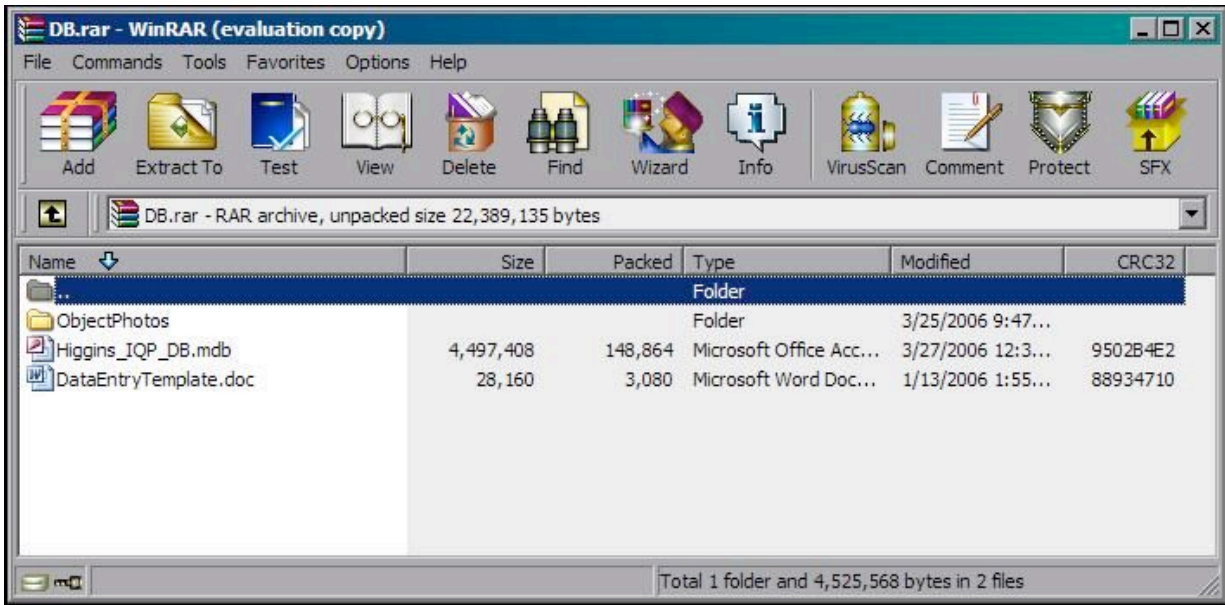
Extract the files to a folder you'll be able to find them. Navigate to the folder you stored the extracted files to and double click the Higgins_IQP_DB.mdb and Click the "Open" button,circled in yellow, on the pop-up.
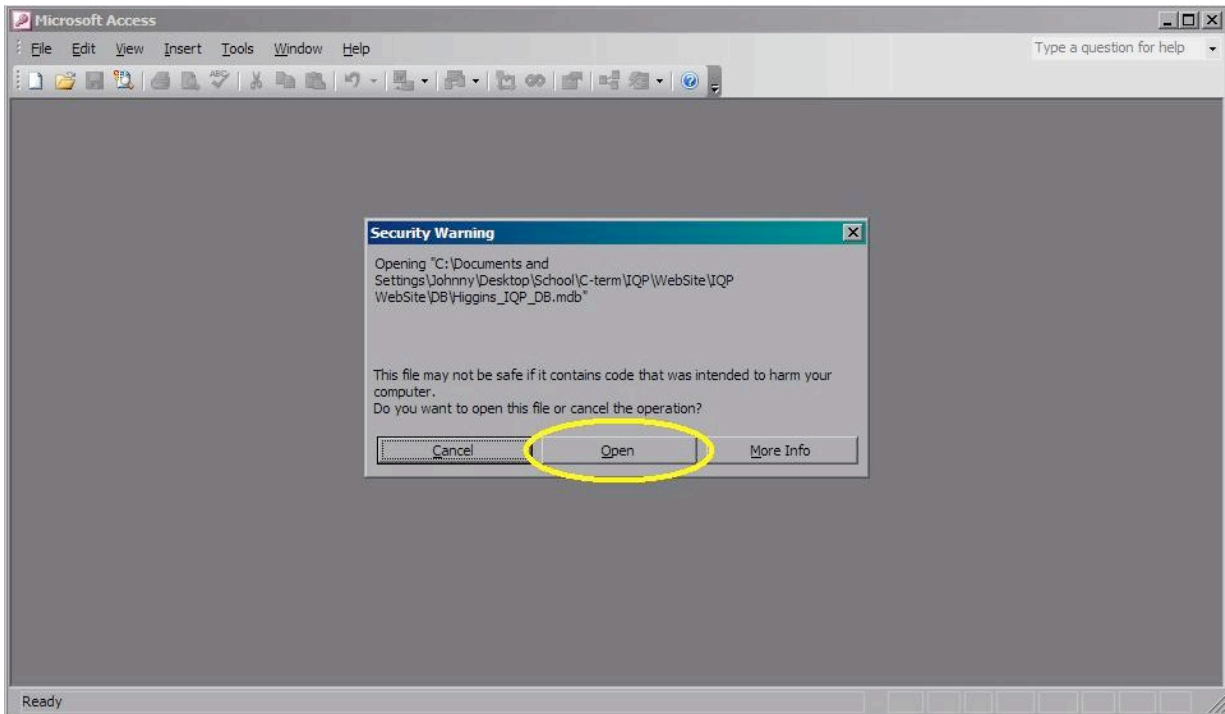
Next click the Reports Icon and double click "General Query Report-Public", circled in yellow.
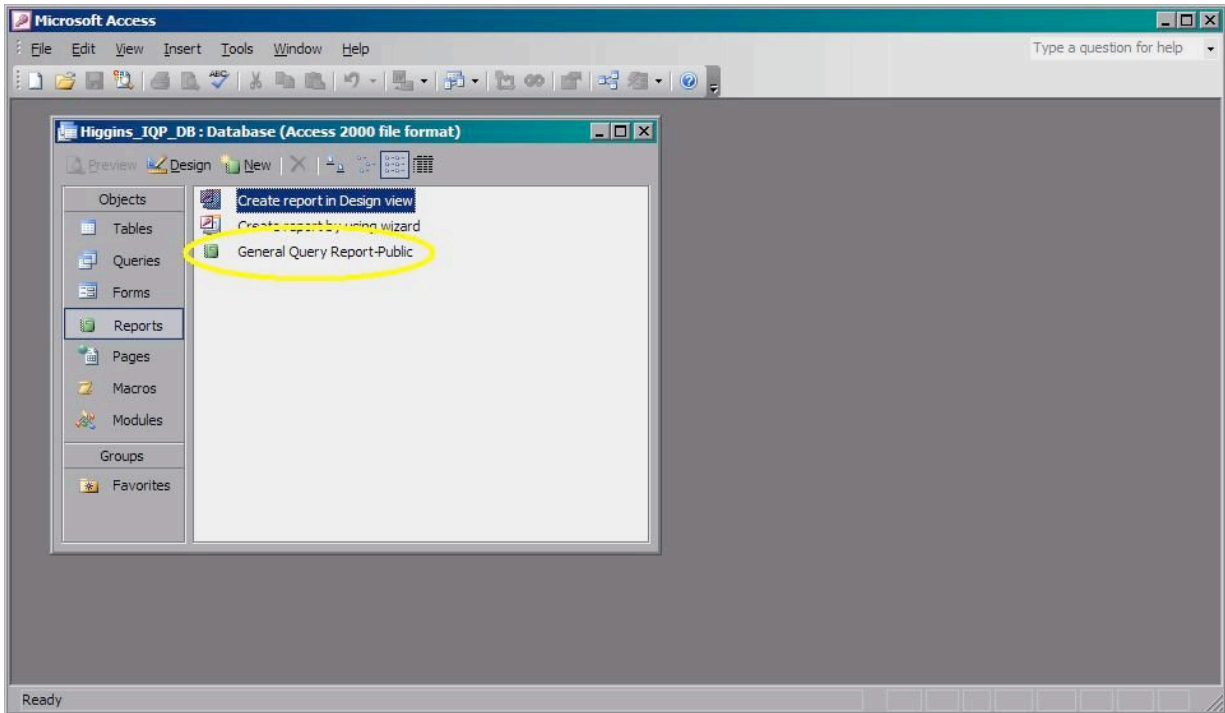
The Database will prompt you for the Minimum Date, Maximum Date, Geographic Origin, and Type of Armor for which you are looking.

Once you have filled the reports you can choose to navigate through the Reports with the buttons circled in yellow, (The information you seek is circled in Red)
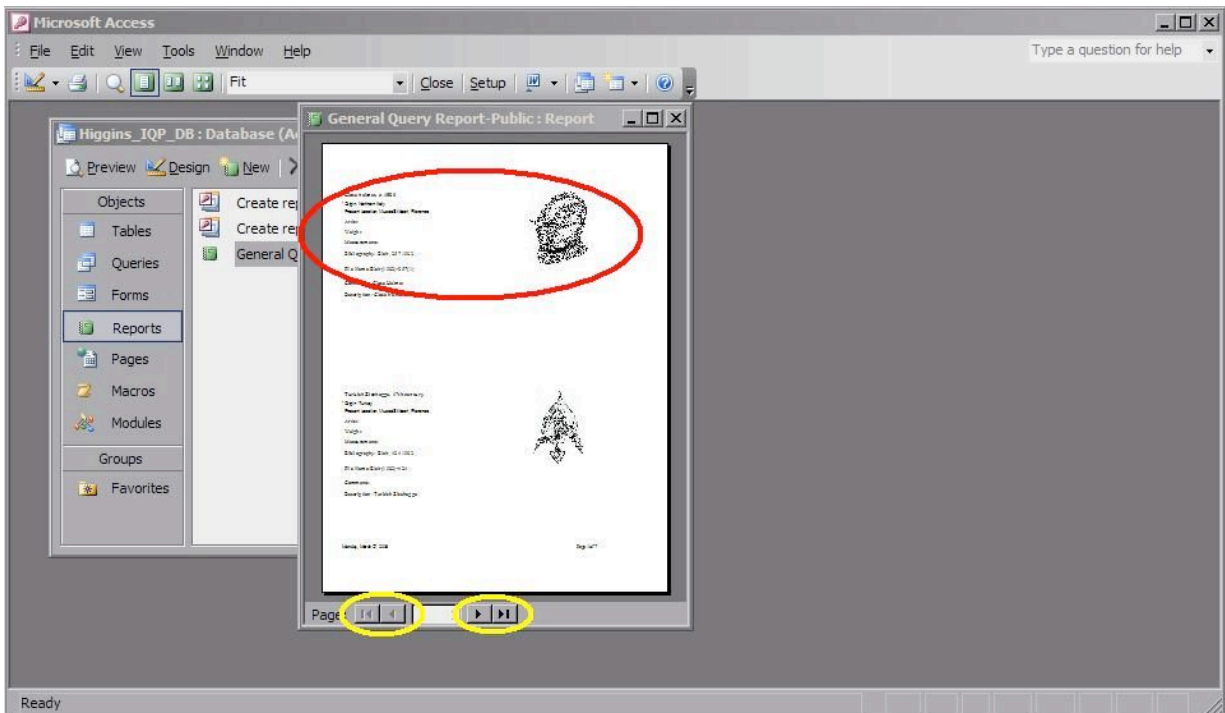
or you can navigate these pictures through use to the form with the same type of navigation buttons, circled in yellow.
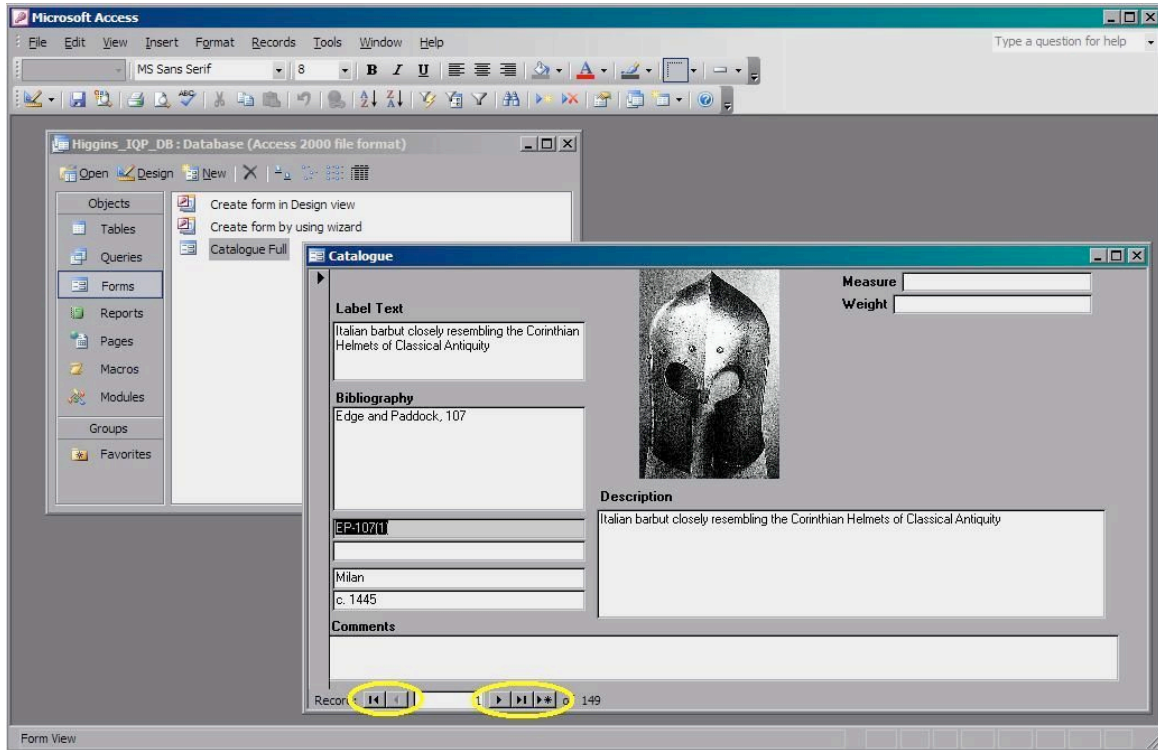
This database can be used for research purposes or just general interest.

The About Us Page contains the teams contact information.

About the Project

PDF Downloads

Database Dowload

About Us

About the Project Group

We are students from Worcester Polytechnic Institute. During the 2005-2006 academic school year we completed an interactive Qualifying Project for Higgins Armory with Dr. Jeffrey Forgeng as our advisor.

Our various academic backgrounds in combination with our longlasting friendships made our project what it is.

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John Prudente 2006 Management Information Systems jjp@wpi.edu

Written by Keith Coleman, Alex Knight, Angela, Leo, and John Prudente

Website Design by John Prudente

Conclusion

The classic suit of armor IQP has been time consuming. Each week we had group meetings with Professor Forgeng that ranged from fifteen minutes to three hours. Outside meetings we had anywhere from two to ten hours worth of report writing to do. Plus we had to consider the amount of time it took to research, analyze a armor piece or edit a film, which is an additional two to ten hours. During the three main terms of IQP each group member put in anywhere from five hours to twenty hours worth of work per week. Choose your group members wisely because IQP can either bring you together or break you apart. Luckily for us we were all close friends before we decided to do IQP together. Knowing each other's work habits and abilities helped us to plan each week's work and to judge what could be done in a term's time.

During PQP we formed our base of operation. We went to the Higgins library to create a working annotated list of sources (listed in the Appendix), we set goals to accomplish for each term of IQP, we made a week by week break down of jobs for each member to accomplish during our first term, and we read the previous group's "classic suit of armor IQP". If we had to do it again we would have spent more time in the library reading general books on the history of plate armor to build a strong base before we had to research specific topics.

Our goals for our first term of IQP were to research information for our research document. Each week each member of our team had a specific topic to research and write about, ranging from the components of a suit of armor, to how armor was made, to how the armor was used and who used it. Research takes a long time we cannot stress this point enough. The first four weeks of the term we spent an average of ten hours a week in

the Higgins library. By the end of the term we had developed an in-depth knowledge of plate armor and its history. Now it was time to select a suit of armor. We based our decision on aesthetic appeal, completeness of the armor, and amount of documented information. We chose the HAM 2879, which is a full suit of armor with extensive decoration and minimal documentation. In the end, B term was the most time-consuming term.

C term was busy as well because in combination with starting our analysis of our armor and making our website and database, we were still correcting documents from B term. However, getting to examine the armor is cool because you get to work with the armor you chose. Professor Forgeng is really helpful when examining the armor, we recommend asking him any questions you have. When examining our armor it was astonishing how many pieces had been replaced or repaired. The most recent documented repair was engraved on the inside of one of the greaves, but it was apparent that some of the leather straps were replaced more recently. Most of the repairs were very well done and were only recognizable from hammer marks or slight discoloration. Our website was also fun. The website houses all the information and pictures of our project. It is nice to know that our work will not just be a paper in storage, but a website for the public to see and use as they see fit. C term was really rewarding because it was the term our project really came together and we got to experience something only a handful of people have gotten to do with in the previous century.

At the end of C term our D term was looking a little empty. When we were making our week-by-week schedule for the next term we decided to make a video documenting the construction and history of our armor, HAM 2879. Over spring break

we made a script and decided how we wanted to shoot the film. It was only a ten-minute film, but we still had to finalize the rest of the project and did not have time to do more. At the end of our IQP we really had something to make us proud.

We put a lot of work into this IQP. During all of that work we learned that almost nothing as involved as an IQP goes smoothly. We had a few problems along the way. For any group doing this IQP or one like it in the future we have a long list of recommendations:

- When scheduling, treat week one as a stepping stool into the term. The first week of each term is not a full week, thus giving yourself a full week worth of goals to accomplish will force you to start your term behind schedule.

- During PQP read a book or two from our recommended book list in the appendix on the general history of armor and the time period armor existed. This will give you a base and save you tons of time and stress in your first few weeks of the first term.

- While making your annotated list of sources, write all the dewey decimal numbers next to each book for easy access later in the year. Also, talk to Al, the Higgins Armory librarian, and ask him to leave the books you put on the bottom self of the book cart each week. Otherwise he will put them away every Wednesday and you will have to find them again.

- At the end of each term create a complete task list with week-by-week goals for the next term. Assign each goal on a voluntary basis to each member of your group. Then there are no arguments later in the term about whose job it was or who has more work to do than someone else since you picked your own jobs.

- Correct all documents handed back by Professor Forgeng immediately. Expect the first drafts to have major corrections ranging from reorganization to adding entirely new sections of research; therefore you need to allot research time specifically for revisions. Expect there to be additional drafts to correct. On average each document had three to four drafts, but some ranged as high as six or seven. Finally keep all corrections because Professor Forgeng will want to review what you have done over the term.

- Research correctly. There are several things you can do to make writing your research documents easy for yourself down the road: keep your annotated list of sources up to date, record the page numbers of the books you get information from, mark pictures you might use as you see them, and compare information from a variety of books because some information is misleading or incorrect.

- Assign a secretary for each week. A secretary's job will include writing notes from the meetings with Professor Forgeng, making sure every group member is on top of their tasks, and grouping documents into a single file or hard copy to be handed in at the same time to Professor Forgeng because that is how he likes it.

- Be sure to keep communication open so there are no blow ups randomly during the term. If someone is having trouble getting his or her work done or someone is not doing enough, talk about it. You do not want a huge fight early in the year that could make you hate your group members.

Through our IQP we have left our mark on the Higgins Armory, WPI and anyone else who has a desire to learn about medieval culture. Doing this project has taught us a lot, but there is still more to be learned and done for the Higgins Armory to help them

study and document medieval history. We started a database of all the pictures we used in our report and of our armor. There are still thousands of pictures that could be added for easy access to future historians or spectators. As stated before, our video was short. In the future, an IQP group could make an in-depth documentary on how to analyze a suit of armor, instructing the general public on how to tell original pieces from non-original or how each piece fits together. Another film idea is to document how to build a suit of armor, demonstrating the different anvils and hammers were used or how to make strong and light steel. A group could also do more research on topics already covered, making even more complete documentation. Another research idea is to gather pictures and paintings to document the history of armor as captured through art. A final idea is to make an interacting timeline to show when certain types of armor came into development with pictures and possibly videos.

About the Project Group

We are students from Worcester Polytechnic Institute. During the 2005-2006 academic school year, we completed an Interactive Qualifying Project for Higgins Armory Museum with Dr. Jeffrey Forgeng as our advisor. Our various academic backgrounds in combination with our long-lasting friendships made our project what it is.

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Annotated List of Sources

Manufacturing

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-Thirteenth to sixteenth century history of armor
-Good illustrations
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    -Good for researching our suit of armor since it includes drawn-out discussions of particular designs
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    -Easy reading and good for a quick overview
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  -Helmet information
  -Tournament armor
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Blackmore, Howard L. *Arms and Armour.* **London: Studio Vista, 1965. ***
  -Information on early plate armor with illustrations
  -Follows evolution/decline of armor

Blair, Claude. *European Armour* **circa** *1066* **to** **circa** *1700***. London: B.T. Batsford, Ltd., 1958; 2ⁿᵈ ed. New York: Crane, Russak and Co., 1972. ***
  -Detailed descriptions
  -Good for researching our suit of armor since it includes drawn-out discussions of particular designs
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  -Great description of orders in the crusades and plate mail eras.

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    -History of armor broken down by structure (helmets, body, etc.)

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    -First 4 volumes pertinent to project
    -Volume 1—general history
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    -Good for history overview
    -Awesome illustrations

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-An accelerated introduction to the java programming language and its key APIs

*—denotes book is in more than one section

Appendix

Template For the Analysis of a Harness

Armor Piece

Dimensions: The dimensions of the piece of armor in HeightxWidthxDepth

Weight: The weight of the piece of armor in lbs and oz

Description: Brief description of the piece of armor

Materials: Materials used to create the piece

Observations: The armor piece is a composite of original and non-original pieces

Analysis of armor by sections of the armor (Skull would go here):

- Start with main plate (i.e. for helmets, start with the skull), from there discuss plates attached to main plate (i.e. for helmets, upper bevor, lower bevor, visor proper, and gorget plates)

Structure: The structure section contains the functional physical features and articulations of the piece. Remember to mention what features contribute to the originality of the piece and what features imply the piece is not original. Also, this section discusses how the piece relates to other parts of the suit - attachments, etc.

Decoration: The decoration section covers the decorative features of the piece. This includes color, gilding, roping, rivet caps, etching, embossing, in-laying.

Marks: The marks section discusses assembly marks (notched indents), bevel marks (notches on edges), other marks (dots on armor), and armorer marks (stamps).

Manufacture: The manufacture section contains information on how the piece was made, including good/poor craftsmanship, turned edges, hammer marks, etc.

Bibliography: The bibliography section covers related examples or other information related to the piece.

Photos Appendix Add any photos referred to in the analysis of the piece. Any number in parenthesis is a reference to a picture within the photo appendix.

Video Script

Intro
- Brief introduction to armor
- Quick overview of the project

Break Down of Armor
- Introduce Blue Steel - #2879
  1. Helm
     - The helmet is of good craftsmanship and mostly original
     - It is a good example of the mobility and flexibility of armor
  2. Breastplate/ lance rest/ cod piece
     - Single ridge breastplate
     - Gussets move in and out because of a sliding rivet
     - Lance rest - Decoration doesn't match suit and has 2 bolts to connect unlike breastplate that has 4 holes
     - Cod piece – It connects to the breastplate with a locking pin on the third lame of the skirt on the breastplate.
  3. Backplate
     - Connects to the breastplate with two studs on the shoulders but one side is missing the stud and connects near the arm holes with studs.
  4. Pauldron
     - The pauldrons are asymmetrical and have different assembly marks
     - They are articulated by rivets and leathers and attach to the backplate and wrap around the arm with leathers
  5. Arm Harness
     - Each arm harness connects to the pauldrons and the tuner
     - The arm harness has good mobility
  6. Gauntlet
     - Gauntlet provides a wide range of motion to the wearer
     - The thumb is protected thoroughly
     - The left gauntlet has been repaired and has lost some of its protection
  7. Poleyn
     - Connects to the sabatons with the two holes on the bottom that lock into pins on the sabaton
     - Quatrefoil on knee caps
  8. Sabaton/Greave
     - Pins with hook locks connect the two plates of the sabatons
     - Quatrefoil on toe caps
     - Documentation plate has been hammered into the interior of the right sabaton and says that toe caps, waist armor, parts of the cuissards, 1 poleyn, 1 back of lower leg is modern and was done by R. Bartel in 1916
     - Conclusion

Credits

Introduction:

Body armor has been around since the ancient period. During most of the Middle Ages, the predominant type of body armor was essentially a robe made up of small interlocking iron links known as mail armor. During the 1200s, armor started its evolution into full suits of articulated plate steel that provided the wearer with impressive protection from the 1400s through the early 1600s. However, with more efficient training of infantry, combined with the increasing importance of firearms and necessity for added mobility, the bulky, restrictive suits were left behind by 1700.

A typical full suit of armor might weigh about 45-60 pounds. On average, a full suit would be made up of about 12 pieces; however, some suits consisted of upwards of 20 separate pieces. Since mobility was one of the most important characteristics of a suit, the joints were usually made of articulated plates to increase flexibility. Craftsman spent endless hours heating and hammering pieces of metal in order to create the perfect plate armor.

As powerful firearms came into play in the 1500s, the popularity and appeal of wearing armor dropped significantly and by 1700 it had largely become obsolete. By 1800, it had acquired a new importance as a collectible artifact. Some people collected armor for show, some to display their political power, some as a relic of the past, and others to advance scholarly knowledge. Collectors and dealers also refurbished and repaired their suits of armor to increase their visual appeal. Most surviving suits of armor are actually "composite" suits which consist of pieces of armor from multiple sources that were assembled together as a full suit.

Overview of the project:

This video documents the work of our team of research interns from Worcester Polytechnic Institute who studied a composite suit, HAM #2879, in the Higgins collection. Our research involved weeks poring over books in the Higgins Armory library, as well as studying the plethora of suits displayed in the Higgins collection. Since a composite suit is made up of pieces of armor from multiple sources that were assembled together as a full suit, we researched the evolution of plate armor in its heyday from the fourteenth to the seventeenth century in order to be able to identify the parts of the full harness. Based on this knowledge, we examined the parts of the suit for evidence of when and where each piece was made and how it had been modified since its time of manufacture.

Script

1) Helm
   - The helmet is of good craftsmanship and mostly original
   - It is a good example of the mobility and flexibility of armor
   - Originality theme

Camera In.

This is the helmet. It is possibly the most important piece of armor because it covers the head and face.

Start with a view of the entire helmet and then zoom in to show the roping and gold paint.

The helmet is of very good craftsmanship. The roping along the helmet is very uniform and the surface is very smooth. The blue tint of the steel and gold paint throughout the suit were added in the modern period.

Show the roping and gold paint.

There is an armorer's mark on the back of the skull which is equivalent to a signature of the craftsman. The mark also supports the idea that the skull is an original artifact.

Zoom in on the armorer's mark (or show a screen shot of the rubbing).

The visor proper and upper bevor can be raised to add increased visibility and air flow.

Press the buttons to release the upper bevor and the visor proper.

The many holes for ventilation on the visor proper and the upper bevor are not symmetrical. The inconsistencies of these holes suggest that these pieces are modern.

Zoom in on the holes.

The gorget plates, like the upper bevor and visor proper, have sets of equally spaced assembly marks.

Show the assembly marks.

Camera Out.

3) Breastplate/ backplate/ lance rest/ cod piece
   - Single ridge breastplate
   - Gussets move in and out because of a sliding rivet
   - Lance rest - Decoration doesn't match suit and has 2 bolts to connect unlike breastplate that has 4 holes
   - Cod piece – It connects to the breastplate with a locking pin on the third lame of the skirt on the breastplate.
   - Connects to the breastplate with two studs on the shoulders but one side is missing the stud and connects near the arm holes with studs.
   - Functionality theme

Next is the breastplate, backplate, lance rest, and cod piece. These pieces of armor were designed to protect the torso of the wearer.	*Camera In: Johnny on screen with breastplate lance rest, cod piece, and backplate.*
It is a single ridged breastplate with gussets at the armpits that use sliding rivets to move in and out. The roping on the gussets is a turned edge, which increases the strength of the edges.	*Point out the ridge. Move gussets in and out Show the roping on the gussets*
The tassets and the skirt hang below the breastplate and protect the thighs.	*Point out the tassets and skirt.*
The lance rest is a removable piece that connects to the breastplate with two bolts.	*Hold lance rest and show the bolts.*
The cod piece is a removable piece that connects to the breastplate with a locking pin.	*Hold the cod piece and show the locking pin.*
The backplate connects to the breastplate with studs on the shoulders and under the arm holes. There are assembly marks on the lames of the neck just like the helm.	*Point out where the backplate connects to the breastplate and the assembly marks on the lames of the neck.*
The assembly marks on the armor match the marks on the visor proper and upper bevor indicating that the pieces were repaired at the same time as they are not original.	*Zoom out to whole suit. Camera Out*

2) Pauldron
   - The pauldrons are asymmetrical and have different assembly marks
   - They are articulated by rivets and leathers and attach to the backplate and wrap around the arm with leathers

Camera In

These are the pauldrons or shoulder pieces.

Show the two pauldrons next to each other for comparision.

They are asymmetrical in shape. The left side of the body required extra protection during combat and the right side needed extra space for a lance.

Show the pauldrons side by side to show asymmetry.

There are different assembly marks on each pauldron which means they may have been assembled by two different people. The bottom lame of the left pauldron has been repaired.

Zoom in on the assembly marks to show the difference

Notice the discoloration of the lame compared with the rest of the pauldron. The repair was of poor craftsmanship as seen in the poor gold paint job and the space between the lames.

Zoom in on the discolored lame.

The left pauldron is therefore not entirely original but it may have been assembled from old pieces of armor.

Camera Out.

4) Arm Harness
   - Each arm harness connects to the pauldrons and the tuner
   - The arm harness has good mobility

Camera In.

These are the vambraces or arm harness. They cover the majority of the arm and the elbow.

The turner is connected by a rotating groove to allow the arm to twist.

Show that the turner groove allows shoulder to turn 360˚ in respect to the rerebrace.

The lames of the couter allow the arm to flex with out exposing the elbow.

Flex the elbow and demonstrate how the lames allow no gaps between couter and rerebrace or vambrace.

The armor covering the forearm, has hinges for easy fitting in order to be snug once the harness is closed around arm.

Clip and unclip the studs to demonstrate ease of vambraces fit.

Even though the mechanics are nearly identical the left arm harness has significantly more heat treatment discoloration suggesting a modern restoration.

Zoom to a view to see the difference in discoloration of the two arm harnesses.

5) Gauntlets
- Gauntlet provides a wide range of motion to the wearer
- The thumb is protected thoroughly
- The left gauntlet has been repaired and has lost some of its protection

These are the gauntlets. They protect the hand, fingers and wrist.	*Adjust camera to view gauntlets.*
A series of articulated lames cover the knuckles and fingers allowing the hand to be flexed without exposing the fingers.	*Pick up a gauntlet and bend the lames to show flexing*
The thumb is hinged with a series of articulated leathers that offer the thumb full mobility and protection.	*Show how much the thumb can bend and twist*
The gauntlets have two types of manufacturing marks. The assembly marks on the cuff are like the ones on the gorget plates and there are bevel marks on the inside edges of the lames. Two types of manufacturing marks indicate two separate repairs and like the pauldrons, the different types of marks indicate a possible restoration of either gauntlet.	*Zoom into gauntlets interior.* *Point out the different marks.* *Camera Out*

6) Poleyn
   - Connects to the sabatons with the two holes on the bottom that lock into pins on the sabatons
   - Quatrefoil on knee caps

	Camera In: Keith on screen with poleyns and sabatons/greaves.
Now here are the poleyns which protect the knee.	*Show how it covers the knee.*
The poleyns connect to the tassets with the leather on the top of each poleyn.	*Point out the leathers on the top of the poleyns.*
The poleyns' eight lames are connected with a combination of rivets and leathers to hold the lames in place for additional mobility. This method of connecting lames is common throughout the suit of armor.	*Point out the eight lames and the leathers and rivets that connect the poleyn to the leg.*
There are four leathers attached to each poleyn for strapping them to the wearer's legs.	*Manipulate the poleyn to view the the leather straps.*
On the bottom of each poleyn there are two holes that connect to the pins on the greaves and lock into place with hooks.	*Show on the greaves where the poleyns lock onto them.*
The decorative quatrefoils on each knee cap are slightly different. The left quatrefoil is of less quality than the right indicating a replaced plate.	*Point out the differences of the quatrefoil crests.*

7) Sabaton/Greave
   - Pins with hook locks connect the two plates of the sabatons
   - Quatrefoil on toe caps
   - Documentation plate has been hammered into the interior of the right sabaton and says that toe caps, waist armor, parts of the cuissards, 1 poleyn, 1 back of lower leg is modern and was done by R. Bartel in 1916

Lastly, here are the sabatons and greaves.

Adjust camera view towards the sabatons and greaves.

The greaves are two plates connected with pins and hooks to lock them in.

Show the left greave closed and the right greave open. Show the pins and hooks and how they connect.

The sabatons cover the feet and are made with articulating lames, mail and toe caps.

Show the articulation, the mail, and the toe caps on the sabatons.

There are embossed decorations on the toe caps.

There is also a documentation of repairs on a armor. The inscription is on the interior plate of the right greave. It reads as follows:

Point out the quatrefoils.

"Toe caps, waist armor,
parts of [cuissards], 1 knee, 1 back
of lower leg modern.
Restoration by R. Bartel 1916"

Camera Change: Zoom in on the inscription on the plate for its explanation.

Camera Out:

Conclusion:

We hope you enjoyed our analysis of this suit of armor. For more information about our project, Suit #2879, or armor in general, visit our website at:

 The inscription describes the replacement of missing pieces by Raymond Bartel, armorer at the Metropolitan Museum of Art, in 1916. The reference to a replaced poleyn confirmed our finding that the knee caps of the poleyns do not match. The left poleyn is of poor craftsmanship and most likely the replaced one.

The inscription also documents the creation of toe caps. Again, this confirms the team's finding. The mail links connecting the toe caps are not riveted, and must have been made in the modern period, so the toe caps were also likely to be modern.

Our team found evidence that visor proper and upper bevor were also modern. The ventilation holes are not symmetrical and lack the craftsmanship some of the others pieces possess. This is not mentioned in the inscription, which suggests that the repairs done in 1916 were not the first repairs done to this armor in the modern period.

There is still much to be learned about this armor. There are three armorer's marks on the suit: one on the skull, one on the pauldron, and one on the tassets. At this time, we have not been able to identify any of the armorers, but future teams could investigate the origins of the marks in order to identify their creators.

The knowledge we gained while researching the evolution of armor combined with the opportunity to analyze a five hundred years old suit of armor was an amazing experience. Even after this project has long since ended, we will always be proud of the numerous important discoveries we made and all the useful information we gathered. We hope you enjoyed sharing in our discoveries today.

Credits:

Written, Directed and Produced by

Keith Coleman
Alex Knight
Angela Leo
Johnny Prudente

Narrator

Angela Leo

Faculty Advisor

Jeffrey Forgeng

Special Thanks:

Higgins Armory for providing the team with a plethora of resources on armor

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Jeffrey Forgeng for advising the team during the project

Alex Masi for allowing the team to use his music

THE CLASSIC SUIT OF ARMOR

Project Proposal

By

Keith Coleman

Alex Knight

Angela Leo

John Prudente

December 11, 2005

Introduction

During the course of *The Classic Suit of Armor*, a survey of the evolution of plate armor in its heyday from the fourteenth to the seventeenth century as well as an investigation of a composite suit of armor of the Higgins Armory Museum will occur. The Armory houses over 100 complete suits of armor, as well as many single pieces that demonstrate the evolution of armor from the Greek helmets of the B.C era to the ornate full harnesses of the 1600s and the eventual decline of armor as new firearms emerged. Throughout the project, the Higgins Armory library as well as the plethora of suits displayed there will be used to compile information.

Initially, body armor was developed in order to defend against the piercing blows of hand-to-hand combat. One type of body armor was essentially a robe made up of small interlocking chain links known as mail armor. Over time, armor evolved into full suits of plated steel that provided the wearer with impressive protection. However, the more efficient training of infantry, combined with the necessity for increased mobility, caused the bulky, restrictive suits to be left behind. As more powerful weaponry came into play, the popularity and appeal of armor dropped significantly and eventually, armor became obsolete.

A composite suit is made up of pieces of armor from multiple sources that were assembled together as a full suit at some point in history. Therefore, much research is needed in order to learn information about the full harness. Besides researching the origin of the composite suit, we will also be examining and photographing the parts of the suit for the web database. Thus, any visitor to the website will be able to have an in-depth look at the composite harness. The website will also contain general facts about armor as well an interactive armor identification section. In addition to the website, a hardcopy report of our findings, as well as documentation of the processes performed during the project and electronic copies of all materials will also be produced.

Plan of Work

Term 1

General Tasks

Week 5:
- Artifact and photography orientation
- Select candidate harnesses for study

Week 6:
- Select final harness
- Outline of website contents
- Acquire any supplies for artifact study and photography
- Discuss term 2 tasks

Week 7:
- Full draft of all research documents
- Finalized architecture of website
- Portfolio of materials submitted during the term
- Return all borrowed items
- Update plan of work

Individual Research and Writing

Each week, each team member will submit a research subdocument on the assigned topic, along with any revisions required from previous weeks. The topics for each week will be as follows.

Armor Manufacturing (Keith)

Week 1: Context of production (Craftsman, guilds, etc.)

Week 2: Metallurgy

Week 3: General Design and Production (shaping, heating, molding)

Week 4: General Design and Production (decoration)

Week 5: Physics of armor-physical properties of armor, etc.

Week 6: Sharing of sub documents

Week 7: Gather images

Armor Evolution, Cultural and Societal, Web Site Production (John)

Week 1: Research armor used by heavy and light cavalry (Post-Maximilian-1650)

Week 2: Research armor used by infantry (Post-Maximilian-1650)

Week 3: Research armor used by jousters (Post-Maximilian-1650)

Week 4: Setup MySQL server and working database

Week 5: Setup web server

Week 6: Sharing of sub documents

Week 7: Gather images

Armor Evolution by Piece/Types of Harnesses (Angela)

Week 1: Helmet

Week 2: Torso armor

Week 3: Arm and shoulder armor

Week 4: Hand and foot armor

Week 5: Leg and miscellaneous armor

Week 6: Sharing of sub documents

Week 7: Gather images

Armor Evolution, Cultural and Societal (Alex)

Week 1: Research armor used by heavy and light cavalry (1350-Maximilian)

Week 2: Research armor used by infantry (1350-Maximilian)

Week 3: Research armor used by jousters (1350-Maximilian)

Week 4: Research on unusual armors

Week 5: Effects of European events on armor evolution (wars, renaissance, etc.)

Week 6: Sharing of sub documents

Week 7: Gathering images

Term 2

This term will chiefly be given to artifact study and photo documentation; after each photography session the images will be reviewed and edited as necessary. Each team member will also be individually finalizing the content of their draft, and writing up a part of the report of the selected harness.

Week 1:

- Gather all photos and documents on selected suit.
- Begin artifact study
- Input information into database.
    - Alex—Arm, hand & shoulders.
    - Angela—Helmets
    - Keith—Leg & foot & miscellaneous
    - John—Torso.

Week 2:

- Organize photos and documents.
- Input information into database (con't).

Week 3:

- Begin artifact writeups
- Database pilot completed
- Task list for website.

Week 4:

- Samples of website components to be accessible online.
    - Navigation bars & active links.
    - Website layout complete.

Week 5:

- Begin suit writeup
- Deadline for updated versions of individual research documents and draft documents on selected harness.

Week 6:

- Team to submit updated SOP for hardware and software used (e.g. camera).

- Discuss tasks for term 3.

Week 7:

- Return all loaned material.

- Each team member to submit finalized research document.

- Each team member to hand in a portfolio of materials submitted during the term.

- Team to submit all artifact documentation materials generated during the term (e.g. artifact photos).

- Update plan of work.

- Finalized write-up on harness.

Term 3

This term will be spent finalizing the product in electronic and hardcopy format.

Week 1:

- Team to finalize introduction for the website, homepage text, all website components and texts
- Submit final draft of suit write-up
- Full draft website accessible (Johnny)
- Finalized video script (Angela and Keith)
- Tape breastplate, lance rest, cod piece, and backplate

Week 2:

- Draft conclusion (Alex)
- Draft of the introduction (Angela)
- Edit breastplate, lance rest, cod piece, and backplate
- Tape helmet, pauldrons, poleyns

Week 3:

- Draft abstract (80 words maximum), (Angela)
- "About us" text and photos (Alex and Keith)
- Website documentation (including images) for project report (Johnny)
- Edit helmet, pauldrons, poleyns
- Tape greaves/sabatons, gauntlet, arm harness

Week 4:

- Full draft of project report and updated website.
- Edit greaves/sabatons, gauntlet, arm harness
- Tape introduction and conclusion components

Week 5:

- Updated project report and website.
- The final version of the video
- All materials to be submitted on CD rom, including website, electronic version of the project report (MS Word and pdf versions), final project proposal (MS Word

only), and any electronic material created by the team (e.g. photographs, website, programs, etc.).

Week 6: (we don't have a week seven because Angela is graduating)

- One CDR form from each team member, with personal information and abstract filled in.

- 3 bound hard copies of the project report for the whole team (1 in color).

- 2 cd-roms containing an electronic version of the project report (MS Word and pdf versions), project proposal (MS Word only), and any electronic material created by the team (e.g. photographs, website).

- Portfolio of materials submitted during the term.

- Documentation of all permission letters sent and received.

- All loaned material.

Annotated List of Sources

<u>Armor and Arms</u>

Manufacturing

Edge, David and Paddock, John. *Arms and Armour of the Medieval Knight.* **Greenwich, CT: Crescent Books, 1988. ***
-Thirteenth to sixteenth century history of armor
-Good illustrations

Ffoulkes, Charles F. *The Armorer and His Craft.* **London: Methuen & Co. Ltd., 1912.**
-Detailed discussion of armor design and construction
-Why armor was designed the way it was
-Not a good general reference

Fliegel, Stephen. (1997). *The Making of Armor.* **Cleveland: The Cleveland Museum of Art.**
-Describes all major manufacturing techniques used by armorers
-Describes certain suits of armor and how they were designed uniquely for individuals and troops

Flint Institute of Arts. (1967). *The Art of the Armorer.* **Flint Michigan: The institute. ***

Gamber, Ortwin. *Glossarium armorum.* **Graz, Akadem. Druc- u. Verlagsanst. 1972.***
-Glossary of armor, text is in Czech, Danish, French, German, Russian, Spanish, Polish and Italian.

Pfaffenbichler, Matthias. *The Armourers. Medieval Craftsmen Series.* **Toronto: University of Toronto Press. 1992.**
-Describes how the armorers had their own unique design for the pieces they created

Price, Brian. (2000). *Techniques of Medieval Armour Reproduction.* **Boulder: Paladin Press.**

Stone, George Cameron (1934). *A Glossary of the Construction, Decoration, and Use of Arms and Armor in all Countries and in all Times***: Southworth Press. ***
-Very old, and subject to the limitations of any pioneering reference work, but still one of very few general reference works on the subject.
-Good encyclopedia
-Great armor section with illustrations for each time period.

Armor Evolution by Piece

Blackmore, Howard L. *Arms and Armour.* **London: Studio Vista, 1965. ***
-Information on early plate armor with illustrations
-Follows evolution/decline of armor

Blair, Claude, and Leonid Tarassuk, eds. *The Complete Encyclopedia of Arms and Weapons.* **New York: Simon and Schuster, 1982.**

-Good reference; more for orientation than research

-Great picture of armor terms

Blair, Claude. *European Armour* circa *1066 to* circa *1700*. **London: B.T. Batsford, Ltd., 1958; 2ⁿᵈ ed. New York: Crane, Russak and Co., 1972. ***

-Detailed descriptions

-Good for researching our suit of armor since it includes drawn-out discussions of particular designs

-Key source

Edge, David and Paddock, John. *Arms and Armour of the Medieval Knight.* **Greenwich, CT: Crescent Books, 1988. ***

-Thirteenth to sixteenth century history of armor

-Good illustrations

Ffoulkes, Charles F. *Armour and Weapons.* **Oxford, Clarendon Press. 1909. ***

-Whole chapter on plate armor

Flint Institute of Arts. (1967). *The Art of the Armorer*. **Flint Michigan: The institute. ***

Gamber, Ortwin. *Glossarium armorum.* **Graz, Akadem. Druc- u. Verlagsanst. 1972.***

-Glossary of armor, text is in Czech, Danish, French, German, Russian, Spanish, Polish and Italian.

Kottenkamp, Dr. F. *History of Chivalry and Ancient Armour.* **Translator: Rev. A. Löwy. London: Willis & Sotheran, 1857. ***

-History of armor broken down by structure (helmets, body, etc.)

Laking, Sir Guy Francis. *A Record of European Arms and Armor (5 Volumes).* **London: Chiswick Press, 1920.**

-First 4 volumes pertinent to project

    -Volume 2—helmets etc.

    -Volume 3—body/types of armor

    -Volume 4—helmets/weapons

-Maybe good for identifying our suit

Laking, Sir Guy Francis. *Catalogue of the Wallace Collection of European Arms and Armour Part I & II*. **London: Hartford House, 1924.**

- Exhibition catalog

Morrison, Sean. *Armor*. **New York: Thomas Y Crowell Company, 1963.**

-Not a lot of pictures

-Not very specific

-Easy reading and good for a quick overview

Oakeshott, Ewart. *A Knight and His Armour.* **North Hollywood: Beinfeld Publishing Inc., 1982.**

    -May not be an accurate reference

Oakeshott, Ewart. *European Weapons and Armour.* **North Hollywood, CA: Beinfeld Publishing, Inc., 1980. ***

-Helmet information

-Tournament armor

-May not be an accurate reference

Stone, George Cameron (1934). *A Glossary of the Construction, Decoration, and Use of Arms and Armor in all Countries and in all Times*: **Southworth Press. ***

-Very old, and subject to the limitations of any pioneering reference work, but still one of very few general reference works on the subject.
-Good encyclopedia
-Great armor section with illustrations for each time period. (about 40 pages)

Armor Evolution, Cultural and Societal (types of harnesses)

Ashdown, Charles Henry. *European Arms and Armour.* New York, NY: Brussel & Brussel, 1967
-Extensive information about evolution of armor
-old source; first published in the 1800s

Blackmore, Howard L. *Arms and Armour.* London: Studio Vista, 1965. *
-Information on early plate armor with illustrations
-Follows evolution/decline of armor

Blair, Claude. *European Armour* circa *1066 to* circa *1700*. London: B.T. Batsford, Ltd., 1958; 2nd ed. New York: Crane, Russak and Co., 1972. *
-Detailed descriptions
-Good for researching our suit of armor since it includes drawn-out discussions of particular designs
-Key source

Boalt, Gunner, et al. *The European Order of Chivalry*. Stockholms Kungl. Boktrycheriet P.A. Norstedt & Söner. 1971.
-Great description of orders in the crusades and plate mail eras.

Clephan, Coltman R. *The Tournament, Its Periods and Phases*. London: Methern & Co. Ltd., 1919.
-Whole thing looks useful, all tourney stuff

Contamine, Philippe. *War in the Middle Ages*. New York, NY: Basil Blakwell Ltd., 1984.
-Good description of battle tactics

Edge, David and Paddock, John. *Arms and Armour of the Medieval Knight*. Greenwich, CT: Crescent Books, 1988. *
-Thirteenth to sixteenth century history of armor
-Good illustrations

Ellis, John. *Cavalry*. New York, NY: G.P. Putnam's Sons, 1978.
-Good source for cavalry history and strategies

Ffoulkes, Charles F. *Armour and Weapons*. Oxford, Clarendon Press. 1909. *
-Whole chapter on plate armor

***Foot Combat in the Fifteenth & Sixteenth Centuries*. IQP. 1981.**
-Good descriptions of the types of infantry armor

Gamber, Ortwin. *Glossarium armorum*. Graz, Akadem. Druc- u. Verlagsanst. 1972.*
-Glossary of armor, text is in Czech, Danish, French, German, Russian, Spanish, Polish and Italian.

Heer, Eugen and Wilkinson, Frederick. *The Universal Soldier: Fourteen Studies in Campaign Life A.D. 43-1944*. Enfield, Middlesex: Guinness Superlatives Ltd. 1971.
-Very useful first hand accounts to give a feel for life as a soldier.

Hewitt, John (1855-60). *Ancient armour and weapons in Europe: from the iron period of the northern nations to the end of the seventeenth century: with illustrations from contemporary monuments.* **Oxford, London: J. Henry and J. Parker.**
>   -Longwinded History but valuable

Keegan, John. *The Face of Battle.* **The Viking Penguin Inc., 1976.**
>   -Great description of English long bowmen tactics (late 14th early 15th century)

Kenseth, Joy. *The Age of Marvelous: An Introduction.* **Hanover, NH: Trustees of Dartmouth College. 1991.**
>   -Describes many European Events that occurred between 1100 and 1850 and their effects

Kottenkamp, Dr. F. *History of Chivalry and Ancient Armour.* **Translator: Rev. A. Löwy. London: Willis & Sotheran, 1857. ***
>   -History of armor broken down by structure (helmets, body, etc.)

Laking, Sir Guy Francis. *A Record of European Arms and Armor (5 Volumes).* **London: Chiswick Press, 1920. ***
>   -First 4 volumes pertinent to project
>   -Volume 1—general history
>   -Maybe good for identifying our suit

Laking, Sir Guy Francis. *Catalogue of the Wallace Collection of European Arms and Armour Part I & II.* **London: Hartford House, 1924. ***
>   - Exhibition catalog

Miller, Douglas. *The Landsknechts.* **London: Osprey Publishing Limited, 1976.**
>   -Good source of infantry tactics during the 16th century
>   -Good source of pictures of formations often used

Miller, Douglas. *The Swiss at War 1300-1500.* **London: Osprey Publishing, 1979.**
>   -Good source of Swiss tactics.

Norman, Vesey (A.V.B.). *Arms and Armour.* **London: Octopus Press, 1972.**
>   -Looks informative
>   -Good for history overview
>   -Awesome illustrations

Norman A.V.B., *Treasures from the Tower of London.* **London: Lund Humphries Publishers Ltd. London, 1982.**
>   -Good history of Arms and Armor

Oakeshott, Ewart. *European Weapons and Armour.* **North Hollywood, CA: Beinfeld Publishing, Inc., 1980. ***
>   -Helmet information
>   -Tournament armor
>   -May not be an accurate reference

Wilkinson, Fred. *Arms and Armour.* **London: Hamlyn Publishing Group Ltd., 1978.**
>   -Good illustrations

Catalogs of Armor

Bruno Thomas and Ortwin Gamber. *Katalog Der Leibrustkammer.* **Austria: Kunsthistorisches Museum und Anton Schroll & Co Alle Rechte Vorbehalton, 1976.**
>   -Good pictures for comparing chosen armor to

Ffoulkes, Charles John, *Inventory and survey of the armouries of the Tower of London***. London, H.M. 1916.**
    -Inventory and information on the London armories.
Grancsay, Stephen V. *Catalogue of Armor: The John Woodman Higgins Armory Museum***. Worcester: Higgins Armory Museum, 1961.**
    -The original silver-colored catalogue, almost exclusively of armor. Must be used with caution, as much of the information is outdated.
    -Limited use for general resources
Karcheski, Walter J., Jr. *Arms and Armor of the Conquistador, 1492-1600***. Gainesville, FL: Florida Museum of Natural History, 1990.**
    -Exhibition pamphlet catalogue; topical essay and artifact entries; out of print, but available through the Higgins Armory Museum Store.
    -limited use for general research
Wallace Collection and Guy Francis Laking. *Catalogue of the European armour and arms in the Wallace collection at Hertford House***. Under the authority of the Trustees. London, Printed for H.M. Stationery off. 1910.**
    -Catalogue of the Wallace collections European armor and arms.
Wallace Collection and J. G. Mann. *General guide to the Wallace Collection. Brief guide to the arms and armour***. London : Printed for the Trustees of the Wallace Collection. 1938.**
    -A brief guide and overview to the Wallace Collection.

Web Design and Management

Concepcion, Anne-Marie. *Professional Website Design from Start to Finish.* **Cincinnarti, Ohio: F&W Publications, Inc., 2001.**
    -Step by step how to make a website book
Flanders, Vincent. *Son of Web Pages That Suck: Learn Good Design by Looking at Bad Design.* **USA: Flanders Enterprises, Inc., 2002.**
    -A good entertaining book to teach how to make a website
Koch, George and Loney, Kevin. *Oraclei: The Complete Reference.* **Berkeley, California: McGraw-Hill Companies, Inc., 2002.**
    -A great reference on how to use oracle9
O'Reilly, Jennifer Niederst. *HTML Pocket Reference, 2ⁿᵈ Edition.* **USA: 2002.**
    -An up to date HTML book that has useful charts of character entities and decimal-to-hexadecimal conversions
O'Reilly, David Flangagan. *Java In A Nutshell, 5ᵗʰ Edition.* **USA: 2002.**
    -An accelerated introduction to the java programming language and its key APIs

*—denotes book is in more than one section