48-JLS-0069

The Virtual Armory

Interactive Qualifying Project Proposal

Submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for graduation

by

_____ _____

Patrick Feeney Jennifer Baulier

_____

Ian Fite

February 18th 2013

Professor Jeffrey L. Forgeng. Major Advisor

Keywords: Higgins Armory, Arms and Armor, QR Code

Abstract

This project explored the potential of QR technology to provide interactive experiences at museums. The team developed content for selected objects at the Higgins Armory Museum. QR codes installed next to these artifacts allow visitors to access a variety of minigames and fact pages using their mobile devices. Facts for the object are selected randomly from a pool, making the experience different each time the code is scanned, and the pool adapts based on artifacts visited, personalizing the experience.

Contents

Figures

Introduction

Over the past term we have been generating QR based content for the Higgins Armory Museum focused around providing information relevant to artifacts on display. QR content is a relatively new area for museums to explore; hence the Higgins Armory Museum was interested in testing out the uses of this technology. Our project is on the forefront of developing interesting and informative QR based experiences for museum patrons.

There are many possible benefits for the use of QR content in a museum setting. One benefit that pertains particularly to museums is the ability to add information without filing up space or spending time and money rearranging existing exhibits. An extensive amount of text can overwhelm the standard museumgoer. Many people would not wish to stand at one location for too long reading information. QR content is a way to make information available for those who desire it without overwhelming the casual visitor.

QR content is also a way to create a more specialized experience for the museumgoer. The patron can choose to glance over things of less interest but delve into topics that excite them. Furthermore the creator of the content, through the simple use of cookies, can adapt content based on things the patron shows interest in. We scratched the surface of this possibility in our project by having random fact pages that will only show certain facts if the patron has already looked at the QR pages for other specific items. These facts related the current artifact to the earlier one, helping the reader notice connections between the two and further their knowledge of both.

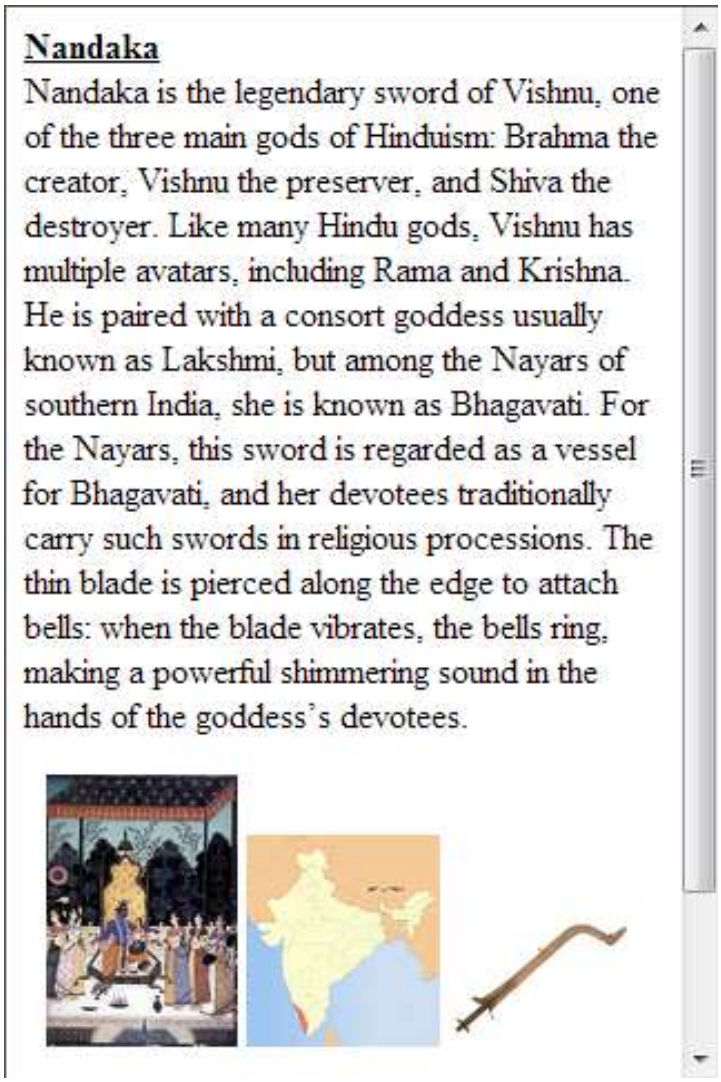
QR content can act as a branching point for those who wish to continue to seek information. Our fact pages all link to the Higgins Armory Museum database. This is an existing resource we were able to easily point patrons to, presenting them somewhere to start if they wish to continue their research. The fact that you can easily connect information to existing content is also a benefit in terms of time and money. Saving time is something QR content is generally good at. Often times it is rather easy to set up a template so that additional pages and information can be added, and it is normally less costly to program a webpage than to install a new display.

QR content presents an opportunity for visual and audiovisual learning experiences as well as interactivity that could not be possible otherwise. A museum that deals with artifacts could use virtual tools to give a better idea of what the artifact would have looked like when it was created and how it would have been used. Interactivity is useful in helping people learn and actually remember the content that is learned.

Our IQP focuses on QR based content aimed to improve the visitor‟s experiences while at the Higgins Armory Museum. Alongside our QR content each of us did research on four different artifacts that were intended to fit into an overall category. We also branched out and did other tasks meant to help with the Higgins website, database, and hard drive of archival footage.

Our work on QR content branched into three parts. One of those parts involved continuing work started by an early group, and the other two involved our own personal research. The previous group had created four QR labels that linked to pages in the virtual tour that they had helped design. These pages were for the nandaka, warhammer,

katana, and matchlock musket. The information displayed well on a computer monitor but was hard to read on a mobile device. Our first task related to QR content was to take the pages they created and design a second version that was explicitly intended to display well on mobile devices. We also created new QR label sheets that gave a description and linked to the new pages. These labels are to be displayed in the museum next to the corresponding artifact in the museum.



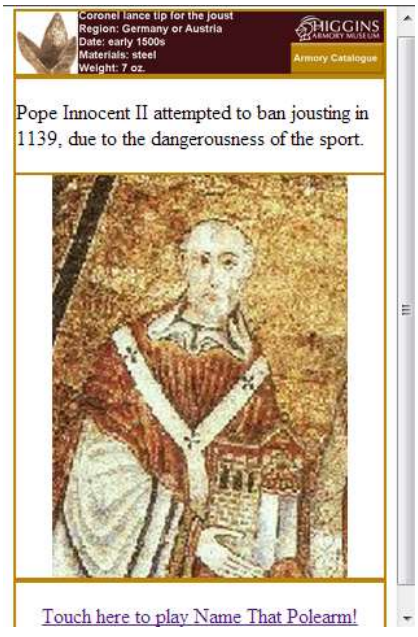
(Nandaka front page reformatted to fit well on a phone)

Nandaka (sword of Vishnu)
Southern India, c. 1600's
Steel; silver; iron
Weight: 1 lb. 13 oz.
Accession number: 1495

Nandaka image page reformatted for phone

Our second QR related endeavor took on several iterations. We wanted a way to display info on various artifacts that would adapt and change to make connections to artifacts the user had already visited. We started with the idea of giving a few paragraphs of information that would integrate in certain sentences that made connections to other items visited. It was felt that this was more than the average user desired to read and the connections didn"t seem to be adding greatly in some cases. Through several iterations the professor moved this project towards its final form. Now when the user scans the QR

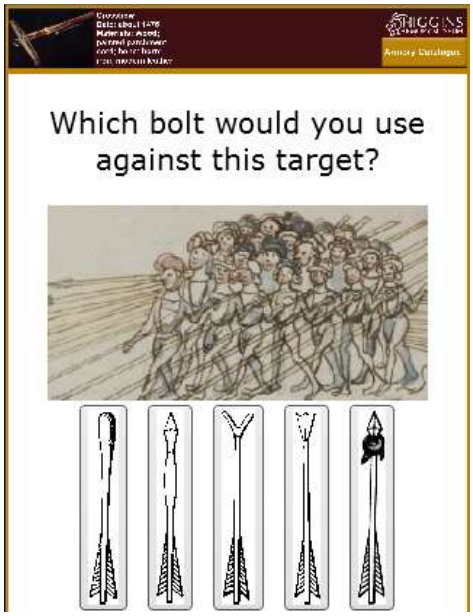
code for an artifact they will reach a page that displays info on the artifact on the top bar, a fun fact, and a large image relevant to the fact. The top bar contains a small image of the artifact that links to its database lookup, and the info in the bar includes things such as material and location. The fun fact is randomized each time someone accesses the page. The list of possible fun facts consists of ten base facts and a set of facts that relate the current artifact to other artifacts. The random generator will only consider facts from the second list if the patron already visited the related artifact. We wanted to keep this aspect of our original idea because the professor felt it was innovative and that few museums present an experience that adapts based on what the patron has been interested in visiting. He also felt that it was an interesting idea to present experiences that differed each time the patron went back for information. The bottom of the page links to a game, which is the final part of our QR content. The artifacts that have the fun fact pages are the knightly sword, the crossbow, and the coronel lance tip for the joust.



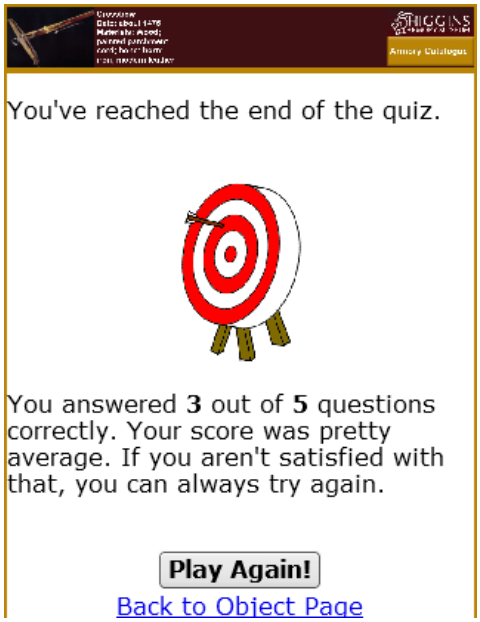
(Examples facts and images from two different artifacts)

The final portion of our QR content was a set of interactive games. Each of us made one game that included some information on our corresponding item from our fun fact page but could also include info on other items we researched.

Ian, who did the page on the crossbow, created a game in which the player matches a target to the crossbow bolt that would be used on that target. After guessing the player will receive info on the correct target and why the given bolt would have been used. Artwork from the medieval period is used for the images of each of the target items to keep the graphics thematically relevant and the bolts are black-and-white diagram style images. To make the game more appealing to a young audience the player"s end score is represented by an image of an arrow hitting various rings of an archery target.



(One of the question pages)



(One of five possible end game results)

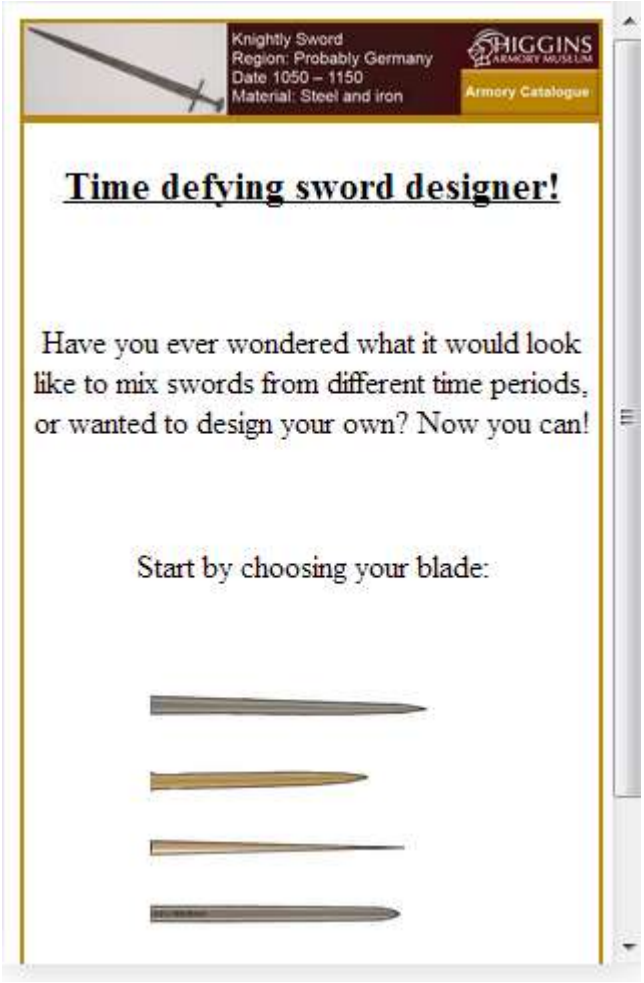
Patrick‟s fact page was about the coronel tip used on jousting lances, and his game was a quiz challenging the player‟s knowledge of different types of polearm. The player would be presented with a name and 3 images and would have to determine which image the name corresponded to. If they pick correctly they would get info on the item selected and if they do not they will get info on the similarities and differences between their choice and the correct answer. All of the images are pictures of actual artifacts from the museum so visitors can directly relate the facts to things they have seen.

(Example question)

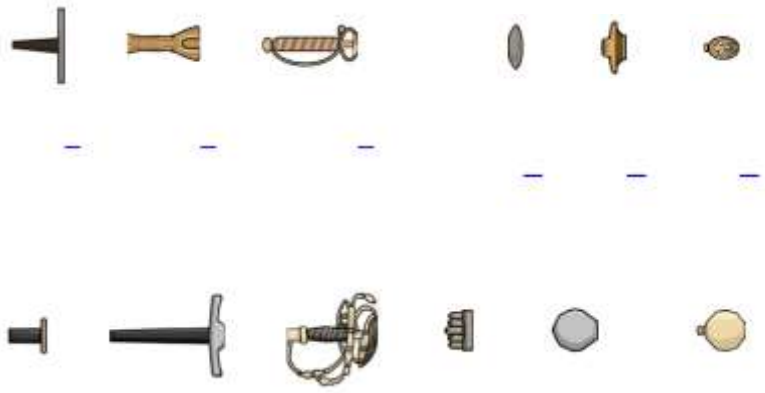
(Possible endgame result)

Jen‟s fact page was on the knightly sword though her game spread to cover different European swords from various time periods. In the game players get to experiment to see what it would look like if they could combine sword parts ranging in origin from ancient times up until the late renaissance. Players design their sword by selecting a blade, a guard and grip combination, and a pommel. Six types of swords were used and broken up into these three parts. Options in each section include a bronze sword, a Viking sword, a knightly arming sword, a hand-and-a-half sword, a rapier, and a smallsword. Images are stylized and are hand drawn in computer graphics software such as Photoshop. This was done so that parts will fit easily together, look similar enough in appearance and quality, be representative of what the sword would look like new at the time, and would be informative in a similar way that a diagram would. At the end players receive info on their selected sword. If they choose all of one type of sword they will get a short paragraph all about that sword type. If they chose a mix of parts then there

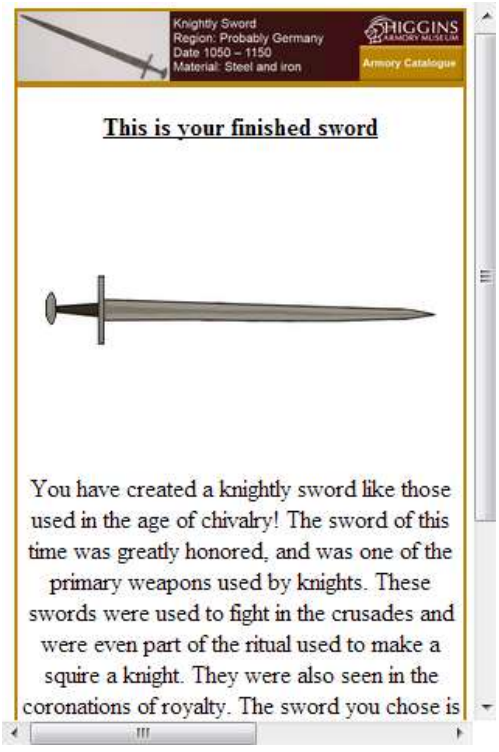
paragraph will contain info on each part individually and why the part would look how it did given the sword it came from.



(Front page)



(Choices for guards/grips and choices for pommels)



(one possible result)

To begin our QR project work each of us researched one major topic consisting of four subtopics. Prior to our research we created a bibliography of useful information relevant to each of our topics. During the research phase we all took notes from a large range of sources, focusing on one sub-topic at a time, and compiled our notes into a research paper for each subtopic.

Jen researched European swords broken into categories based on time periods: Bronze Age swords, Viking swords, medieval and early renaissance swords, and rapiers and smallswords. Through her documents it is possible to see how the European sword advanced over time. Patrick did research relating to European-style polearms in four subcategories: spears and their history, from ancient times through the use of bayonets, the history of staff weapons derived from civilian farming implements, the development and impact of halberds on medieval warfare, and the history and development of cavalry lances. Ian researched various ranged weapons from around the world. His topics include the crossbow, early European firearms, the Japanese longbow and archery techniques, and African throwing knives.

Outside of our research and QR work we had several tasks aimed to improve the Higgins Armory‟s website, database, and hard drive content and organization. Early on we made a list of needed changes to the website and we did edits to some content in the website‟s Virtual Tour section. We updated the database and fixed some problems that were causing data to show up incorrectly. We then made a list of improvements that the database needed, and intended to help implement them. An outside party came along with interest in fully reworking the database so the task was handed over to them. Another task

outside of our main focus was to come up with a system of cataloging the armory‟s hard drive, and using it to make it easier to navigate through all of the video files on the drive. This involved a table with keywords, video thumbnails, and short descriptions placed into the root folder. The table was organized as to resemble the file path in the database.

The Double Edged Sword in Europe

Researched by Jennifer Baulier

The European Bronze Age Sword

The first appearance of a weapon that could actually be considered a sword occurred during the Bronze Age. Despite this, it is important to take a brief look at edged weapons that came before in order to get a better idea of the overall progression.

Ancient edged weapons prior to the Bronze Age

Flint was one of the primary materials used for edged weapons. Flint that resided in riverbeds sometimes gained a sharp edge over time as a result of movements in the water and erosion against various items. It is very likely that man found these sharpened stones near rivers and saw the potential to use them as tools. These tools have been called eoliths or „dawn stones". Some of the eoliths found appear to have man-made edges, implying that man learned to sharpen the stones themselves recreating that which they found in nature. Flint stones used as tools developed into hand axes and later, around 6000 BC, they were used to form the heads of arrows, axes, and clubs. Flint tools and weapons were produced in such great numbers that at one archeological site 459 hand axes were found amongst hippopotamus bones (Wilkinson, Edged Weapons).

The earliest metallurgy came from the Middle East. Attempts to make early daggers out of copper occurred in Iran, but it was unlikely these would be able to have a

useable edge for a significant amount of time. Bronze was due to the metallurgical discovery that adding tin to copper made a harder metal. Bronze consisted of around 10% tin, and sometimes contained very small amounts of lead, zinc, silver, or other metals (Wilkinson, Edged Weapons).

Not long after bronze"s discovery it started being used to create daggers. These early daggers had thick ridges in the center and thin edges, and some were kept in hilts made of metals or ivory. At first it was not possible to make longer blades but over time increases in technology allowed this to change. Around 1500 BC the dagger was able to be extended, and changed into something closer to what is thought of as a sword. This shift occurred in both Europe and the Mediterranean around this time (Wilkinson, Edged Weapons).

The transition to these longer weapons may have been partly the result of newly developed mounted fighting techniques that came along in the second millennium BC. A very early example of the shift to longer weapons came in the form of a 32 inch sword found in a tomb in the Near East that dated back to the end of the third millennium BC. Not many Bronze swords were found in the Near East after the very early portion of the Bronze Age. Crete soon became one of the areas where the most Bronze swords could be found, but the use of bronze swords spread throughout Europe (Coe, Sword and Hilt Weapons).

Uses of European Bronze Age swords, general trends, and common innovations over time

The idea that Bronze Age swords cannot be used for practical combat is a myth, as made evident by blade damage and re-sharpening apparent in many artifacts that were found. Blocks normally occurred slightly bellow the hilt and this area was often damaged more to one side than the other indicating a consistency in how wielders would hold the blades. Another sign that bronze age swords were used in practical combat was the fact that hilts were sometimes warped off of the blades that are found. Damage in the middle of the blade indicated where the blade was blocked during an attack made by its wielder, and bending at the tip of the blade suggests that a shield stopped a thrust. It is also not uncommon to see re-sharpening where a sword tip appears to have broken off (Kristiansen, *The Tale of the Sword*).

Other than combat some Bronze Age swords had ritual applications. At times swords were deposited after a victorious battle was fought. This ritual was practiced in Celtic, Germanic, and Greek cultures. In Bronze Age warfare those carrying swords were normally the highest rank, so the depositing of swords was symbolically significant and represented the party as a whole. In cases where only a few swords were found in a deposit it may indicate that single combat between commanders had occurred at that site. In late prehistoric Europe single combat was an accepted part of warfare and followed strict rules. The deposits were likely considered a tribute to the event, given that such combat was sometimes seen to be heroic. At times swords that had gained fame were deposited in such a manner. It is evident that swords held a sort of mythical role in tales

of the time. This is likely due in part to the higher status of those who would own them and the craftsmanship that went into making these weapons (Kristiansen, *The Tale of the Sword*).

Some common attributes were seen in the weapons of most areas throughout the Bronze Age. Two common hilt shapes were the flange-hilt and full-hilt, but both hilt types were very short. The swords were often heavy and had most weight in the blade, so the short hilt shoulders provided control and a stronger grip. The shoulders were intended to be used as part of the hilt and wielder would partially grip them. This would lock the sword, helping the user make finer motions. This was useful for both slashing and thrusting weapons (Kristiansen, *The Tale of the Sword*).

Many swords from this time would have a slight leftward bend in them, or rightward if the user was left handed. The bend would always be inward towards the opponent‟s heart. The position of the balance point determines whether the weapon was better at slashing or thrusting, but in general Bronze Age swords were not as specialized as later weapons and could possibly be used for both with a focus on one, especially if the blade was made in the mid Bronze Age period (Kristiansen, The Tale of The Sword).

Both flange-hilted and full-hilted swords were common in many areas throughout Europe. In general, after the creation of the more practical flange-hilt, flange-hilted sword became the weapon that professional warriors used. In contrast full-hilted weapons were sometimes given to commanders. As a result full-hilted swords would be found less damaged, while the flange-hilted swords often appear to have been repaired many times indicating a long period of use (Kristiansen, *The Tale of the Sword*).

Along with the fact that some weapon features were commonly seen throughout Europe, there were also innovative advancements that affected European bronze swords as a whole. Early Bronze Age swords were universally used almost exclusively for thrusting, then moved to being balanced for thrusting and slashing, and finally shifted to being made with a focus on slashing (Oakeshott, *The Archeology of Weapons*). This change appears to be widely due to technological advancements in the methods used to attach sword blades to their hilts.

The early blades were fastened to the hilt just using rivets. If the user slashed or did not thrust in a straight enough motion the rivets could become detached from the blade. Many early Bronze Age blades were found in such a state. As a result of work done towards creating a better hilt, narrow tangs were made in one piece with the blade. This would then be riveted to plates. Another change was a shift to leaf-shape as the most common shape for blades throughout Europe. This shape better supported using the blade for either slashing or thrusting. At 1000 B.C one of the most typically found bronze swords started being made. This was a long, thin, leaf-shaped blade, with a grip secured by a tang covered in plates. This leaf-shape sword and hilt type lasted for the rest of the bronze age and was actually translated into the iron age (Wilkinson, *Edged Weapons*).

(A close up of the hilt of a bronze age sword seen in Higgins Armory.)

Another innovation of importance was an early variation of the ricasso, an unsharpened, and possibly narrower, area of the blade right below the hilt. The ricasso was created to help prevent enemy blades from destroying the blade‟s shoulders or harming the wielder‟s hand (Kristiansen, *The Tale of the Sword*).

Greece in the Bronze Age

Information on early Greek weapons was sometimes only known through literature, tablets, vase paintings, and similar means, as opposed to always having actual artifacts to reference. Greece could be divided into two areas with distinct sword types: Minoa and Mycenae. Weapons from 17th century B.C. Minoa were about thirty-nine inches long and may have had hilts covered with gold sheets. These blades were narrow and had a high stepped reinforcement down the middle. Despite this the blades had small tangs attached with two rivets making it impossible to use them with a great amount of

force. The weapons were intended for thrusting, and it is theorized that they would have primarily been intended for one-on-one fencing duels. This style of blade was short-lived, but was an indication that this area of Greece had less focus on combat. Mycenaean Greece, or mainland Greece, likely had a much stronger emphasis on war (Coe, *Sword and Hilt Weapons* and Snodgrass, *Early Greek Armour and Weapons*).

The swords of the Mycenaean area can be divided into three main time periods: the Shaft Grave period, the Palace Period, and the Late Period. The Shaft Grave period occurred from 15th to 16th century BC. The weapons found from this time period were discovered in the graves of princes buried in Mycenae. Such princes were buried with more equipment than they would have required in life. For example, in once case ninety weapons were found in a grave with only three men in it. Several types of swords were found in these graves, one type being the aforementioned Minoan made weapons. There were also several weapons made by Mycenaeans found as well. These were smaller, and more practical. These weapons, medium in size, had larger tangs and a flanged hilt. They were also flatter and able to be used for cutting (Snodgrass, *Early Greek Armour and Weapons*).

The Palace period occurred around 1375 to 1350 BC and was named for the „Palace Style" of pottery. The weapons of this period were mostly variations of arms that were in use during the Shaft-Grave period. The most interesting development of the time was actually not an innovation related to arms, but instead was the adaptation of plate armor. In terms of developments related to swords, two new sword types were created: „homed" and „cruciform". „Horned" swords have narrow long hilts with horn-like bronze projections acting as the sides of the handguard. These were mostly used for cutting. The

„cruciform" sword was the more common of the two types. It was constructed using one piece for the tang and blade and had a flanged hilt. Its guard had two round projections sticking out at right angles. These were shorter and may have actually evolved out of the Minoan dagger (Snodgrass, *Early Greek Armour and Weapons*).

In the palace period instead of being buried with excess weapons warriors were now often found buried with only one sword. The only case of multiple blades found with any frequency included one long, and likely horned, sword and one short sword. It is believed that these were used for different combat situations and not fought with in unison. An interesting archeological find of this time period consisted of 22 „sword" tables from the palace at Knossos. Some of the tablets depicted cruciform blades, but it is quite possible that the depictions were not of cruciform swords but of cruciform daggers (Snodgrass, *Early Greek Armour and Weapons*).

The late Mycenaean period was the last fully indigenous sword development in Greece. This period occurred from 1200 to 1100 BC. There were several interesting features of this time period. For the first time, a reasonable number of damaged bronze tools and weapons were collected to be used for scrap and reworking. This new use for damaged weapons seems fitting along with the other major change of the period: the overall decrease of luxury in arms and armor. Due to outside circumstances the older value in more fanciful weapons had been cast down and overshadowed by a need for practicality. Short, wide, workmanlike blades were now commonly seen (Coe, *Sword and Hilt Weapons* and Snodgrass, *Early Greek Armour and Weapons*).

New raids and migration occurring in the Aegean area created the need to carry a weapon in everyday life. These shorter swords had strong hilting devices, flat-straight

edges, and were often not much longer than daggers or general purpose knives. The most characteristic sword of the period was less than two feet long and evolved from the flat knife. This was eventually out-competed by a new sword that had become mass-produced in Greece. Large-scale production to this degree of any sword had not prior been seen in Greece. This blade has the German classification the „Griffzungenschwert". This sword design lasted for a long period of time and ultimately was translated into iron after the end of the Bronze Age. These blades, which have been found throughout Europe, have curvilinear outlines, flanged hilts, and branching ears on the top of the blade (Snodgrass, *Early Greek Armour and Weapons*).

The styles of blades seen throughout Greece in various points of the Bronze Age had a lot of influence on other areas of Europe. One interesting example is seen in the early Bronze Age swords of Scandinavia. The Danish sword hilts of the period had qualities similar to those of the Minoan sword hilts of the same period. Despite this the blades of the swords were long and narrow, similar to the blades seen in the Mycenaean area at the time. This was a good indication of a strong trading link between Scandinavia and the Aegean area in the early Bronze Age. Later in Scandinavia these blades went out of use and were replaced by leaf shaped blades with hilts containing plates of horn or wood (Oakeshott, *The Archeology of Weapons*).

Central Europe in the Bronze Age

The innovations going on in Central Europe were probably separate from those going on in the Aegean area at the time. The first swords to appear in this area likely

came around midway through the 2nd millennium BC. Many early Bronze Age blades in Central Europe starting at the hilt forming a triangular shape. Like in all areas these early blades started out having hilts that were riveted to the blade. In the Northwest some of the hilts were intricately decorated. One hilt found in Bush Barrow grave near Stonehenge contained thousands of tiny gold nails that together formed a zigzag pattern. They are so small that it is believed the maker would have used a rock crystal lens to be able to focus on them while creating the pattern. It was also not uncommon to see blades decorated with geometric designs in some regions at this point in time. These were daggers at this time but they were the start of many longer blades soon to come (Coe, *Sword and Hilt Weapons*).

The blade began gaining length before there was any improvement in the early riveting method. The people of the time eventually developed a better way of attaching hilts and blades. This method was very similar to that which developed in the Aegean area. They used one piece of metal to create the blade and hilt pushed rivets through the hilt and shoulder. Flanges were used to keep the hilt plates in position. This started the emergence of the „flange-hilted" or „grip-tongue" sword. This sword had a long blade with triangular shoulders and a tongue-like grip coming from the shoulders. The tongue often flared into ears. A large number of rivets were used to fasten the hilt plates (Coe, *Sword and Hilt Weapons*).

Some revisions were done to this design in various areas of Europe over time. Britain, France, and Iberia created a variation called the „carp's tongue" blade. Other areas experimented with a version of this sword with a leaf shaped blade. The shape of the cross section was also experimented with from area to area. Most were roughly

lenticular but may have steeper, possibly angled, swellings in the center. The blades that had these swellings also often had grooves on either side of the swelling used to reduce the weight. The top of the blade‟s edge sometimes was made with an early version of a ricasso in order to protect the wielder‟s hand. The grip-tongue ultimately spread throughout Europe and even to some areas of the Near East. It is theorized that European mercenaries may have taken these blades with them while traveling to the Mediterranean (Coe, *Sword and Hilt Weapons*).

Another advancement was the metal-hilted sword. This looked similar to the grip-tongue sword but had a different method of being hafted. A metal tube with an elliptical cross-section was cast onto the top of the blade and merged with the blade‟s triangular shoulder. The ends of the grip went into a disk shape with a circular knob above it. Early grips of this fashion would often be decorated with geometric designs. Many times this would be spirals arranged in bands, but later different techniques such as openwork were used for decoration (Coe, *Sword and Hilt Weapons*).

A large variety of interesting swords came out of western central Europe. One such sword was the aforementioned „carp‟s tongue‟ sword. The sword was large and the blade ran parallel for around two-thirds of the blade, and then abruptly tapered into a narrow point. In Ireland swords over 30 inches long and 5/8 inches broad were found. The middle of these blades had a lozenge shape, and the blades were riveted onto flat shoulders. Early riveting techniques aside, these blades displayed excellent craftsmanship (Oakeshott, *The Archaeology of Weapons*).

The Hallstatt is a blade that rose from Southern Britain during the Bronze Age, but had a much larger presence after the start of the Iron Age. Most swords from the

Rhone Valley were almost as small as large daggers, but there were some that were very large. All sizes of these blades had patterned bronze hilts. The end of the pommel transitions into long points that curve inward. These points would go into tight ringed coils, curve up slightly but for the most part stick out to the side, or curve sharply and point upward (Oakeshott, *The Archaeology of Weapons*).

Other areas of Gaul had long double-edged swords, with narrow leaf-shaped blades. Two styles of hilt have been found with this Gallic blade. In one case the metal of the blade continues up to the pommel and is nearly as broad as the actual blade. Holes are put in the hilt and it is placed between two sheets of wood and bound with rivets. With the other style the blade stops abruptly and two or three spikes go out in line with the blade. These spikes go into a wooden cylinder in order to make the handle. Some of these swords resemble Greek blades. As a result some Archeologists are suspicious that these swords may not be Gallic at all and actually made by late Romans but modeled after Greek blades. Whether this is true or not the weapons are currently considered Gallic, but are different from the blades the ancient Gauls used to invade Italy. It is believed that the fall of Gaul to Rome was in part a result to their inferior blades that could be bent very easily. This belief was formed with the knowledge that at the time of the invasion the Romans did not yet have the strong discipline and tactical ability they soon become to be known for (Boutell, *Arms and Armor*).

Artifacts on display in Higgins Armory:

(A set of Bronze Age artifacts from the armory.)

Collection of Bronze aged swords, accession numbers: 238.38, 238.25, 238.33, 220, 238.10

Viking Age Swords

The Viking age was a period primarily between the 8th and 11th century. This was a stage between the Heroic Age and the Age of Chivalry. To the Vikings, the sword was an integral part of their life and culture. It was mentioned frequently in their writing, and immortalized in sagas.

The 9th through 11th century was the time of the strongest Viking attacks. In the year 845 the Vikings flocked to France"s coast and plundered a convent called Saint-Denis. They were paid to leave and agreed to but later came back requesting more money and pulling off more attacks. Acts such as these led to castles and walls around cities being built. Mounted fighters with mail and lances were able to defend against the Germanic groups. In this way the Viking"s piracy in part helped lead to the Feudal kingdoms that where next to come. Through their interactions the Vikings passed on parts of their culture that remained into the next period. It is believed that the Vikings sense of honor helped manifest what later became the codes of chivalry (Grancsay, *A Viking Chieftain's Sword*).

The sword in Viking life

Outside of combat Viking cultures were actually noted to be quite good at farming, commerce, and trading. Though they were often remembered for their exploration, sea raids, attacking of monasteries, and piracy they had a strong sense of honor and treated their weapons with great pride. The Vikings favored the sword over all

other weapons. Vikings had many kennings they used to refer to the word sword. A kenning is a poetic name to use in place of a noun. Swords have been giving kennings such as “Corpse Bramble”, “Widow-Maker” “Odin‟s Flame”, and “War Snake”.

The most common, and perhaps the most telling, kenning that refers to a sword translates to “Ancient Heirloom”. As can be guessed by the name, swords were often passed down through generations. At times a child would be given a sword at birth. At other times a father would go to a son, now just old enough to understand, and bring the boy his sword. He would then go on to tell the boy the sword‟s name and how he will one day inherit it. The father would proceed to tell stories about achievements he has done with the blade, and achievements his father had done with it, and down the line. In this sense passing the sword became a way of preserving family history, and the sword itself became representative of family ties (Pierce, *Swords of the Viking Age*).

If not passed down to family members a blade would often be buried with its wielder, though unfortunately robbers would sometimes loot the graves. The practice of being buried with one‟s sword is very similar to the ritual deposition of swords seen during the Bronze Age. A set of swords found in Swedish graves dating back to the 8th century had grips decorated with with interlace work and dragons. They also had rings or stones in the hilt, suggesting that the blade either belonged to someone in a position of office or was a gift from a chief (Pierce, *Swords of the Viking Age*). During Pagan times the officers themselves would have their graves equipped with everything they believed was needed to reach Valhalla. This definitely included a sword, but the sword was often bent when it was put into the grave so others could no longer use it in the living world (Grancsay, *A Viking Chieftain’s Sword*). At the end of the Viking age swords used during

the Age of Chivalry began showing up in viking graves indicating some overlap between these two times (Peirce, *Swords of the Viking Age*).

A sword was quite commonly given its own name. Names ranged from intimidating to descriptive. A few examples include „Gramr", "Fotbitr", and „meofainn" respectively meaning fierce, leg biter, and ornamented down the middle (Coe, Sword and Hilt Weapons). The sword was carried everywhere by some. They would have it on their back at meals and next to their bed at night. That is how it received another interesting kenning "shoulder-companion" (Peirce *Swords of the Viking Age*).

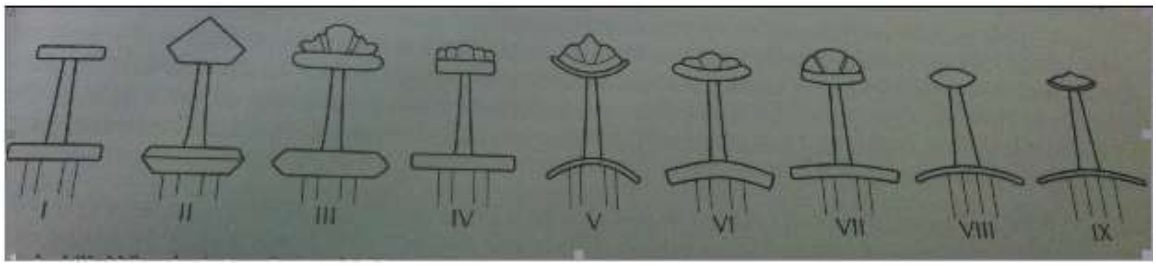
The close bond between the sword and the Viking holds many similarities to significantly earlier Germanic tradition. The Roman soldier Tacitus focused on the importance of the sword to the Germanic people in his description of the Germanic tribes from 300 C.E. when the Romans were clashing with them. Tacitus claimed that the Germanic tribes kept armed during any and all interactions, personal or otherwise. That said, he believed they were disciplined enough that one of them would only hold a sword if their leader felt the soldier was skilled enough with a weapon to use it safely and effectively. Tacitus noted that at meetings held by these Germanic tribes, a child would sometimes be given a weapon by a parent or chief. This would indicate that the child now counts as a citizen as opposed to just a member of a family. He commented on how the toga had a similar connotation in Roman life (primary source document, *Tacitus on Arms Among The Germanic Tribes*).

The sword, through single combat, was also used to settle struggles that came up in personal life. This use is mentioned in several sagas. Kormaks saga for example mentions a variation of formal combat called holmganga. A book called "The Viking

Achievement" by Foote and Wilson gives details on this form of combat. Holmganga translates to "island going". As predictable, this combat was always done on small islands. Fighters were given a small square of space to fight within, and the edges of this space were marked with cloths. The area was then surrounded with rope. A second person accompanied each combatant holding a shield and protecting the fighter. Blows were taken in turn, similar to a system later used in 19th Century Germany. Stepping out of the square equated to fleeing the duel, and after first blood the injured fighter could pay money to the opponent in order to end the fight. The cloths around the edges were supposedly used to help see if blood was spilt (Coe, *Sword and Hilt Weapon*).

Pattern welded swords and decorations on Viking swords and hilts

There was not a lot of variation in the design and shape or Viking blades, but the hilt, pommel, and decoration did vary greatly. They also changed over time. Early Viking Age pommels had 3 segmented pyramid shapes. Triangles were also common early on. Blades with these pommel shapes were made in Norway and brought to Ireland and Scotland‟s west Isles during raids. This was likely in the 8th or 9th century (Coe, *Sword and Hilt Weapons*).



(Major hilt categorization)

Over time hilts took on so many different shapes that Jan D. Petersen was able to come up with 26 types of Viking sword and additional subcategories. These groupings can be simplified into nine major types (see above). The first two types are probably Norwegian and are believed to be from 775 to 900 C.E. Type 3 has been found with between 3 and 5 lobes and dates to the 9th and 10th century. It was found in North West Europe and is similar to 5th and 6th century pommels found in the same area. Type 4 is flatter than type three and is practically a subtype of it. Hilt type 5 is believed to be from between 875 and 950 C.E. The pommel and guard both have a strong curve (Peirce, *Swords of the Viking Age*). Viking swords with guards that curved down towards the blade started being made later than straight guards (Coe, *Sword and Hilt Weapons*). Type 6 has reasonable chance of either being 10th/11th century Danish or 11th Century English. Either way it is a later pommel. Skipping forward, type nine cannot be pinned down to any given location (Wicker, *Swords of the Viking Age*).

(A sword on display in Higgin˝s Armory with what appears to be hilt type 8.)

Decoration was a major feature of the Viking age sword. It was often just simple designs on iron created in different manners, but there was a lot of variation. Early on in the Viking age punching dots or crosses into silver plates to form geometric patterns was common. These may also be engraved with interlace, similar to books, or could even have stones with runes decorating the sword. Niello may be applied to these stones. Later on in the Viking age a method of inlaying brass geometric patterns onto tin and outlining these patterns with strips of copper wire was somewhat commonly used for decoration. There were cases where the entire surface would be covered in strips of alternating tin and copper. There would sometimes also be small herringbone patterns inlaid between these strips (Peirce, *Swords of the Viking Age*). Damascening is a term meaning to inlay one metal on another. Various types of metal would be used for this processes. The below image is a hilt decorated by iron and copper wire that was placed into grooves made in the metal. Silver strips alternate with niello to make a very noticeable pattern. Niello is paste made of silver, lead, copper, and sulphur that is fused to a metal surface when used for decoration. (Grancsay, *A Viking Chieftain's Sword*).

(A Viking hilt decorated using damascening)

Damascening was a process that was not only of great significance to sword decoration but also to blade making as well. The nydam was a sword that was in use as early as 300 AD, and made in the part of the Rhine Valley influenced by Roman Culture. These had harder metal than quite of few of the blades from the early Iron Age, and the early Viking swords. Some Vikings ended up using nydam swords. Nydam swords were pattern welded, meaning they were not made straight out of iron but created by folding strips of iron and carburized iron (steely iron). The welded-together strips of iron would be formed into a bar or lump and then twisted multiple times causing the fibers to cross in various directions. The result was a metal that was more elastic and less likely to get bent. The elasticity occurred as a result of the varying hardnesses in the strips of metal used during its creation. If a pattern-welded blade comes in contact with acid an interesting result often occurs. The pattern ends up showing more clearly because the iron corrodes

more than the steely metal (Grancsay, *A Viking Chieftain's Sword*). Another interesting feature found when studying these blades today, is that the patterns can be seen in xrays even if the blade has deteriorated to a very poor condition.

One of the most common designs on pattern-welded blades was wide bands of shifting swirls. Some believe that prior to the 10th century a single center in the Rhineland was responsible for the creation of most pattern-welded blades. After this time pattern welded blades die out. It is suggested that the workshop may have been destroyed at this time (Coe, *Sword and Hilt Weapons*).

Designs found on Viking swords, be it interlay, engraving, inlaying, or other method of decoration, seemed to be influenced by a mix of steppe art and designs traditionally seen in Scandinavia. Written inscriptions were also very common on blades especially in Norway, Ireland, Russia, and Finland. The inscriptions were most likely either the maker or the owner. The maker was most commonly seen on the center groove of the blade and the owner was more commonly seen on the cross guard. To get the lettering to stay in place the blade would be reheated and the letters hammered in. This was also used for geometric and animal designs. Geometric designs were very common (Coe, *Sword and Hilt Weapons*).

(A viking sword on display in Higgin‟s Armory that has gold strips inlaid in the hilt)

Another common form of blade decoration other than using damascening on the hilt and other parts of the weapon is plating. Sheets of gold, silver, copper, brass, or tin foil would be hammered onto iron and polished. The iron may also be covered in many cuts that would be filled with niello. Thicker plates may be embossed or engraved. The engraving was often a phrase or name (Peirce, *Swords of the Viking Age*).

(^An example of plating used to decorate a blade)

Two inscriptions frequently seen were “ULFBERHT” and “INGELRII” The ones saying ULFBERHT, which will be described more later, were around for too long a period to simply imply one maker. It may be the work of a family, a trademark of some sort, or some other reference to a center where they were made. Later inscriptions were often more clear to their meaning. As an example a late Viking age sword was found with the inscription “NISO ME FECIT” or “Niso made me” (Coe, *Sword and Hilt Weapons*).

Metal Smithing and the Ulfberht Blade

There are many stories about early Viking blades bending greatly in combat and needing to be bent back into shape. The early smiths actually had some knowledge of how to take iron ore and extract pure iron but the results of doing so were not consistent.

The smith could get anything from a soft metal to a hard steely iron. The process was hard to control precisely. Steel was a lot more common at this time than many people would suspect, but it was hard for a smith to produce on purpose. When the iron was left to be heated by charcoal for a long enough time it would absorb some carbon, converting at least parts of it to steel. At this time smiths would not understand the chemical reaction that was taking place and had no way of knowing for sure how to cause the difference. When a good blade was made they would just try to get conditions of later attempts as close as possible to how they were when the success occurred. In part this was why smiths in Viking stories were given an almost mythical character (Grancsay, *A Viking Chieftain's Sword*).

Only one iron compound was available that was divalent and this was bloomery. Divalent means that the compound has two electrons that are able to form bonds with other substances. The method of extracting pure iron from this involved leaving it in a small furnace heated by charcoal, because as mentioned above burning charcoal is a source of carbon. An iron oxide combined with carbon will react and result in carbon dioxide and iron. The iron that came from this iron ore normally would not melt because the melting point of iron is 1550 degrees Celsius, though over very long periods of time it may be possible to melt the metal because absorbing carbon reduces the melting point of iron (Williams*, A Metallurgical Study of Some Viking Swords*).

Slag was normally found in objects made in this way. Slag is non-metal impurities found in the ore that may or may not be separated out from the actual metal during the melting process. Slag liquefies at 1100 to 1200 degrees, but often the impurities may not fully separate from the metal, and traces of slag are normally found in swords. Also

portions of the iron used to make swords may have chemically become steel through carbon bonds while others did not. While it would be favorable to just use steel parts while making the weapons it was likely not possible to separate the two metals (Wicker, *Swords of the Viking Age*).

During the Viking age pattern-welded swords died out and were replaced by swords made of one or few piece(s) of steel. This type of blade was the sort that the inscription "Ulfberht" is commonly found on (Williams, *A Metallurgical Study of Some Viking Swords*). People were always moving around at this point so the location that a sword was found does not indicate where it was created. That said it is still commonly believed that the highest quality blades came from the Rhineland, either where Solingen later formed or the Romanized area Noricum (Wicker, *Swords of the Viking Age*).

Metallurgical studies resulted in an interesting find related to blades with the Ulfberht inscription. Though they looked similar there were several variations of blades with these inscriptions, quite a few being fakes made during the time period. The lower quality blade would often be purchased and the difference may not be known until it got damaged during practical application. The superior ones were actually found to be made of crucible steel imported from Afghanistan and Iran. Real Ulfberht blades would have about three times as much carbon as the fake ones. This is still only half the amount of carbon present in modern carbon steel. The fakes were very hard and had a very sharp edge but were very brittle making them not very safe to use. Often the hardness of these blades was achieved by putting the hot blade into cold water (Maev, *Flaws in Viking Swords Found*).

The properties of these fake "Ulfberht" blades can be in part explained using Vickers Pyramid Hardness. Vickers Pyramid Hardness is a scale used to measure the hardness of various materials. Pure iron has a VPH of 100 while .8% Carbon steel has a VPH of 250. Using the method mentioned above, placing hot metal in cold water, on .8% Carbon steel raises the VPH to somewhere between 600 and 800. The extreme hardness causes the weapon to break easily due to resistance to change shape under pressure. Lightly reheating the blade after creating it is a way of making the blade tougher and less hard, but it is hard to do with precision and to get the results correct so it is not seen that frequently (Wicker, *Swords of the Viking Age*).

The maker of the high quality Ulfberht blades had access to high carbon steel, which as mentioned likely came in the form of ingots imported from the Middle East. It is quite likely that the trade route went through the Volga River. The Baltic area was the end of the trade route and where many Ulfberht blades were found and possibly made. High carbon steel actually needed to be forged with lower temperatures. If made correctly the result would be a blade that is both hard and tough giving the blade a high value that resulted in the many attempts to copy it (Williams, *A Metallurgical Study of Some Viking Swords*).

A study focused on the differences that appeared between weapons with various spellings of the Ulfberht inscription found that the real Ulfberht blades would have the inscription written as +VLFBERHT+. Often the copies would be seen with different spellings of this inscription, and the quality of the swords created by these other workshops would vary. There is one workshop that consistently used the correct spelling, but would place the second cross somewhere other than after the end of the word. This

workshop fairly consistently had steel at the edges of their blades. The swords with the +VLFBERHT+ spelling tended to have consistent metallurgy that was rather different from all other spellings found (Williams, *A Metallurgical Study of Some Viking Swords*).

The fall of the Saminids and the rise of Russian principalities caused the trade routes to die out. Eventually the decline of trade lead to the end of production of the mighty Ulfberht blade.

Artifacts on display in Higgins Armory:

-The viking sword in the case on the third floor near where the rapiers are (private collection, no number)

-The two viking swords in the new viking display

Medieval and early Renaissance Swords

The sword played a huge role in the age of chivalry, maintaining a lot of the early mystique that surrounded it during the Viking age.

Arms Training, fencing, and blade uses outside of battles:

Training is an important aspect to look at when studying and understanding medieval swords. The training of a boy aiming to become a knight is an interesting example. The training would begin around age 10, and would occur every day. A child would start with a light sword that they are able to wield early on and move on to heavier weapons as they grow. Around age 15 the boy is able to used full-sized weapons. There is a misconception that medieval swords were clumsy and heavy to use, but this was not the case. Most full sized swords were under 3 pounds and well balanced. This weight would not be unreasonable to someone who had spent their entirely life training how to properly use a blade (Oakeshott, A Knight and his Weapons pgs. 47 - 51).

Fencing as a practice for armed fighting was seen in many areas of Europe. The city of London apparently did not allow the teaching of fencing as stated by a statute dating to 1286 A.D, but it was legal to practice in most areas of Europe"s mainland. Such areas would sometimes have established fencing guilds such as the Fraternity of St. Mark which existed in Frankfurt-on-Main in Germany. Before the 16th century many of the fencing masters who would teach at such guilds would not only teach swordplay. They would also teach the use of staff weapons, two handed sword styles, and even wrestling.

They would try to be prepared for all situation and ready to use the style that would be their best option (Norman, Arms and Armor pgs. 95 - 99).

Fencing and training were not the only purposes swords held outside of structured battles during the middle ages. At this time many swords were used for ceremonial purposes such as coronations, or kept in treasuries or arsenals by the state or the church. It is rather likely that a sword kept in such a treasury was in some way connected to a famous person. A regalia sword is a term for a sword used in someone‟s coronation. One of the earliest dating regalia swords found was that of Charlemagne from 950 to 1025 A.D. This fanciful weapon was single edged and slightly curved. It was decorated with images of dragons and copper overlay. The hilt was made of ray skin and the scabbard mount was covered in silver gilt with embossed bands crossing each other. The quillons were short and were rounded at the ends (Coe, Sword and Hilt Weapons pgs. 34 – 35).

Another ceremonial sword was the Sword of St. Maurice that was used for the coronation of various German emperors. The pommel was the shape of a brazil nut and covered with gold leaf with Latin inscriptions on it. The blade was decorated with a cross in a circle. The scabbard was made of olive wood and had gold panels for the mounts. The panels were decorated with an image of an emperor and cloisonné enamel bands. Many regalia blades were refitted at different times. This phenomenon is illustrated by this blade whose hilt decorations seem to made between 1198 and 1218 but whose blade and scabbard are earlier 11th century.

(A ceremonial sword with the shape of lion heads at the sides of the Guard)

Swords were still found in the tombs of royalty as in early periods but were no longer found deposited on battlefields. In fact it was rare to find swords from this period at the site of a battle at all. Swords had high values at the time and a field would quickly be scoured for all weapons. Also swords might be preserved by churches as mentioned above. In 1170 Thomas Becket was killed and deemed a martyr. The sword that killed him was revered and kept on an altar in Canterbury Cathedral. Pilgrims visiting the cathedral were able to buy small replicas of the sword that were sold in hilts. The Altar stayed around until the reforms done by Henry VIII at which time he ordered its removal (Coe, Sword and Hilt Weapons pgs. 34 - 35).

Evolution of blade, hilt, and guard forms

A lot of general changes in the three major parts of the sword can be seen by looking at Europe as a whole through various periods of the middle ages. The medieval sword could have evolved in part from the first Celtic iron swords, but more directly had evolved from the swords of the Viking Age that the age of chivalry followed. Many swords at this time still strongly resembled Viking swords, especially early on in the

Middle Ages. Tapestries depicting swords from the beginning of the Middle Ages show that the main differences between the swords of the time and the Viking swords were that the shape of the pommel was often either that of a tea cozy or a brazil nut, the quillons were long and unbent, and the blade was longer and narrower. Those two pommel shapes were seen up to the mid 13th century, as did one style of Viking hilt. The idea that hilt types changed very frequently during the Middle Ages is exaggerated. Often times after one area stops commonly using a design another would pick it up or continue it for longer. Also 13th century English knights carried a mix of hilt styles that were designed in the 9th 10th and 13th centuries. (Coe, Sword and Hilt Weapons pg. 38, North, An Introduction to European Swords Pgs. 5-7, Norman, Arms and Armor Pgs. 95 – 99).

In the 12th century disk-shape pommels were common. Southern Europe may have been the area that came up with this shape. Later in the period the disk pommel gained a second circle raised on one of the two sides. This shape became known as the wheel pommel and was used for at least the next 150 years. Other pommel shapes of the 12th century included ovals, pyramids, and divided rectangles, with the last two not showing up until the end of the 12th century. Most hilt shapes that cropped up in the 12th century continued on at least into the 13th. As a result the pommels alone cannot be used as methods of dating weapons. Quillons were commonly made of steel but there were rare cases of them being made out of jasper and rock crystal. Brass inscriptions with religious messages were frequently seen in the 12th century. Most were straight and wide cutting weapons with a single narrow fuller. Starting early in the 12th century some guards had a slight curve in the sides. Early 12th century guards may have had animal

depictions on the ends of each side such as the lion seen above. (Norman, Arms and Armor, Pgs 95 – 99 and Coe, Sword and Hilt Weapons pg. 39).

(A sword with a simple wheel shaped pommel)

In the 13th century a broad double-edged sword called the falchion became common. This was a slashing sword with a cleaver-like shape. A falchion found in Northeast England was broad with a channel running down its length and a cross-shaped guard. The guard had imagery of dragons and plants. It had a standard wheel shaped pommel and was decorated with copper and enamel on both the pommel and guards. The pommel had an image of an eagle on one side and three lions on the other. This sword may have belonged to Richard Earl of Cornwall and was likely not only found in England but made there. Swords of this century were fairly long relative to early swords. averaging around 36 inches. In this period there started to be a shift towards a focus on weapons made for thrusting (Coe, Sword and Hilt Weapons pg. 39 and North, and Introduction to European Swords pgs 5-7).

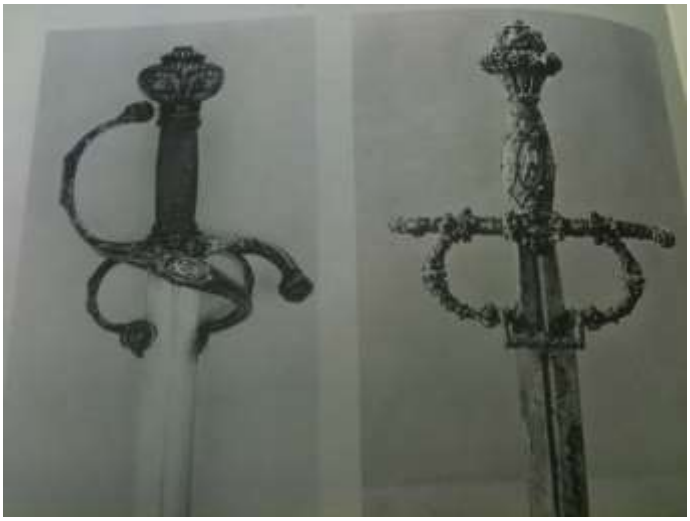
Also in the mid 13th century we see the emergence of two-handed swords intended for cutting. The pommel was often long and heavy with shapes such as pears or kites. The purpose was to help balance the heavy weight of the blade. There were two

early two-handed swords that were used. These were the war sword and the true two-hand sword. War swords were smaller and could be used with 1 or 2 hands. It was 38 inches long plus a 7-inch grip. The true two hand swords were 50 inches in length with a 12-inch grip. Instead of being shaped like a two handed sword as we know them today, two hand swords of the time were shaped like larger versions of single handed swords of the time. The War Sword, as it name implies, was only used for battle and often reserved for combat on horse. It weighed between 4.5 and 5 lbs. (Norman, Arms and Armor pgs 95 – 99, North, An Introduction to European Swords pgs. 5-7 and Oakeshott, A knight and his Weapon pgs. 47-51).

In the 14th century the focus on thrusting became greater. Some swords were made longer and skinnier to accommodate this. The shift back to thrusting as the primary style was likely a result of advancements in plate armor. Early 14th century blades were roughly 50 inches in length. Most had wide edges that ran parallel and then went into a sharp point, but some tapered from hilt to point. The blades could have had a single wide channel, multiple skinny ones or no channel at all. Double-edged weapons were more commonly seen than single edged ones. Wheel pommels are still common at this point but not as often decorated. Quillions became longer and were normally downturned. Another partially two-handed blade also came along in the 14th century. This was the hand-and-a-half, and as the name implies this sword could either be used by one or two hands (Norman, Arms and Armor pgs 95 – 99, Oakeshott, A knight and His Weapons pgs. 5-7, and Coe, Sword and Hilt Weapons pg. 39).

Early 15th century knights would carry both a hand-and-half and a short sword referred to as an Arming Sword into mounted combat. The short sword hung from their

belt and the hand-and-half was fastened to the front of the saddle. In combat on foot two weapons would still often be carried, one being the arming sword. The second might be a hand-and-a-half but could also be an axe, hammer, mace, pole-hammer, or pole-axe. In the 15th century triangular, conical, or oval shaped pommels were seen as well as some wheel-shaped ones still remaining. Around 1450 the curve seen on quillons became sharper. In Southern Europe and some other areas fighters began hooking their forefinger around the front of the quillon, so several features were added at this point to protect the fingers. Another reason for these additions was to help light infantry given they would not be wearing gauntlets. One such precaution was the ricasso. This was an unsharpened 1.5-inch section of the blade right below the hilt meant to catch the opponents‟ sword and stop it from harming the fingers. A ring was also added to the upper side of the quillon to protect the fingers. Around 1450 a second ring was added, either so both sides of the blade would be usable or for symmetry. By the end of the 15th century the two rings were connected by an additional horizontal ring. Also another guard was sometimes added, this went from the quillions to the pommel. More rings and protective guards continued to be added in the 16th century (Oakeshott, A Knight and his Weapons, North, An Introduction to European Swords pgs. 5-7, and Norman, Arms and Armor pgs 95 - 99).



(As more rings and protective guards were added sword hilts began looking like this.)

Background on the Crusades:

The crusades were a major part of the Middle Ages and took place from 1096 to 1291. In the year 70 AD the Romans had built a city where Jerusalem once was. This City was called Aelie Capitolina. Constantine the Great, eager about his conversion to Christianity, wanted to see holy sites remove the changes that occurred as a result of Roman conquest. He also would often have churches built on holy sites that he found. He strongly preached the idea of taking Pilgrimages to holy sites. The church greatly liked the idea of pilgrimages and whole-heartedly felt that relics and holy locations had mystical properties. (Bradford, The Sword and Scimitar pgs. 9 -14).

It was believed that making such a pilgrimage acted as a way of absolving ones sins. At times specific instructions would be given after a confession to take a trip to a given shrine, tomb, or church and do some religious act there. Sometimes a person making a pilgrimage for such a reason would have to wear an iron chain on their waist or a hair shirt as a sign of their transgressions. Lower-class citizens would at times make such journeys in the hopes that what they found in this new area would be better than the

terrible living conditions they currently maintained. The promise of a better life after death was also a motivating factor. Sometimes a person would make a pilgrimage just to gather relics or relocate martyrs bodies to churches. Palestine was the most common destination (Bradford, The Sword and Scimitar pgs. 9 -14).

Eventually the use of pilgrimage became a business for the church as the system of indulgences emerged. Under this system a person could be fully removed from both temporal retribution and fear of punishment in the afterlife. The system was started by Pope Urban II and ended up earning the church a lot of money. A quote from Pope Urban II states that "whoever shall go to Jerusalem out of pure devotion and not to gain honor or money but to liberate the church of God, the same may count that journey in lieu of every penance." This was one of the primary tools that was used to promote the crusades (Bradford, The Sword and Scimitar pgs.11-14).

In Jerusalem there was some degree of understanding between Muslims, Christians, and Jews before the Turks came seeking power. The Roman and Arab groups both increased military forces to try to hold onto power. The Turks were interested in the Islamic ideas they discovered in this area and embraced them strongly. They were particularly moved by messages that implied they should be fighting nonbelievers. They were warriors by nature and held onto that mentality but still took on other aspects of Arab culture (Bradford, The Sword and Scimitar pgs.19-21).

A huge turning point that led to the start of the Crusades was the battle of Manzikert in 1071 A.D. At this point the Byzantine Empire existed but had a weakened influence. When Emperor Romanus Diogenes attacked Armenia they were destroyed in an ambush conducted by the Turks. Romanus was taken prisoner when the army fell, and

the empire received an irrecoverable blow. As a result many of the routes pilgrims traveled to holy locations could no longer be protected and kept open. Michael VII became the new emperor, and he decided to do something about the Byzantine Empire‟s situation. He wanted the Byzantines to once again control Asia Minor so he went to Pope Gregory VII to ask for help in exchange for agreeing to finally unite the eastern and western Christian churches. This is something that the western churches had wanted for a long time. There had been ideological disputes between the two churches and also the west dreamed of having one church led by Rome as its center. Up until this point, Constantinople was unwilling to agree to this idea. The Pope made an early attempt to do what Romanus asked for and managed to raise an army, but local disputes caused this first attempt to be stopped (Bradford, The Sword and Scimitar pgs. 22 - 26).

In 1095 in the Byzantine court the Pope officially agreed to launch the first crusade. At this time he made a speech in front of a large crowd. His claim was that the Turkish army would soon attack the holy land and that people attempting to make pilgrimages were facing extreme struggles at this time. He claimed that it was immoral to fear a death that came for a religious cause especially because they would be saved in the afterlife as a result of it. Some noblemen were led to the crusades for monetary reasons such as a hope to procure new land, but generally most people had religion as their main motivation for undergoing these battles (Bradford, The Sword and Scimitar pgs. 28 and 31).

Weapons of the Crusades:

After the first crusade occurred seven more followed. The sword was a primary weapon during these battles. Very few actual weapons remain from the Crusades and what was found was often retrieved from Crusader castles. A 13th century stained glass window from the church of Saint-Denis contains illustrations of Christian knights in combat during the crusades. The sword was the primary weapon illustrated. The swords seen on the battlefield were often ones that had great similarity to the Scandinavian Viking Swords they were close descendents of. The fact that the blades tapered from a point starting at the top of the blade was part of what made these swords so useful to early crusaders. Though these were primarily slashing weapons the point was still frequently used (Bradford, The Sword and Scimitar pgs. 95 and 97, and Coe, Sword and Hilt Weapons).

The Norman sword is an example of a sword that was an improved version of a Viking weapon. The pommel on the Norman sword is even more elaborate than the forms seen in the Viking Age. The blade has a fuller down its length to lessen the weight. The crossguard is also different than that of the Viking swords. The guard consists of two quillons that are either straight or have a slight curve. If a knight"s full weight was put into a slash made with the Norman sword it could manage to cut through a helmet and continue down to the enemy"s shoulder. The power of these swords was devastating. Graves were found close to battlefields in which the skeletons were missing an arm or leg and others with cuts going from the shoulder to thigh (Bradford, The Sword and Scimitar pg. 97).

Scabbards were used to hold the swords and were hung on the left side for a right handed fighter. The scabbards of the time were made of leather over wooden strips. They may have a metal guard at the opening of the scabbard and a metal cover at the tip. Most of the time if the knight was wearing mail the scabbard would be placed over the mail but there were illustrations from the time that suggested the mail was cut such that the scabbard could rest under it and the hilt of the sword could stick out. The Muslims were depicted to be using lamellar armor, helmets with rounded tops, circular shields, and swords that tapered to a point. The swords had small guards and pommels and could either be curved or straight (Bradford, The Sword and Scimitar pg. 97).

Artifacts on display in Higgins Armory:

-1100s knightly sword: (private collection, no number)

-Knightly swords in the display on the fourth floor: 1996.01.2, 2036.1

(The broadsword of Casttillon, 1400s. Accession # 2007.03)

Rapiers and Smallswords

The time when smallswords and rapiers were seen across Europe was a drastic change from earlier points in the history of the European sword.

The Rapier and weapons that led up to it

In the 14th century projectile weapons such as long bows started to be used more in combat tactics than swords. 14th century swords were cruciform in shape and were no longer just focused on cutting but used for both cutting and thrusting. There were some weapons focused mainly on thrusting in the 13th century though. This type of weapon was called a tuck. The tuck did not bend easily and tapered into a steep point. The idea was to be able to break chain mail or thrust through gaps in plate armor. This weapon had a cross section shaped like a flattened diamond or a lozenge. In the 14th century mounted soldiers would be seen with both a thrust weapon and a cut and thrust weapon (Coe, *Sword and Hilt Weapons*, pg. 44).

In the 15th century full body plate advanced to the point where several new swords needed to develop. The estoc is a short and steep thrusting sword that developed for such a reason. In the middle of the 15th century sword hilts started changing form. Quillons gained a more noticeable curve. By 1450 rings and knuckle gaurds started being added, and in 1475 the knuckle guards and the arms were joined together and later a bar was added that went between the ends of the arms. This bar was called the side ring. The knuckle guard then was changed to go from the quillons to the pommel and a ring

was added to the side to protect the back of the hand (Coe, *Sword and Hilt Weapons*, pgs. 46 & 47).

The hilts that had the design described were essentially the first rapier hilts. These hilts were used on blades made for cutting and thrusting that were carried by light infantry, and in Spain cavalry also used them. When they were adapted to civilian use they were put onto narrower blades intended only for thrusting. As well as there being a large difference between civilian and military swords with rapier hilts, there was also sometimes a difference between fencing swords and those carried for fashion. Fencing blades were sometimes made close to 5 feet in length, but the civilian rapiers would be smaller in size. A document written by John Stow, who was alive from 1525 – 1605, mentioned guards who supposedly stood at every gate in London. A Royal Decree stated that if someone tried to bring in a sword with a blade that was longer than a yard the guards were required to break to tip of said blade. (Coe, *Sword and Hilt Weapons*, pgs. 46, 47, & 50).

The swept hilt rapier came out around the mid 1500s with two side rings and additional bars. Some of these bars went form the quillon to the knuckle guard and others went to the arms of the hilt causing the bars to cross each other. These bars were not good methods of protecting the hand. A later development was the addition of pierced plate towards the end of the 15th century. This would be between branches of the guard and was sometimes seen on German swords called Tucks (North, *An Introductioin to European Swords* pgs 7-9 and Coe, *Sword and Hilt Weapons* pg 50).

(Pierced plate)

In the 17th century the plate had the form of two shells but later became a single cup. Spain continued to use the cup hilt rapier until rapiers fell out of fashion. This type of rapier was even used by the Spanish military during the Napoleonic war. The type of cup hilt rapier was called a Bilbo and was likely not usable with very precise movement. England also had a variation of the cup hilt rapier. This variation had many connecting bars along with two shell shaped guards on the bottom. In most areas the cup hilt rapier stayed around until the 1630s (North, *An Introduction to European Swords* pg 12).

(A hilt with two shell guards)

(A sword from Higgin‟s Armory that has a hilt that has two shell guards)

In the 1600s it was hard to say what nation a hilt belonged to. Especially because the 30 year war led to rapiers of different areas being found throughout Northern Europe. Decorations may also need to be looked at. Decorative techniques included etching, nielloing, carving, chiseling, gilding, and many others. Materials such as ivory, semi-

precious stones, and leather were often used in decorations. A large number of pommel types were found in the 16th century. Disk and wheel shapes were still in use. From the end of the 15th century to the early 17th century cockle shell, egg, cone, polygon, and sphere shape pommels were also seem on some weapons. Rapiers would be held by decorative embroidered belts In the 16th century Dagger and rapier fencing was not uncommon so a person may have a dagger rapier pair with similarly decorated hilts. The dagger would be attached to the belt and the rapier would be attached to a sling that goes down from the belt and embroidered in similar decoration (North, *An Introduction to European Swords* pg 12 and Coe, *Sword and Hilt Weapons* pgs. 50, 58 & 59).

(^ a belt and sash for a dagger and rapier combination)

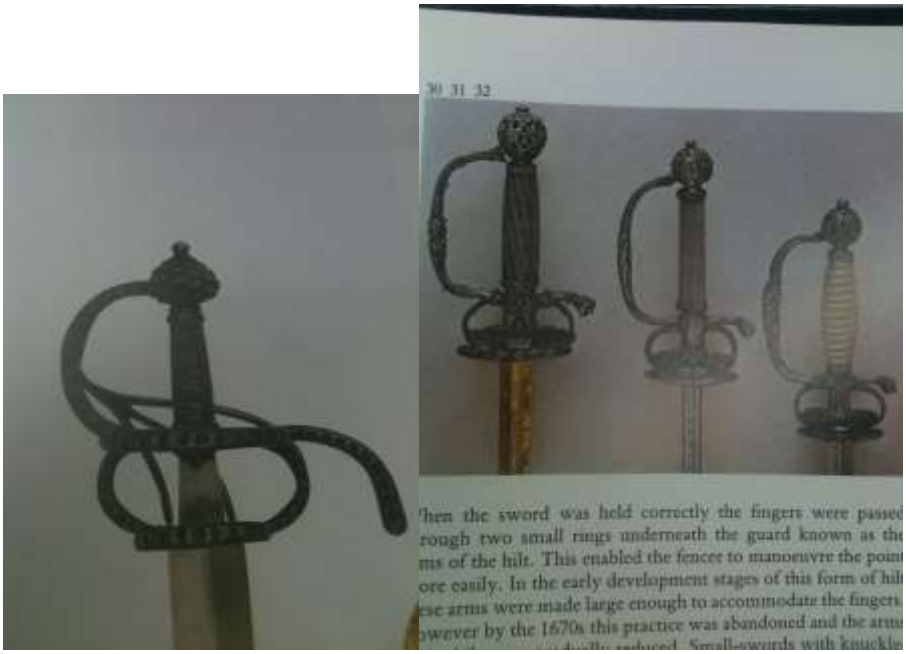
The Smallsword

A new French fencing style developed in the 17th century. This style became the focus over previously popular Italian style. The French style put a lot of value in speed so a lighter sword was needed. One predecessor to the smallsword was a long rapier that had two shells for guards. Another predecessor was the scarf sword. This was a smaller rapier

with unbent quillons. Both of these swords were used from 1630 -1660 The flamberge was a thin blade with a hilt that was simpler than the earlier rapier hilts. It had quillons attached to one shell. This was another predecessor of the smallsword, and like the smallsword was only meant for thrusting (North, *An Introduction to European Swords*, pgs 18 & 19, and Aylward, *The Small Sword in England: Its History, its Forms, its Makers, and its Masters* pg 22).

The smallsword was carried by civilians from the middle 17th century until the 19th century, and was believed to show one‟s wealth and nobility. At first England resisted the acceptance of the smallsword, but came to adapt it eventually. For a time newspapers would confuse the words rapier and smallsword and would use the two terms interchangeably.

The smallsword was roughly 31 inches in length. The early smallswords had a knuckle bow on one side, a shell guard with a sharp rim, and large arms. Another hilt form frequently seen had a loop guard consisting of a knuckle bow, quillons, and a bow from the knuckle bow to the guard. This style lasted from 1640 into the 18th century. Yet another early variation consited of an S shaped bar along with a quillon that extended to one side and went downward near the guard. The guard was oval shaped. Later in the 17th century using one quillon become less favored than using two (Aylward, *The Small Sword in England: Its History, its Forms, its Makers, and its Masters* pg 22, Coe, *Sword and Hilt Weapons* pg. 58 & 59, and North, *An Introduction to European Swords* pgs 18 & 19).



(S shaped guard with a single quillon and a set of smallswords with hilts consisting of a knucklebow and a shell guard.)

(A collection of smallswords in Higgins Armory that have a hilt made up of a knucklebow and shell guard)

(A sword from Higgins Armory that has an S shaped guard and one quillon)

The small sword‟s blade and guard are made separately and the blade is put through the center of the guard. The shellguard stays close to the blade, held in place by the quillons. The arms of the small sword likely would have been more for grip than protection. The blade of the small sword varied somewhat over time. The first blades were designed like more narrow rapier blades. In 1660 a new blade style was used that likely came from Germany. This style had an edge that was hollow ground to make it lighter (Coe, *Sword and Hilt Weapons*).

The 18th century involved changes in the style of hilts and pommels seen. The curve of both the shell and the knuckle bow become less sharp. In 1720 England added bars connecting some of their shell guards and in 1760 the two shells changed to one plate. In the mid 18th century military swords had heart shaped guards. This style stayed

around until 1830. Pommel, globe, pear, and urn shaped pommels came into existence. Urn shaped pommels became frequently used in court swords and still is used on ceremonial swords today (North, *An Introduction to European Swords* pgs 18, 19, 21).

(An urn shaped pommel)

Small swords were often covered in fanciful decorations similar to those seen on rapiers. Various colors of gold may sometimes be used for decorations. There are stories of merchants giving swords with gold hilts and thanks for kind actions or helpful services that were done for them. A large number a swords with silver hilts have been found and these silver hilts often have the maker"s name or other markings on them. As a result of people selling old hilts for their metal value when trying to buy new ones, much fewer hilts were found made of precious metals than likely existed. Most small sword hilts found were made of steel, and the decorations on them were impressive the difficulties in creating fine details in steel. Sometimes bronze or brass would be used to cast the hilt instead of steel, but these hilts would very frequently be coated in gold or silver, especially the brass ones. Bluing was also a technique used on some hilts, though gilding, silvering, or bluing would come off over time with cleaning. Common decoration types

found on small swords include chiseling, inlay, and piercing. (North, *An Introduction to European Swords* and Cou, *Sword and hilt weapons page 58,59, 6, an 67*).

Scabbards were still made uniquely for each blade because they had to be fitted to the blade itself causing each to vary. Scabbards were made using strips of sycamore, pine, or beech. These were sized by placing them against the blade. This was then lined with wool, glued together, and wrapped in linen thread. The material used on the outside of the scabbard was dampened before it was sewn on. This material varied between parchment, shagreen, morocco leather, and other materials. The mounds of the scabbard were pressed onto the material while it was still damp. If the scabbard was intended to be held by two rings that would attach onto a sling, then three mounts would be needed. Two of these mounts were the chape at the point and the locket at the top. The third mount was a band that went in between them but closer to the locket. Another carrying method only requires the locket and chape to attached this way (Aylward, *The Small Sword in England: Its History, its Forms, its Makers, and its Masters* pg 22).

Fencing

Italian fencing schools highly promoted the primary use of a sword‟s point. Some theorize that one primary reason for the rapier developing the small narrow shape it is most known for was to accommodate the fencing style taught by these Italian schools. In the 16th century the Italian schools were highly respected and many schools in other areas would seek out Italian masters. Fencing became a standard part of a nobleman‟s

education, and some young noblemen would even travel to Italy to study in the schools there (North, *An Introduction to European Swords* pgs. 7-9 and Coe, *Sword and Hilt Weapon* pg. 56).

Spanish and Italian schools felt very strongly about this fencing style, but the French schools adapted over time. The focus shifted to speed, and this was believed to cause the shift from the rapier to the flamberge, and ultimately to the small sword. Other changes occurred in fencing schools as well. For example masks were not worn until the 18th century but prior to this time hits were only allowed on the opponents torso and schools were rather strict on enforcing this (North, *An Introduction to European Swords* pgs. 7-9 and Aylward, *The Small Sword in England, if Forms, it's Makers, and it's Masters* pgs. 11-16).

Contemporary manuals Illustrate the shifts in fencing styles as well as some features that did not change. *Opera Nova de Achille Marozza Bolognese, Mastro Generale de l'Arte de l'Armi*, or New Work by Achille Marrozo of Bologna, Master General of the Art of Arms, was an influential early fencing manual. This discusses a style using cut and thrust in which both fighters keep their right foot forward. A manual from 1553 by Camillo Agrippa called *Trattato di Scienza d'Arme e un dialogo in detta material,* or Treatise on the Science of Arms and a dialogue concerning the subject, had a strong focus on thrust. It displayed four different on guard positions. It discussed the idea that the fencers should keep the left arm back and up, similar to a stance used in some fencing styles today. That said this stance was not widely adopted until the 17th century when the French school of fencing gained popularity.

Both manuals also mention ideas about styles of fighting with sword and shield, sword and cloak, halberd, and dagger. Agrippa mentions a few additional techniques such as how to defend against daggers when unarmed and several wrestling moves. Another manual made soon after in 1570 mentioned both attack and parry showing an early shift towards the form of fencing we see today (Coe, *Sword and Hilt Weapon* pg. 56).

Culture

The sword was starting to be less important in military use and for the first time was seen as a statement of civilian fashion or a tool that was dictated by the currently popular style of fencing. The sword itself became lighter given that they were carried by people other than trained soldiers. As a result of being seen as an object of fashion the sword became very decorative (North, *An Intorduction to European Swords* pgs 7-9). The rapier has been given the title "the civilian sword par exellence" though its name may have come from the Spanish word "espada ropera" which means clothing sword (North, *An Introduction to European Swords* pgs. 7-9).

The individual sword may have had sentimental value to some, but this value had decreased greatly, and was certainly of a different type of value than that held by the swords of the Viking Age or the Age of Chivalry. Men of the 18th century would often buy many swords for all types of occasions and outings. As styles of hilts changed a person may even trade in an old one for the worth of its metal and use that towards buying the newer design (Aylward, *The Small Sword in England: its History, its Forms its Makers, and its Master* pgs 11-16 and North, *An Introduction to European Swords* pg 21).

(A sword hilt design included in a design for a jewelry set)

That said swords had high monetary values and newspapers would frequently print ads for lost or stolen swords. Many times the descriptions provided would not be adequate at making the sword easy to identify. One such article described "a Silver gilt Sword done with several Figures, with a Chequer Gold handle done one half of it with a Black Ribbon." In another newspaper advertisement a man spent the entire time describing his anxiety over his lost sword and did remember to even include a description (Aylward, *The Small Sword in England: Its History, its Forms, its Makers, and its Masters* pg 25).

The articles indicate that the sword still often played an important role in the lives of their wielders but it was more of a social importance. It acted as a sign of status and a way of eliciting respect. Up to the first half of the 18th century it was a key part or any social circle. Ned Ward wrote *The London Spy* between 1689 and 1702. In this he discussed an interesting experience he had while under cover. He was pretending to be a man who had given up items he considered vanities, such as the sword. He traveled to an inn with a friend who was carrying a sword on him. While at the inn he noted how his

friend was shown a much greater degree of respect (Awylard, *The Small Sword in England: Its History, its Forms, its Makers, and its Masters* pgs 11-16).

In 1716 duels did occur but may not have been overwhelmingly common. This is believed because a fatal duel would be a major even in the newspapers of the time. Some of the people who would carry a sword may have had little knowledge on how to properly use it. That said, relative to earlier times, a lot of people were trained in sword fighting to some degree. The number of people around who may have known how to use a weapon may have been a deterrent (Aylward, *The Small Sword in England: Its History, its Forms, its Makers, and its Masters* pgs 11-16).

Prior to the 1740s a man might still place his sword on the back of their chair at meals and put their sword under their pillow at night. After this time people did not treat their swords with this degree of reverence but still would carry them when they left their homes. While at one point some would have complained about it seeming indecent to be seen without one people started to take them off while entering certain public establishments. In 1774 the Reign of Beau Nash at Bath put an end to civilians carrying swords in public. It so strongly lost fashion that the sight of someone carrying a sword in public would cause a panic (Aylward, *The Small Sword in England: Its History, its Forms, its Makers, and its Masters* pgs 11-16).

Artifacts on display in Higgins Armory

-rapiers: 3035, 697

-small swords:. 1997.01, 639, 3259, 2247.9, 3089, 1997.03, 1999.02.1

Ranged Weapons

Researched by Ian Fite

The African Throwing Knife

While the basic shape of bladed weapons was for the most part consistent throughout Europe and Asia, those of central Africa varied wildly, even within a comparatively small region. No group of weapons better demonstrates this than the tenuously named throwing knives. Outside Africa, the term "knife" refers to a short, single bladed weapon or tool, but the African throwing knife generally consists of 3 or more blades arranged in a divergent pattern. Furthermore, many weapons classified as throwing knives were never intended to be thrown, as evident by their thick handles and low centers of mass. Considering this, it would seem the name is whole inappropriate, however it has become the historical convention and no more fitting names present themselves. The weapons themselves do not have a unifying name in their native Africa, each local name, such as hunga munga, daniso or njinga, referring to a specific knife variation in a specific region and will generally only be used by one or a handful of tribes. Conversely, it is safe to say that every human language contains a word for "knife," so referring to this class of weapons as such lends itself to easy translation, lacks ambiguity and is generally much more convenient. Supposedly, such knives were powerful enough to severe a man"s, or his horse"s, leg at a distance of twenty meters, and aimed effectively at up to fifty meters, but such a claim is likely greatly exaggerated since there have been no documented cases of them being used effectively at these ranges. Much more likely, they can wound a man at twenty meters and severe a limb at no further than just a few meters at most. Because the knives are so narrow and aerodynamic, they

can travel to the edge of their effective range losing very little momentum or accuracy, however after that they tend to destabilize, rapidly lose speed and stray from their intended path.

In the more northern areas of the region in which throwing knives were, can continue to be, used, an „F" style of knife is more prevalent. So named because some specimens resemble a capital F, such knives were used both for hunting and warfare on the open plains. A soldier from this region would probably carry a sword and thatched grass shield as well as two to four spears, and depending on his tribe and social class, two to four throwing knives. Armor was not used in the same geographic regions as the throwing knife as a matter of practicality. Usually, battles in such an environment could more accurately be described as a series of single combats in proximity to each other, though if a warrior found himself without an opponent, he was not above ganging up on an ally"s chosen foe. The spear was the preferred weapon is such an environment, though tribes that favored the bow are not unheard up, so warriors would, as a rule, exhaust their supply of spears before drawing their knives or swords. Not only is it considerably easier to become proficient with a throwing spear, it is considerably more massive than a knife"s, and it focuses its momentum on a single point. This gives it considerably more penetrating power, so where a knife would likely glance off a shield harmlessly, a spear would stick into it, or, at very close range, penetrate the shield completely to strike the unprotected warrior behind it. The knife had a few advantages over the spear, but the shield was so widely used that they could not compensate for its penetrating power. The throwing knife, rather than striking with a single point, was sharpened along its entire 30 centimeter length. A larger striking surface like this allows for a some margin of error in

the thrower‟s aim since straying a few centimeters‟ from its mark would not negatively impact the throw. Throwing knives are also lighter and smaller than spears allowing them to be carried while encumbering the warrior less, generally on the inside of his shield or in a shoulder mounted pouch in the case of cavalry.

In the more southern, forested regions in which the throwing knife was used, they took a different shape, described as "Z-shaped," "winged" or "circular". At first glance, these knives would appear to be more balanced, suggesting a more practical application, however, the thick brush in this environment made throwing such knives impractical. In fact, iron was rare enough that throwing it at an enemy was not economically feasible. Instead, the so called "throwing knives" used in such regions were more often used in hand to hand combat exclusively, never being thrown or used in hunting. As a result of this limited use, throwing knives were never nearly as important in such areas.

Although there practical use was noteworthy, throwing knives also had a great deal of symbolic importance. Lacking any widespread formal currency, throwing knives were used to facilitate trading since protection was one thing that was always in demand. Prices naturally varied greatly over time and distance, but to give a ballpark figure, two throwing knives were approximately worth one day‟s worth of grain. While this likely started a series of barter conventions, it was evidently very practical since a number of broad, dull throwing knives were created that would have been unsuitable as weapons. Such artifacts became increasingly common with the introduction of firearms, once the throwing knife had become obsolete. Throwing knives were of great symbolic importance. Often they were used as a badge of office, heavily decorated with engravings. Similar knives were used in religious rituals. In a few cases, throwing

knives were such important symbols to the status of a soldier that they were required to state their intent before throwing them, lest it be thought that they were casting aside the king‟s steel in fear.

Japanese Archery and Arrowheads

Archery in some form or another is nearly ubiquitous across human culture, perhaps because of the relative simplicity of the most elementary forms and the great utility it offers in hunting and warfare. The Far East is unique, however, in the mystical emphasis they place on the art of archery. The weapon was of great importance in the warrior culture of feudal Japan, even more so than even the sword that made the Samurai famous in the west. It is ironic that their curved blades, as beautiful as they are, have become synonymous with the elegant warrior when just as much if not more training, artistry and craftsmanship went into their bows and arrows.

Archery has left a deep imprint on Japanese culture that persists even today. Originally, there were two broad categories of Japanese archery. Ceremonial archery is focused on religious and magical applications. Military archery, as one might guess, is used in war, but is further divided into three categories, infantry, cavalry and temple. Infantry and cavalry techniques were used on the battlefield to actually slay the enemy and have survived in some form to the modern day. The first archers were hunters, but they were very successful once they took to war. So great was the power of the bow and so few were skilled archers that it was considered the most honorable nobleman‟s fighting style. In fact, the legendary first emperor of Japan, Emperor Jimmu, is depicted favoring this weapon in almost all cases. The Japanese people identifies with this traditional art, to the point that archery contests were held as early as the fourth century AD to celebrate the nation‟s founding.

Temple archery is a nonlethal tournament style based on stamina and shooting numerous arrows at a low trajectory inside a temple. The skills on temple archery have

no battlefield application since the arrows strike with little force and would not harm an enemy signicantly. Such a contest would last all day or longer, so competitors had to shoot their arrows the minimum distance required while using as little energy as required. This style has not survived in any form since the early 1900 when archers lost access to Sanjusangendo, the temple where they traditionally competed. Despite such dying branches, the tradition of archery became so engrained that it was still considered a noble art, even after technology advanced to the point that it was no longer tactically relevant. In the twelfth century, "people in high positions were delighted when their ability as archers was acclaimed but made every endeavor to have their prowess with the sword hushed up" (Lidstone).

The longbow holds a special place in traditional Japanese warfare. Archeological evidence of the bow being used in war suggests it first happened after the Yayoi period, that is to say, the third century, however, there is no literary evidence of such a weapon before the medieval period. The bow first became popular with horse archers who were vital to repelling the Mongolian invasion of Japan. Samurais would begin a battle with a hail of arrows before dismounting for single combat, at least against other samurai. A high ranking archer would not bother to finish off a foe he considered beneath him, such as a common soldier. In such a case, a foot soldier would be expected to deliver the killing blow. Early on, mounted archers were used almost exclusively, but as time went on, beginning in the mid fifteenth century, mounted archery became increasingly less common until they were completely replaced by large formations of infantry archers. At about thirty yards, a fully drawn longbow could pierce the armor of the day, so this was the ideal range. Foot archers could shoot 50 yards accurately and 100 yards at a large

target, such as a large formation of soldiers. This range doesn"t have the same armor piercing power. Later on, archers would fire from behind a large bamboo shield, called a tedate, with their bows held horizontally. Cavalry archers had a shorter range since the warrior"s attention had to be divided between aiming and directing his mount. Eventually, firearms made the bow much less tactically relevant.

(A Japanese longbow)

The Japanese longbow, or Yumi, did change slightly as technological advances were made, but a single proven design stood the test of time. The majority of bows from around the world are held near the center of the bow staff, but the same does not hold true in Japan. This longbow, which is typically seven to eight feet tall, though they are up to nine feet in a few older cases, is held two thirds of the length from the top. This lopsided design allows a bow with a much greater strength, as a result of having longer arms, to be used while mounted on a horse without the bottom wing obstructing the user"s ability to ride. The longbows were given permanent reverse curves using stone blocks to bend the staff. This gives the bow a double bent shape. The most successful make of bow was

constructed from several lengths of wood, generally bamboo, glued together. Metal cords covered the bent ends to reinforce the staff and these steel cords would make a distinct sound when struck by the bowstring. This sound was sometimes used for signaling. Bowstrings were made from long fibers of hemp, sinews or in the case of ceremonial bows, silk. These strings were supplemented with wax or pine resin coats to form a hard, smooth surface. Smaller, short bows were used in religious ceremonies and incantations by priests and enchanters, but such weapons were never intended for open combat. Early quivers were broad and spread outward like a peacock‟s tail to allow for quick drawing and prevented the fletching from being ruffled. Later on, such quivers gradually were replaced by narrower, closed quivers that protected the arrows better from the elements, a benefit worth being able to carry fewer arrows. The Japanese arrow, called a ya, is crafted from a bamboo shaft, three or rarely four feathers. Such arrows have a wide variety of heads crafted from wood, metal and clay, each used for its own purpose. The term Kabana refers to the head, but it is sometimes used to refer to the entire arrow. Practice arrows have wooden, pear shaped heads. Turnip shaped, perforated, clay arrow heads would make a shrill whistling sound when shot and would be used to signal the start of a battle. Such arrows were first used in the Gawa period, about the seventeenth through nineteenth centuries. Practical purposes, such as hunting or war, used steel arrow heads. Unusual arrowhead shapes that were actually used include Y shaped double pointed, flesh-tearer and barbed. Each shape had a specific purpose. Barbed arrows were more destructive to flesh, and sometimes poison was used. Supposedly a legendary archer used a forked head to remove the feet of an osprey without killing it to save the fish it was about to eat, thus preserving life in the sacred

garden. There are also many varieties of broad, ornately carved arrowheads that were used ceremoniously and would not have seen the battlefield.

Lidstone, R. A. *An Introduction to Kendo*. Surrey, England: Judo, 1964

The Crossbow

The crossbow is a unique weapon in that while it is clearly a technological advancement of a preexisting weapon, the bow, even in its most advanced forms it is never unambiguously superior to the bow. While it had a significant advantage in accuracy and firepower, it could not overcome the low rate of fire compared to the longbow. Fortunately, the weapon more than made up for this one drawback and carved out its own niche in the history of warfare.

The earliest evidence of a European crossbow is a stone carving in a Roman grave from the fourth century. It is worth mentioning that the Chinese crossbow is much older and the African crossbow did exist, though it was only used for hunting and not war. This paper, however, focuses on the European crossbow. It is speculated that the crossbow was developed from bow traps used when hunting, or perhaps evolved from small siege weapons instead. Though crossbows were apparently known in Rome, they went out of favor in Europe from about 500 AD to 900 AD. The crossbow didn"t arrive in England until the latter half of the eleventh century, still of simple wooden construction, essentially a short bow turned on its side with a mechanical release. Even then, this new technology was met with political resistance. Like early firearms, the weapon was considered uncivilized and unfit for use against fellow Christians because the wounds it inflicted were so dire. The composite crossbow came to Europe from the east in the twelfth century. It was made of yew horn and tendon. Despite the papal ban, for a brief period, the reign of King Richard I, 1189-1199, crossbows were commonly employed in England"s armies until the king was killed by a crossbow bolt. Because of his controversial policy, his ironic death was generally considered to be the judgment of

the heavens. Eventually this taboo fell out of favor so by the thirteenth century, France and England were both fielding crossbowmen, but because the nations lacked a tradition of it, most crossbowmen were foreigners. Many advancements were made to the crossbow in the twelfth century, turning it from little more than a short bow turned on its side to a complicated piece of machinery. Even after the introduction of composite crossbows, simple wooden ones continued to be used in parallel since they are much cheaper and easier to make. By the fourteenth century, the crossbow was a common arm of the people in England and Wales but was unknown in Scotland and Ireland where even the bow was used sparingly. The makers of the highest quality crossbow too were foreigners. The Genoese crossbowmen in particular were so dangerous that the Milanese put out an eye and cut off a hand of every crossbowman they captured. The construction of a crossbow was a closely guarded trade secret, and as late as late as the fifteenth century, some crossbow makers refused to teach the art to Christians. In the fifteenth century, simple wooden crossbows fell out of use almost entirely in favor of composites which by now had to compete with steel bows. Steel bows were not more powerful than composite bows, but they were easier to make. The English preferred the longbow in war, but the crossbow had some popularity as a hunting weapon. A bow must be drawn immediately before the shot but a crossbow can remain ready. This is a big advantage when hunting. Fearing that their hunters would be unskilled with the longbow, should they be needed in war, the English outlawed crossbows for the brief period from 1508 to 1539. As guns became more reliable, crossbows fell out of favor and use on the battlefield in the early sixteenth century, though it continued to be used in hunting. Even as their tools became more technologically complex, The writers of the fifteenth and

sixteenth century were superstitious about the hunt. Konrad Kyeser suggests filling a crossbow"s bolt with axle grease or the heart of a bat to increase accuracy. Even at this time archery contests with the crossbow continued to be popular. One of the more widespread formats was shooting a colorful wooden bird called the popinjay or parrot out of a tree. (Payne-Gallwey 3, 4, 33, 48 62) (Blackmore 174, 180, 195) (Held 56) (Alm 6, 7, 13, 14, 19, 22, 31, 34, 35)

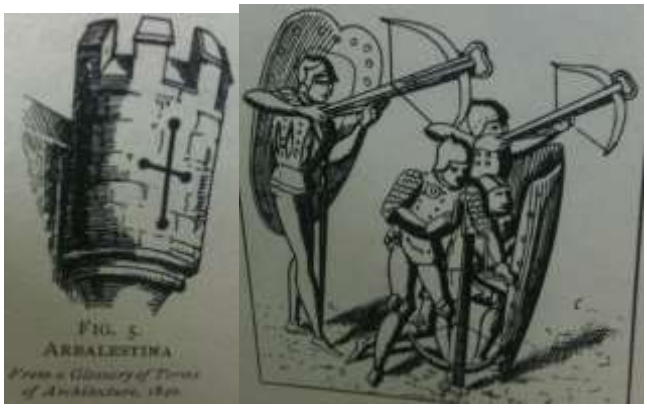
The martial role of crossbows changed over time. Initially they were little more than a variant of the bow slowly developing to take on a similar but distinct role until they were replaced by firearms. Simple muscle-powered crossbows lacked the range to compete with the English longbow, but the crossbow generally had easier requirements of its wielder relative to the longbow, in both strength and skill. Since crossbows had a slow rate of fire compared to bows, a crossbowman might be accompanied into battle by a shield bearer behind whom he would take shelter while reloading his weapon. Some crossbowmen simply carried their own smaller shields if they lacked an assistant.

One of the main advantages of the crossbow was that it is less bulky than the longbow and could thusly take advantage of concealed positions that a bowman could not use. For this reason it was particularly favored on ships. The Arbalestina, a fortification that would have been built into the wall of a castle, was designed to capitalize on these lighter requirements. It is wedged outwards on the inside to allow the archer a greater area he could cover.

The fifteenth century steel crossbow had a range that matched the longbow but was far too slow and heavy to be used against fast moving targets. The hunting crossbow was very successful from the late fifteenth to early seventeenth century because of its

compact size and excellent accuracy at close range, though unfortunately it was too heavy to use against fast or airborn targets, effective only on large stationary targets. Canvas covers were used to protect crossbows from the environment since many crossbows were not waterproof. Mounted crossbowmen typically carried their weapon in a baldric, a shoulder belt and drew their bows using either a device called the goat‟s foot or one called the crannequin. The composite bow functions better than the steel bow in the cold so it more appropriate for hunting or fighting in such environments. Crossbows are much more effective than bows at long range since they maintained their power while an arrow would land softly. If fact, heavy crossbows could pierce heavy armor, no doubt contributing to its reputation as a cruel weapon.

The Russians are noteworthy for their tactic of used whistling bolts. By all firing such bolts at once, the great noise would spook their enemy‟s horses, a scare tactic not unlike the use of early firearms. Crossbows were safer to the wielder than early fire arms since their malfunctioning is never fatal, but eventually advancements in firearms would make the sporting crossbow obsolete. The accuracy of the crossbow could not be matched by firearms until well into the sixteenth century. (Payne-Gallwey 6, 7, 9, 11, 13, 19) (Blackmore 181, 187, 203, 204) (Held 61, 63) (Alm 44)



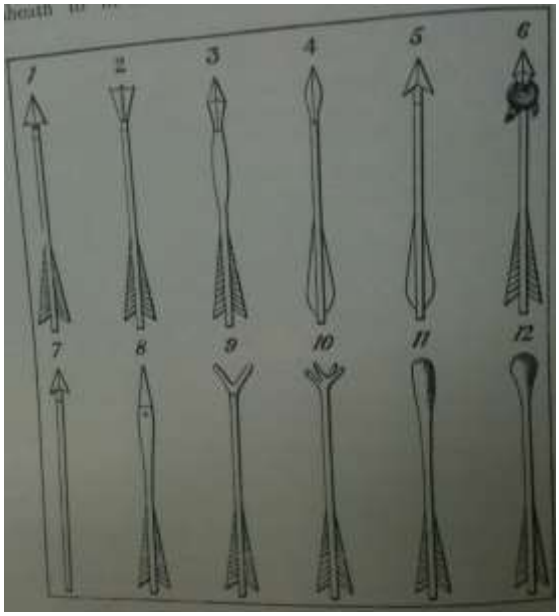
(Image 1: An arbelestina. Image 2: Shield Barers)

The earliest crossbows were made of simple wood. These crossbows were ash or yew and would be bent by manually drawing the string to the lock. When drawing the bow manually, the archer wore leathern guard to protect his fingers. Primitive crossbows were held together by a bridle of cord or sinew. It was light and strong and greatly lessened the jar from the bolt being released. Such crossbows could not shoot effectively when wet since the strings would slack. (Payne-Gallwey 4, 57, 61, 67)

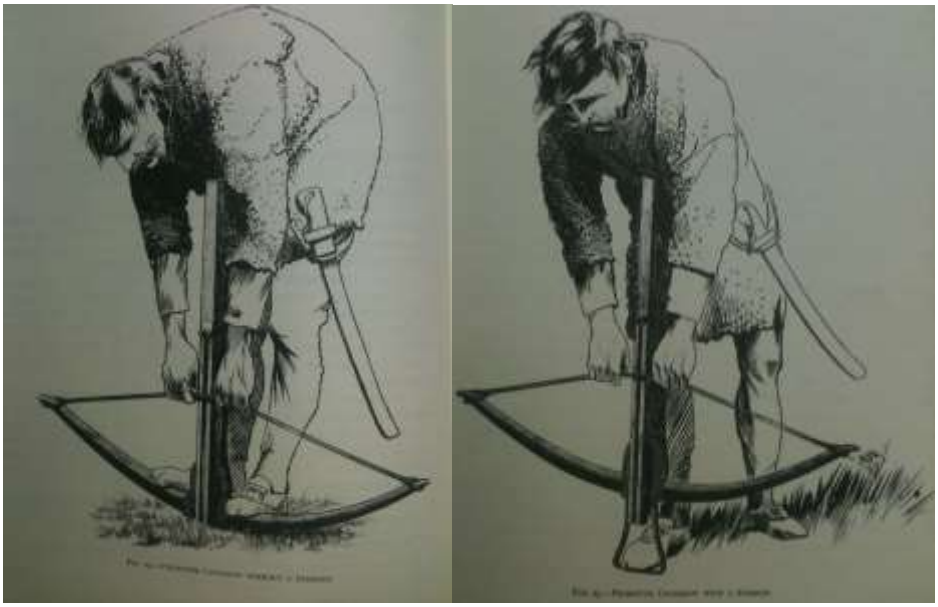
Just as conventional bows can be made more powerful by making them from several different materials, so too is the composite crossbow a natural upgrade to the simple crossbow. It is made of several types of wood or horn glued together. The core of the bow is horn or whale bone with many layers of wood on either side. The core of the bow is always surrounded by a layer of sinew that makes up a third to a half of the bow‟s volume. Asiatic crossbows tend to be think in the center and broad and flat at the wings. Despite its complexity, this bow was lighter, more elastic and more powerful than the wooden bow. The greater tension straightens the bow almost completely, forcing the string to be lack by necessity. The strings are made from hair from horse‟s manes and oxen‟s tails, but in a pinch women‟s hair also works. Since the threads composing the string were essentially detached, they were vulnerable to easily absorbed moisture. (Payne-Gallwey 5, 63, 64) (Blackmore 180, 181) (Alm 15, 16)

In the fourteenth century, the steel crossbow appeared. The steel crossbow, by contrast to the composite, has a tightly strained string, coated thoroughly with beeswax, is completely impervious to water. (Payne-Gallwey 5, 71)

Crossbows, being of different shape and design, could not accommodate traditional arrows. Heavier bolts are required to deliver the full force of the crossbow. The bolts, or quarrels, widen near the front, shifting the center of mass forward for the proper balance. Quarrels were plain in design and unnocked since they were not expected to be recovered. The Vireton was a type of bolt that used angled feathers to spin. It was not more accurate or longer ranged than a normal quarrel and was purely oriental. Pointed metal heads, like the heads of conventional arrows are used against soft targets like animals or lightly armored humans. Square headed, four pointed quarrels are less likely to glance off of armor, so these quarrels were used against armored knights. Blunted bolts were used in hunting as to not damage the skin. The large barbed bolt, called angell-hede, was the standard arrow used to hunt large game. This bolt had a wide concave cutting edge that would hamstring the animal. (Payne-Gallwey 17, 18, 19) (Blackmore 194)



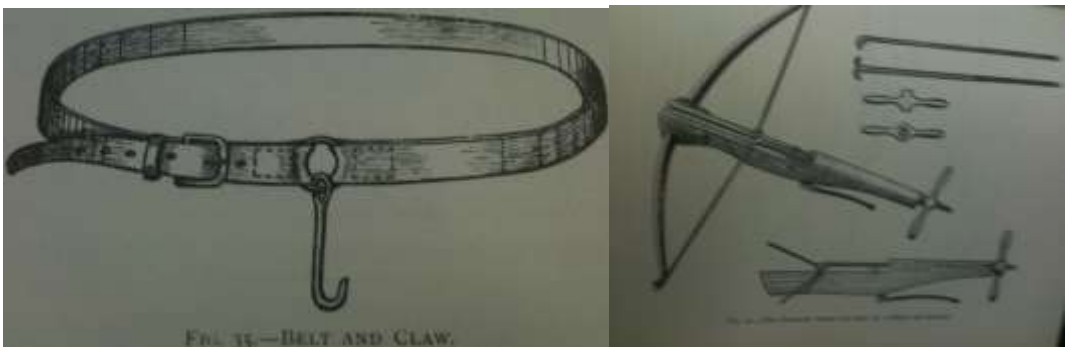
(Crossbow bolts)



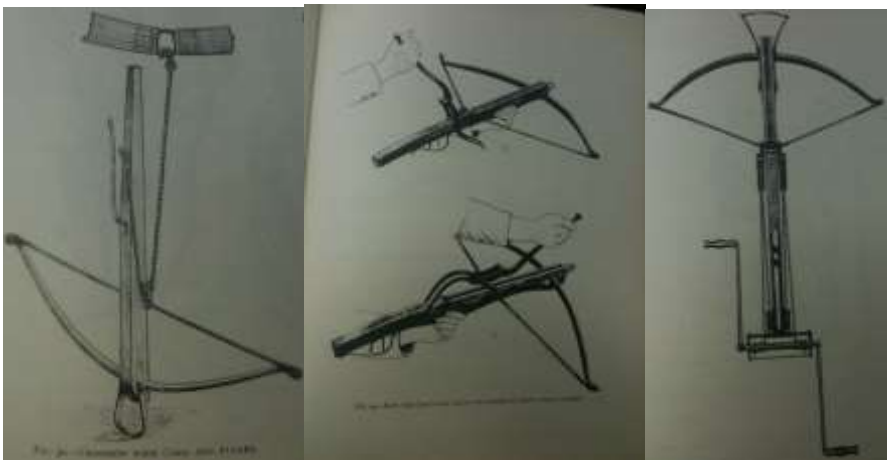
(Image 1: Drawing an earlier crossbow. Image 2: Drawing a crossbow with a stirrup)

Unlike the longbow, the crossbow did not require the wielder to physically hold the bow taught until he is ready to fire. Most crossbows are fired by a long lever mechanism that releases the string. Unlimited by the reasonable strength of a human, the bow could be made much stronger. Unfortunately, a man could not draw so mighty a bow with just his arms. With simple crossbows, the feet were pressed against the bow for leverage, the archer essentially standing on his weapon and drawing it upward. These primitive bows had no stirrups. The stirrup, not unlike the stirrup of the saddle, is a metal protrusion at the end of the bow that the archer braces against the ground with his foot, or in the case of larger bows, both feet. Crossbow drawing mechanisms allowed for greater pull unlimited by direct human strength. Without a stirrup, the bow couldn‟t have been steel or even composite. By the thirteenth century, larger crossbows were readied by a thong and pulley or by a claw attached to the belt that would allow the archer to draw with the strength of his legs. An improved version of this device, called the Sampson belt, incorporated a pulley. In the case of a mounted crossbow, a goat‟s-foot lever, a steel

device that resembles a cloven hoof, was used. It wasn"t as powerful as some of the other methods, but it was much more compact. The screw and handle was a hook on a screw built into the stock of the crossbow. By turning a facet like handled at the base of the stock, the screw would be drawn back, dragging the string with it by a hook. A main disadvantage of the screw and handle method for drawing the bow was that it had to be disassembled each time it was add to or removed from a bow. The windlass is a pulley system for drawing the bow built into the crossbow. The crannequin is a gearbox that gives the archer great mechanical advantage when cranking to draw back the string. Friction is a much greater design concern with the crossbow than the longbow since the bolt had to travel along the body of the bow so stocks were designed to bend away from the bolt other to reduce friction. Because crossbows had so great a pull, it would require an incredible amount of strength to string an unstrung crossbow. To help with this, many had nooks for a helper string that could be fastened to a strong workbench mounted mechanism to bend the bow. (Payne-Gallwey 57, 60, 64, 70, 71, 82, 84, 121, 142) (Alm 9, 20)



(Image 1: Claw belt. Image 2: Screw and handle)



(Image 1: Samson belt. Image 2: Goat‟s hoof. Image 3: Windlass. Image 4: Crannequin)

Payne-Gallwey, Sir Ralph (1958). *The Crossbow*. London: The Holland Press

Blackmore, Howard L. (1971). *Hunting Weapons*. New York: Walker & Company

Held, Robert (). *Arms and Amor Annual*. Northfield, Illinois: Digest Books, Inc

Alm, Josef (1994). *European Crossbows*. Dorchester, Dorset: The Dorset Press

Early Firearms and Noteworthy Guns

The role firearms played on the battlefield completely changed as the underlying technology improved, perhaps more so than any other weapon. Though early guns were very inaccurate and unreliable, they were nevertheless invaluable for the devastating effect they had on morale. Over time the weapon‟s role evolved, and as the crippling flaws were gradually corrected, the gun could be turned to more practical applications, such as actually disabling or even killing the enemy. Eventually firearms came to dominate the battlefield once the majority of their flaws had been worked out for the simple reason that chemical energy provides more force than mechanical energy for the same weight and bulk of weapon.

The earliest known chemical explosive was when the Chinese used saltpeter-based compositions by 1000 C.E, long before anything of the sort was discovered in the west, but it has been disputed that the Chinese truly had any such technology at the time since no primary source of the information can be found. Whether or not China was the birthplace of gunpowder, firearms likely first appeared in the East. Alexander the Great may have fought them in India, but records are scarce and inconclusive. Roman candles made of wood or bamboo were perhaps the earliest firearms, though they operated more similarly to cannons than to muskets. The closest thing classical Europe had, Greek fire, did not contain saltpeter. It wasn‟t until the thirteenth century that gunpowder first appeared in the West. At the time, Europe was going through a series of inquisitions, and, since inquisitors were not known to make fine distinctions between science and

witchcraft, inventors had to hide their work often encoding their notes. This has made finding exact details about the introduction of gunpowder to Europe difficult. In all forms gunpowder consists of three ingredients, potassium nitrate, colloquially known as saltpeter, charcoal and sulfur. Naturally the exact ratio varied over time and distance, but the ratio that survived to the present is three quarters saltpeter, three twentieths charcoal and one tenth sulfur. (Pope, 21-22) (Smith, 14-15)

The earliest weapon that could be called a firearm was the cannon, which first appeared in Europe in the mid thirteenth century. The first king to be killed by a firearm was James II of Scotland who achieved this honor when his own cannon misfired, bursting and killing him unintentionally. The first man portable firearms, shoulder mounted bombards, didn‟t appear in Europe until the early fourteenth century. Stick mounted versions were used on horseback. Some cultures resisted early use of guns on the battlefield, calling them too brutal to be used against living men. Such armies refused to field guns, even as they fought enemies with firearms. The argument was for the most part unfounded since the longbow was more accurate than early guns and had comparable penetrating power so guns were no more deadly or painful than other weapons in use.

These weapons lacked any sort of sophisticated firing mechanism. The marksman had to manually light the powder with a match or torch. Once he had fired his single shot, the gunman, called a harquebusier or a culveriner, was relatively defenseless, so he carried a sword or a spring loaded dagger on the rest of his gun called a Swine or Swedish feather. Harquebusiers had to be familiar with the technical workings of their weapons so they could fix the many ways crude firearms could break. Often it was easier

simply to train gun makers to use their weapons on the battlefield than to train marksmen to maintain guns. This practice was common enough that a gunsmith might be called a harquebusier, even if he were not a soldier. Early guns had a very low rate of fire, comparable to one shot every hour, but this was irrelevant because their main function on the battlefield was not to kill the enemy but to terrify them. Repeating arms, essentially two harquebus attached together, were developed to mitigate this drawback, since once the first shot had been fired, thinking the gunners were vulnerable, the enemy would charge allowing the second shot to be made at very close range where the weapons" inaccuracy would be less crippling. Gunners had to keep the components of their gunpowder, or serpentine, separate and only mixed them before use because premixed powder risked separating into its components if left too long. The process of „corning" was developed to make the grains of the powder larger and combat this problem. The powder was mixed and liquid was added to make it clump. Then the liquid was evaporated off leaving a much faster burning, courser powder, each grain consisting of all three components. In theory, any liquid would work but early powder makers preferred human urine, favoring priest, or even better, bishops. Corned powder was so powerful that it could not be used in cannons since the quantity such artillery pieces used would blow the entire apparatus to pieces. (Greener 18, 19, 45, 55, 58, 61, 62) (Pope 19, 44, 45, 62)

Once guns had proven to have martial value, they underwent rapid experimentation and innovation. The first major improvement was the introduction of the matchlock firing mechanism. The matchlock is literally a C or S shaped piece of metal that holds a slow burning match. The marksman manual pushes it to ignite the powder to

fire the gun. This was a marked improvement over the cannonlock that made aiming much easier. The first improvement on this simple design, the Merz Matchlock brought the match away from the shooter‟s eye rather than towards it, making aiming easier. Later on, more complex cock and trigger mechanisms were used but for quite some time the basic underlying principle behind the mechanism remained unchanged. One of the main disadvantages of the matchlock was that the light exposed the soldier‟s position. Another was that it was hard to keep alight on the battlefield. One of the bigger problems the marksman faced was that between powder bullets, match and the weapon itself, early guns were very unwieldy. This was one of the main limiting factors that prevented them from effectively competing with bows. To help compensate for the huge number of details the culveriner had to keep track of, he was generally accompanied by an assistant called a varlet or gougat who carried some of this and kept the flame lit. Rifling, that is carving spiral groves in the barrel to make the bullet rotate and thus shoot further and surer, and sights were both developed during the use of the matchlock. Several other elaborate mechanical innovations were attempted, but without a good system for sealing the chambers and igniting the powder, none of them were very successful.

Even as engineers embraced firearms, many traditional soldiers continued to resist their use. Armored knights resisted most strongly because while a pike or a well-placed arrow might unhorse a knight and take him out of the battle, a good shot would kill him. Heavier armor might protect its wearer against earlier firearms, but as technology improved, firearms became strong enough to pierce any armor that a horse could carry at short range. (Smith 21, 22) (Greener 56, 58)

The matchlock was a marked improvement, but it still had a number of critical flaws, the most readily apparent being the ease with which the light could go out. The Wheelock solved that particular malfunction. It works like a modern day cigarette lighter. A serrated wheel grinds on pyrite to produce sparks. This wheel is spun by a winch and spring mechanism. This led directly to the trigger system that is still used today. The Monchbuchse of Dresden was a pseudo wheel lock device that was based on linear rather than rotary motion. It was created slightly sooner but never achieved any level of popularity the way it‟s rotary successor did. The wheel lock was invented in Italy but most surviving models are German. Since it is never aflame, it is much less likely than the matchlock to give away the marksman‟s position to his prey or enemy. In fact, wheelocks work even when damp. Unfortunately, as a side effect of the additional moving parts, wheelocks are less reliable than matchlock in ideal conditions and are less durable, compounded by the fact that wheelocks are more complicated to maintain and repair. It was with the introduction of this technology that cavalry began to embrace firearms. Wheel lock pistols are favored by cavalry since they can be fired one handed, leaving the other free to hold the reins, and multiple pistols can be easily carried at once. It has been suggested that the knob of a cavalry pistol was intended to be used as a club but the majority of surviving pistols are not sturdy enough to have been used in such a fashion, so it is more likely that the knob was intended to make the pistol easier to draw. Pistols were first effectively employed on the battlefield in the sixteenth century with the development of the maneuver called the caracole. A squadron of fifteen to twenty ranks of cavalry would close to firing range on the enemy and the first rank would fire and turn off to the sides to allow the second rank to do the same. They would then return to the

rear where they could reload their pistols. This technique gradually but surely replaced the lance. In practice the caracole may not have been very effective since the short range of the pistol didn‟t leave the front ranks much room to lap around and reloading while riding was difficult. (Smith, 24) (Greener, 63) (Pope 73, 74) (Peterson, 336)

One firearm of particular note was the gunshield, a favorite of Henry VIII. This artifact is very rare, and although there are conflicting records about the number of surviving specimens, all sources put it as a matter of dozens. At the most conceptual level, the gunshield is a breech loading pistol superimposed though a small iron shield with a small grating above the barrel, intended for sighting. Usually the shield was steel plating on a wooden base. Colorful fabrics and tassels would have adorned the inside of the shield and the handle, but rarely have these components survived to the present. There are two makes or styles of gunshield, English and Italian. The English build is heavier in both caliber and shield, with the barrel protruding directly through the center of the target. They were often made from existing shields. Perhaps they were used on ships, the heavy shields braced on the ship‟s gunwale. The Italian style had the barrel slightly above the center of the shield and was generally more ceremonial, covered with ornate carvings or gilding. This ceremonial purpose may account for their smaller sight meshes. (Greener, 92) (Richardson, 29) (Metcalf)

Artifacts on display in Higgins Armory:

Wheel-lock Carbine 2001.01 2000.04.2

Matchlock Musket 460 263

Child’s Musket 1998.04.1

Wheel-lock Holster Pistol 1997,02

Japanese Matchlock Musket 1863.3

Staff Weapons

Researched by Patrick Feeney

History of the Spear

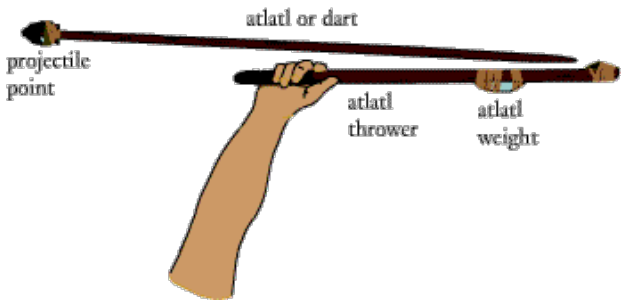
The spear is without a doubt one of the oldest weapons in history by far, having existed for hundreds of thousands of years. They predate Homo sapiens as a species, having been used for hunting by our hominid ancestors long ago, and in modern times have been observed in use by other great apes, namely chimpanzees and orangutans. The principle behind the spear is remarkably simple - a pointed head at the end of a long shaft allows the wielder to concentrate a large amount of force at a point beyond their normal reach. The ancestor to all other polearms, the spear in various forms played an enormous role in human history, and remained in some capacity on the battlefield even into early modern times, where it took the form of the bayonet (Byrne).

Stone Age Spears

Spearheads come in three general forms: triangular, lozenge-shaped, and leaf-shaped. The prevalence of each had regional variation, but overall the basic shapes remained remarkably stable throughout history. The earliest spears were likely made entirely of wood, their ends sharpened and then hardened with fire. Because wood rots, however, the earliest preserved evidence of spear use is in the form of spearheads made of flint and obsidian. These two materials can be readily shaped into extremely sharp blades via striking off flakes with another stone, making them well-suited to the creation

of spearheads in a time before metallurgic technologies. Bone was certainly another common material for spearheads, although rarer to find, since like wood it is prone to decay. It is because of this that we know the Stone Age as such, as although organic materials were also in widespread use, it is the stone implements of this time which have survived into the present to be studied (Oakeshott 16).

A spear can in general be wielded in one of two ways: either as a thrusting weapon, or as a thrown projectile. Spears designed for throwing are generally lighter weight and have thinner shafts, making them easier to throw, while those primarily for thrusting are thicker and heavier, providing a better grip. The last ice age saw the development of the atlatl, which allowed spears to be thrown with greater force and accuracy than if by hand. Like the spear itself, it is a very simple tool, consisting a shaft with a scoop at the end to catch the dart and hold it in place, and a weight towards the middle to provide balance. The atlatl gives the thrower more time in which to impart force to the projectile, resulting in a more powerful throw. The most notable wielders of the atlatl in combat were the Aztecs, from whom we get the weapon"s name and who used it against the Spanish during their conquests in the 16th century, alongside the bow which had supplanted the spear-thrower in other areas of the world (Howard, Whittaker).



(image from http://people.ucalgary.ca/~walde/glossary.html)

Greek and Roman Spears

The Romans used a particular kind of throwing spear known as the pilum, which they used to disable the shields of their enemies. The iron head of the pillum had a thin, elongated neck, which would bend downwards once the head had embedded itself in the shield, preventing it from being removed. The added weight of the spear rendered the shield unwieldy and thus ineffective, and the iron neck resisted attempts to cut it away with a sword. The Roman soldier would throw his pilum at short range, aiming to either maim his opponent by striking him in the stomache or to deny him his defense by striking his shield, before closing in for the kill with a sword. The legionary would carry two pila, to allow him two chances to kill or disable an enemy before closing (Oakeshott 16).

Spears and other polearms were the primary weapons of choice for infantry soldiers from ancient times, until advancements in firearms led to their decline after the 16th century. A metal head attached to a wooden shaft is cheaper and easier to produce than an all-metal sword; both due to the lesser amount of metal required and due to the relative simplicity of the techniques needed to forge it. As a purely or almost purely

thrusting weapon, a spear is able to be wielded in close formation without any loss in effectiveness, and its length, in general six to eight feet, allows the wielder to pose a threat to any enemy attempting to get close with a shorter weapon, so long as they are prevented from simply going around (Markle 331).

Due to the above, the spear is perfectly suited for use by large blocks of disciplined foot soldiers, who can stand together and present an nigh-impenetrable wall of points as they advance. Such a formation, called a phalanx, was used by Greek hoplites beginning in the 7th century BCE. They carried a one-handed spear, and a round shield called the hoplon, from which they gain their name. Each hoplite in the phalanx would use his shield to cover himself and the hoplite to his left, and the whole formation would advance as one. The Macedonians under Phillip II and his son Alexander the Great developed a different form of the phalanx, wherein the soldiers wielded a two-handed pike called a sarissa in place of the hoplite‟s shield and shorter spear. These spears could be up to eighteen feet in length, providing an enormous reach and allowing soldiers as deep as the fifth rank to present their points alongside those on the front. The Macedonian phalanx was copied to some extent by later Roman armies, but the use of pikes eventually fell out of favor, not to be revived until the 15th century (Lorimer 76, Markle 323).

Medieval Spears

The Middle Ages were the time of greatest variety in staff weapon forms. With few exceptions, all retained the basic thrusting capability that defines a spear, usually via a metal spike extending from the top of the blade. These spikes were generally either flat

or pyramidal in shape, and provided the polearm with much needed stopping power with which its wielder could make or receive a charge. One weapon, the awl-pike, essentially consisted entirely of such a spike, a meter long or more, attached to the usual wooden shaft and with a round guard plate at the base to protect the wielder‟s hand.

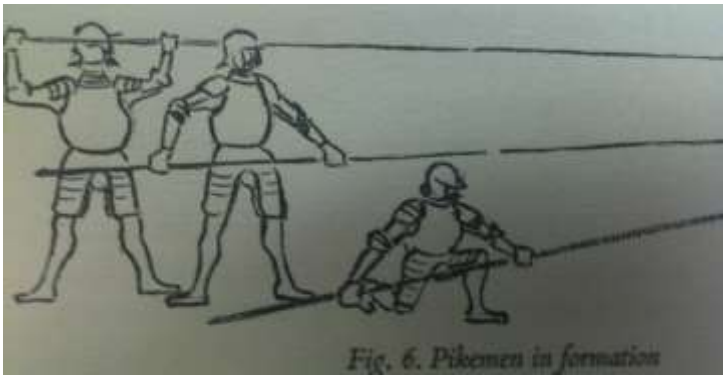
(A partizan in the Higgins Armory collection)

Another weapon, the partizan, had a head that was essentially an enlarged spearhead, triangular in shape. It was developed relatively late into the middle ages, during the 15th century, from the earlier Italian spieda de guerra, or "war spear". The partizan blade had a pair of projections at its base, which could aid in protecting the wielder by catching the end of an enemy‟s weapon. The blade of the partisan grew steadily longer over time, from 40-45 centimeters in the early 15th century to nearly twice that, at 75 centimeters, by the end of the 16th century. The major distinction between the partizan and its predecessor is in the ratio between the length and the width of the blade. In partisans made before the 16th century, the ratio is consistently 5.5:1, while in the earlier war spears it is a much more elongated 11:1. The partizan was never a particularly common weapon, and like other polearms it declined following advancements in firearms in the 17th century. It survived in mostly ceremonial form as the spontoon, which was

used by several armies in the 17th and 18th centuries as a leading staff for their officers (Waldman 123-132).

Revival of the Pike

The last polearm to play a major role in warfare was the pike. A thousand years after it was abandoned by the Greeks and Romans, the weapon and its techniques were picked up again in the 15th century, when their incredible reach ended the dominance of the halberd among infantry. The Swiss developed the tactic of the pike square, which was a highly mobile and nearly impenetrable formation when taken up by well-disciplined troops. Like the Macedonian sarissa before it, the pike of the late medieval and Renaissance periods had a metal cap on the butt end, which acted as a counterweight to the head and could be braced against the ground to help receive a charge. At the other end, the shaft was reinforced with steel langlets, which protected the head from being hacked off.



(Image from Oakeshott, "A Knight and His Weapons")

Even as other polearms began to decline, the pike served a vital function in defending groups of soldiers wielding arquebuses or muskets. Early firearms took a while

to reload, and their wielders were thus extremely vulnerable to enemy cavalry after each volley. With a formation of pikes surrounding them, however, the soldiers reloading their guns could not be charged without the enemy having to first break through a formidable wall of spear points. These combined "pike and shot" formations were the dominant mode of warfare in Europe up until the adoption of the socket bayonet. With every gun now doubling as a spear, there was no further need for a pure polearm, and the long history of the spear as an influential weapon of war came to an end (Oakshott 20).

The Halberd

(16th century German halberd in the Higgins Armory collection)

Development

One of the most varied and versatile, not to mention iconic, infantry weapons of the late middle ages was the halberd, a weapon characterized by an axe blade with a beak projecting from its other side and a spike extending from the end of the shaft. The name derives from the Swiss German words “halm”, meaning “shaft”, and “barte”, meaning axe. It can be distinguished from the related pollaxe by its relatively larger head, and from the voulge by its more slender blade. The haft was in general around six feet in length, slightly taller than its wielder. The halberd was a weapon made for both wide cutting swings over the head or side to side, as well as thrusting with the spike. It was a highly effective at slicing through armor, making it an ideal counter to the heavy cavalry that had dominated the high middle ages. Many first-hand accounts and exhumed skeletons attest to its ability to cleave straight through a man‟s helmet into his skull. The shape, size, and relative position of the three components of the head varied greatly as the weapon evolved over the centuries, while retaining its distinct features and role (Blair, Waldman).

The most readily apparent ancestor of the halberd is the Danish axe, a long-hafted weapon which is also ancestor to the pollaxe, which has a smaller head than the halberd.

The blade of the Danish axe was flared, resulting in two sharp points at the upper and lower ends of the bit.

The halberd was developed by the Swiss in the late 13th century. The first definite mention of it is in a poem by Konrad von Würzburg, who refers to a "hellembart". The exact date of the poem is unknown, but the poet died in the year 1287, giving an end to the range of possible dates. Early halberds had generally squarish or crescent-shaped blades. Their spikes were less pronounced than in later forms, and generally located towards the forward end of the blade. The rear-facing beak was not always present in the earliest halberd forms. Sometimes the spike would be formed by sharpening the end of the pole itself, rather than fastening a metal cap to it. Wood obviously creates a much weaker point than steel, and so this style was not much favored (Ashdown, Blair).

As the weapon developed, the blade tended to become slimmer, and the spike became broader and flatter and moved further back along the blade until it was in line with the shaft. The blade could be square, curved, or crescent shaped. Earlier halberd types continued to be manufactured and wielded alongside more recent developments, however. The shape of the head also varied by region. The slender axe blade of the halberd lent itself to decoration, and so many halberds, especially those of later periods, have shapes and designs pierced into them.

The head of the halberd was constructed in one of several ways. The beak and blade could be slotted through a hole pierced through the spike then riveted or hammered in place, fashioned with "eyes" at the back through which the shaft could be passed and fastened to the head, or the whole head could be shaped from a single piece of metal and fastened to the shaft via a socket at its base and thin metal strips riveted to the pole, called

langlets. The attachment via eye straps was the earliest method of fastening the blade, while socketed heads were developed later in the weapon‟s history. As with other polearms, tassels would be attached to the shaft at the base of the head to soak up blood and prevent it from running down the shaft and spoiling the halberdier‟s grip (Brown).

History and Influence

The first major battle to showcase the power of the halberd was the Battle of Morgarten, fought in 1315 between a force of Austrian knights led by Duke Leopold I and the peasant militia of the rebelling Swiss cantons Schwyz and Uri. Prior to Morgarten it would have been expected that the untrained infantry militia would be totally crushed by the well trained and heavily armed cavalry. However, through the combination of advantageous terrain and the effectiveness of the halberd at receiving a cavalry charge and piercing heavy armor the Swiss were able to rout the Austrians, marking a shift in the balance of warfare away from the dominance heavy cavalry had enjoyed for centuries (Waldman).

The Swiss repeated their performance at the Battle of Laupen in 1339. Though the hill on which the Swiss took their position was more neutral terrain than the swamps and forests at Morgarten and their Austrian foes outnumbered them by a large degree, they were able to win by the superior discipline of their infantry compared to that of the Austrians, and the inability of the knights to break the “hedgehog” formation taken up by the halberdiers (Waldman).

The strength of the halberd was its versatility. It could thrust and be readied against a charge as a spear could, using its spike, it could chop like an axe with the blade,

and the beak gave penetrating power to the backswing as well as being able to pull mounted opponents from their saddles. The ability of the halberd to easily pierce the knightly armor of the 13th and 14th centuries was another critical factor in its success.

(16th century Austrian halberd in the Higgins Armory collection)

The outstanding success of Swiss halberdiers at defending and expanding their territory over the course of over a century led to the adoption of the halberd in other regions of Europe, and the steady decline of heavy cavalry as a dominant force on the battlefield. However, the halberd itself began to decline in favor of the pike following the Battle of Arbedo of 1422, in which the Italian knights under the command of Francesco Bussone fought dismounted and with pikes, which had a longer reach than the Swiss halberds and thus allowed then to threaten the halberdiers without being threatened themselves. Prior to their defeat at Arbedo the Swiss maintained three halberds to every pike in their armies. Afterwards, the ratio shifted in the pike‟s favor, and military treatises began to proclaim that “every man who can carry a pike, should carry a pike” (Blair, Waldman).

(20th century German halberd in the Higgins Armory collection)

The halberd"s role was reduced following the widespread adoption of the pike as the infantry weapon of choice, but not fully eliminated. It remained in use by Swiss banner guards, who with their shorter and thus more maneuverable weapons could move to the flanks of a formation should it become bogged down with the enemy line. It was also used as a leading staff to signify rank by British and colonial sergeants well into the 18th and even 19th centuries, although by this time its functionality had atrophied and many halberds forged for that purpose were of poor quality, made by blacksmiths rather than armorers, and unsuited for actual fighting. This decline from weapon of war to symbol of authority was not uncommon; a related example is the spontoon, a form of half-pike, which was carried by higher ranking officers in the same British and colonial armies (Brown, Waldman).

The legacy of the halberd was the rise to prominence of organized, professional infantry soldiers, who would prove far more effective than the undisciplined peasant armies seen in earlier centuries. Swiss mercenaries gained a fearsome reputation throughout Europe, and their example paved the way for other groups, most notably the German landsknechts who supplanted them.

Bills, Forks, and Scythes

Arming the General Public

While in modern times wars are fought almost exclusively by professional soldiers, for much of history large, standing armies were uncommon. The medieval knight on horseback is the most iconic soldier of the Middle Ages, but the bulk of any army was composed of infantry, either mercenaries or peasants pressed into battle by their lords. Much of the time these latter were required to provide for their own equipment, and to have it at the ready whenever they might be called upon.

In 1181, for example, the English Assize of Arms decreed that "the whole community of freemen shall have a gambeson, an iron cap, and a spear". This was both a requirement and a restriction: a freeman who possessed more arms than those which were required of him had to sell or give away the extras under the law. This was both to aid in the distribution of equipment, and to prevent the peasantry from becoming too heavily armed to the point where they posed a threat to their lords. Those at higher levels of society had correspondingly higher requirements and allowances (English Assize of Arms).

Until the rise of professional mercenaries in the Late Middle Ages the bulk of an army was made of poor farmers, so it is no surprise that many weapons of war ultimately derive from tools of agriculture. Rather than build and maintain a separate fighting weapon, oftentimes the farmer could simply convert his pitchfork, scythe, sickle, flail, or other tool to serve a second purpose. This practice goes back thousands of years, to ancient times. One example is the roncola, a form of billhook used to prune grape vines,

the military version of which was in use from the 5th century into the Early Middle Ages (Waldman).

By far the most common type of weapon wielded by the peasant class was a polearm of some sort. There are several reasons for this. Firstly, mounting a blade or spike to the end of a pole was very inexpensive compared to a sword or other primarily metal weapon, which would have been beyond the ability of a peasant to afford. Many of the tools a farmer would use to manage his crops could very easily be made to work as a weapon, sometimes with hardly any modifications at all.

Secondly, it was much easier and faster to train a man to fight with a spear in formation than it was to teach him sword techniques, which was important as the peasant soldier could not afford to take time off from working the fields in order to train for any great length of time. The long reach of a staff weapon enabled formations of infantry to fight effectively, presenting their opposition with a wall of spear points that provided greater protection to the men in the formation than they would have fighting alone. The main advantage peasants held over knights or mercenaries was that, despite their poor morale, discipline, and equipment, they could very easily and cheaply be raised and fielded in large numbers, something which complements the strengths of a polearm nicely.

The Bill

The bill‟s defining characteristics are a single edged chopping blade with a prominent forward hook on its upper end. This hook could be used to catch onto a knight‟s armor and pull him from his horse. Additional spikes on the top and back of the

blade gave the bill more armor-piercing potential. A topspike in particular, when present, gave the weapon a thrusting capability and the stopping power required in a polearm to defend against a cavalry charge. The back spike is curved in early forms of the weapon, but straightens in later centuries (Waldman).

(A bill in the Higgins Armory)

The English and Italians were the primary wielders of bills on the battlefield, preferring it to the halberd, which filled a similar role in other parts of Europe (Waldman). The English brown bill, with its topspike and rear-facing beak, bears some similarity to the halberd in form and function. Aside from the characteristic hook, the two weapons differed mainly in their construction. Whereas a halberd‟s head was most of the time crafted in two parts – one for the blade and beak and another for the spike – a bill would be made from a single piece of metal, the hook and top spike being formed by splitting the billet partway down the middle. Rather than being fastened via eyes or using a closed socket, the head of a bill would be attached to its pole via a half-open socket, which could be made more quickly and easily than other fastenings (Waldman). A third difference is in the shape of the topspike; while both have a square or diamond cross-section, a halberd‟s spike is turned edge-on to the blade, while that of a bill is in line with the blade for much of the weapon‟s history, and it is only later that the spike becomes

similar to that of the halberd, as in the Italian roncone from the Renaissance period (Waldman).

In general the bill was much less complex in construction than the halberd, and so cheaper and easier to make. This gave it the advantage of being able to be crafted by a local blacksmith instead of a professional weaponsmith. Although professionally-made bills were generally of higher quality than that which the blacksmiths could produce, the fact that serviceable weapons could be made by a larger number of craftsmen was an advantage when arming and maintaining a large army. This advantage of simplicity also applies to other agriculture-derived weapons, many to such a degree that the farmer himself could create them through a simple conversion of their existing tool.

The Military Scythe

The scythe was another tool commonly turned into weapon during times of war. Originating in ancient times as a tool for cutting grass and harvesting grain, it has had a martial use in the hands of peasants for thousands of years, even as recently as the 20th century in Poland and Russia (Waldman). Contrary to their depiction in popular culture, however, an agricultural scythe is ill-suited to use as a weapon as-is. The blade is oriented towards the user, requiring the use of a reaping motion to cut with; such a maneuver is awkward to the point of uselessness in combat. In addition, the curve of an agricultural scythe"s handle is designed with ease of making this motion in mind, but at the same time makes it even more unsuited for use as a spear. The tool as-is is suitable only for fighting grass, not people.

(Military scythe in the Higgins Armory collection)

Despite this, conversion from an agricultural scythe to a military one is remarkably simple. The end of the scythe is cut from the rest of the pole, and fastened to the side of a new, straight staff via a nail and keepers with the blade oriented in-line with the shaft, rather than the right angle it was originally (Waldman). The resulting single-edged slashing weapon is not very effective against heavily armored targets, as it lacks a real thrusting capability and the blade – very thin and hard to help it keep its edge through the harvest – is too fragile to be used against hard targets without breaking. It is, however, quite deadly against unarmored opponents, such as one"s fellow peasant on the opposite side. The sharpness and length of the blade helped it to more easily slice into flesh, and even if the wounded enemy survived the immediate battle, peasants would often coat their blades with manure, causing injuries to become infected much more easily (Waldman).

The Military Fork

When most think of a peasant going to battle, they picture him with the iconic pitchfork. This is another tool that has existed for a very long time, since the beginning of

the Middle Ages, and which has likely been used in warfare for nearly as long. In converting the fork from a tool for moving leaves and hay to one of battle, the form does not change very much. The only modifications necessary are straightening and sharpening the tines, and possibly mounting the head onto a sturdier shaft. In earlier periods, fishermen could use their tridents in much the same way. A fork could be wielded simply as a spear, or could be used to trap and control the point of an opponent‟s weapon between the tines.

(Military fork in the Higgins Armory collection.)

Not all military forks were the result of direct conversion from farming implements, however. Some were made specifically as weapons in later centuries, although their lineage is still readily apparent. Forks of this nature generally had only two tines. Its lack of a cutting surface limited the fork‟s versatility and usefulness, and it was thus not nearly as popular as other weapons of the time, but it remained a perfectly serviceable weapon.

The welsh or forest bill is somewhat similar to a fork, as its back spike is turned sharply upwards and greatly elongated, such that it actually serves as a second forward point. The design is too fragile, however, to be expected to have much effectiveness against armor or in stopping a weapon, and was likely limited in large part to use by law enforcement, rather than soldiers on the battlefield (Waldman).

Knights and the Cavalry Lance

Although it is often popularly though that the sword was the most knightly of weapons, it was not in fact the most powerful tool in the knight‟s arsenal. Foremost among them was his lance. From the 11th and up into the 15th centuries, little could match the tremendous power of a cavalry charge. Along with the nigh-invulnerability of his armor the knight‟s lance made him a dominant force on the battlefield for hundreds of years, before the combination of advances in infantry tactics and increased effectiveness of firearms finally brought the golden age of heavy cavalry to an end.

Precursors to the Medieval Knight

(Parthian cataphract. Image from http://www.cais-soas.com/CAIS/Military/parthian_army.htm)

The Middle Ages were not the first time in history that heavy cavalry were employed in their role as shock troops. Parthian cataphracts in the 1st century BC, for example, played a very similar role to the later knights. They and their horses were heavily protected with scale and mail armor, and used their heavy lances to deliver a unified charge to the enemy line with the full force of both rider and horse, after having forced the enemy to open their ranks through a volley of arrows. Even earlier, in the 4th century BC, the Companions of Alexander the Great were instrumental to the expansion of the Macedonian Empire, and represented the first organization of dedicated shock troops in the ancient world. These early examples and their successes were both copied by later armies but remained, however, a minority, outnumbered by and of lesser overall importance to the ancient battlefield than the light cavalry of the time and by the still-dominant heavy infantry (Denisen 81).

For much of history, the primary role of cavalry was mainly to utilize their superior mobility to harass the enemy flanks, to scout ahead of the main body of an army, or to ride down opposing troops already in flight. The spears used by these troops, when not wielding a bow, sword, or mace instead, were generally lighter and shorter than the lances of later periods. They could be either used for thrusting over or underhanded or thrown as javelins. Ancient Europe lacked the technology of stirrups and certain refinements in the design of spurs and saddles which would provide better control and stability for the rider in ages to come (Denisen).

The Rise of Knighthood

The history of medieval heavy cavalry is intimately intertwined with the workings of feudal society in the Middle Ages. As part of their duty to their kings, the nobility were required to keep arms and armor at the ready in case they were called upon in times of war. A warhorse and full suit of armor provided invaluable protection on the battlefield, rendering the wearer all but invulnerable to many forms of attack, but were well beyond the ability of the average freeman to afford, and so the role of cavalry was limited to the nobility and their retainers. Even if they could by some means afford it, a non-noble would often be legally barred from keeping arms greater than those required for his status. This was a necessary precaution on the part of the nobility, who did not want the lower classes too heavily armed for fear of rebellion (English Assize of Arms).

The proper execution of a cavalry charge requires a great deal of training and coordination among the horsemen, to ensure that they connect with the enemy as a single group and in close order - arriving piecemeal would reduce their effectiveness at breaking through a formation, and increase the risk of those riding ahead of the others being cut down by the defenders. Being nobility, a knight had fewer time-consuming obligations compared to the peasants, who were busy working to provide both for their family and for the taxes owed to their landlords. Thus, whereas the peasant could not afford to spend much time away from his farm for training, knights were professional soldiers (Bennet).

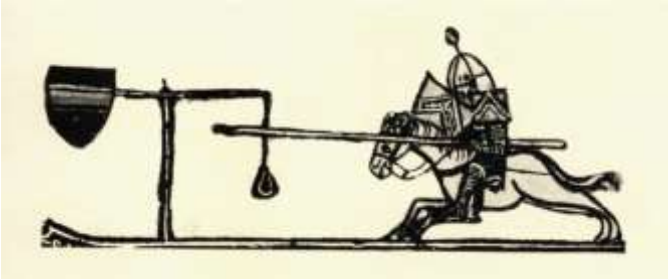
This difference had an enormous impact on the battlefield, where an undisciplined army of peasant foot soldiers might break rank and flee before a charge and be cut down, rather than standing their ground and receiving the charge with their spears at the ready, as would be more effective. Being both better equipped and better trained than all other

soldiers of their time, it is no surprise that knights would be dominant for that reason alone.

Tournament and the Joust

One of the primary means by which medieval knights practiced their group coordination was through participation in tournaments. The earliest tournaments, held around the beginning of the 11th century, were essentially mock battles between teams of knights, complete with companies of foot soldiers accompanying their lords. They were fought over large areas of land between towns, with very little rules or regulations other than the designation of specific rest areas where a participant was safe from being attacked (Barber and Barker 14).

These early tournaments were both highly destructive to the peasants who happened to live on the land where they were staged and dangerous for the knights themselves. Knights would fight with their usual, sharpened weapons, although they aimed to capture rather than kill their opponents, and would often trample crops in the fields on which they fought. Tournaments were sometimes used to settle the score between feuding noblemen, further increasing the danger and blurring the line between real and simulated warfare. In the year 1130 the Pope issued a decree condemning the practice, forbidding the burial of anyone killed in such a tournament on church grounds (Barber and Barker 17).



(Tilting at the Quintain. Image retrieved from http://www2.springfield.k12.il.us/schools/springfield/eliz/sportsandentertainment.html)

Because of their deadliness and the increasing pressure against them, tournaments proper gradually became less common in favor of more organized, less chaotic tests of skill with the lance, collectively known as hastiludes, or lance games. The most iconic of these is, of course, the joust, but other events included the quintain and pas d"armes. The former was a test of the knight"s precision, requiring the knight to score a solid hit against a stationary shield while charging towards it. He had to then follow through with the charge, for if he came to a stop the target would spin and hit him with a heavy sandbag. A similar sport was tilting at the ring, wherein the knight had to direct his lance-point through a small ring suspended in the air. Still another variation, called tent-pegging, placed the target on the ground instead. These sports were played either as practice or warm-ups for the joust (Barber and Barker).

Jousting started out mainly as a matter of private challenges between knights, but over time became increasingly a spectator sport. In a clear example of life imitating art, the nobility of the 13th century consciously modeled their own knightly contests after the deeds portrayed in Arthurian romances. It is during that century that the first accounts are made of ladies being present to observe the games. The pageantry involved in jousting events increased as time went on, becoming more and more elaborate until the social

rituals of the occasion overshadowed the jousting itself. An exceptionally extravagant example is the event accompanying the third wedding of Phillip the Good, Duke of Burgundy, which lasted a full week and included, among other things, a live sheep with gilded horns and wool dyed blue emerging from within an enormous pie (Barber and Barker 10, 12).

The Lance

(A lance for tilting at the ring, in the Higgins Armory collection)

As has already been stated, the cavalry spear of pre-medieval times was a much lighter weapon than that used by a knight. It measured only around six and a half feet in length, and was largely similar to the spears wielded by contemporary soldiers on foot. Even into the Early Middle Ages, the form of the weapon did not change much. The shaft was of uniform thickness and, as was the norm for a polearm, made of ash wood. The spearhead was a simple leaf or lozenge shape (Ashdown 332).

It was only when mounted knights became the dominant troop type that major developments began to show. Beginning in the 11th century, charging with lance couched under the arm was the primary mode of attack for cavalry, rather than thrusting or throwing, and so the spear used became much longer and heavier to better serve this purpose, nearly doubling to 10-12 feet in length by the 12th century, and thickening so as to provide a better grip. The spearhead became narrower to focus the force of impact and

provide greater penetration. In the late 14th century a metal disc was added to the lance just in front of the grip, in order to protect the wielder‟s hand. This became larger over the years, eventually becoming the fully developed vamplate. A further development in the 15th century was the addition of a second disc behind the grip which would be pressed against the shoulder during a charge to prevent the lance from slipping backwards, and helping to distribute the shock of the impact more evenly across the knight‟s body (Wilkinson 102).

As jousting developed as a sport, the lances used diverged from those used in actual battle. One of the most obvious differences between jousting and combat lances was that the former came to have a hollow, fluted shaft, which caused it to shatter impressively upon impact. This enhanced the spectacle of the event, as well as providing a clear way to tell if a hit had been solid or not. The second difference was the coronel tip, which rather than being pointed had four prongs with which to grip but not penetrate armor. This made it safer to joust with, while at the same time making it easier to score a solid blow on the opposing knight (Wilkinson 103).

The lance continued to be used even into the 20th century, until cavalry as a whole was proven obsolete by World War One. It had already been on the decline for hundreds of years prior to that, however. The advent of disciplined, professional infantry who could reliably defend against the charge in the 15th century, and subsequent advancements in firearms that forced armor to become prohibitively heavy in order to be effective brought an end to the dominance of heavy cavalry (Wilkinson 104).

Conclusion

Over the course of this IQP our team‟s goals changed considerably from what they had been initially. The original plan was for each team member to create an interactive piece to accompany each of the four artifacts chosen within their category, to go along with a brief description page similar to the existing virtual armory pages that we created mobile versions of. Due to time delays and interactive concepts with a broader scope than a single artifact, this instead became a single larger interactive for each category, in the form of On Your Mark, Name That Polearm!, and Time-Defying Sword Designer.

One idea our team considered and partially implemented was to connect the various pieces of mobile web content in a dynamic manner, using cookies to let the website know which exhibits a museum patron has already viewed and presenting new exhibits using information already learned as context. In its originally conceived implementation this would be done via adding or altering parts of an artifact‟s description page to add relevant content and context that made more sense when viewed as part of a sequence with other artifact descriptions. As implemented by our team, viewing one of the artifacts‟ Fun Facts pages may add an additional fact to the rotation of other pages. Moving forward, this dynamic content presentation would be a good candidate for expansion into a more robust system.

Much of the project was plagued by technical difficulties, stemming from the team members‟ inexperience with web building. By the end of the project, however, the team as a whole had become much more proficient, and so could perform work much faster in a future, similar project.

Several elements of our project are suitable templates on which to base future content generation for the museum. In particular, the format of the Fun Facts pages can easily be expanded to cover other artifacts in the museum, and more links with existing pages. To facilitate such linkage, it might be wise to establish a database for the Fun Fact content, to replace the current hard-coded pages built off of the team"s template. To a lesser extent, the team has developed a unified style for the appearance of mobile artifact pages, consisting of a burgundy banner at the top of the page containing a link to the main Higgins Armory website and to the Armory Catalogue database, along with the picture and vital information of the artifact currently being viewed.

The artifact categories and research topics of each member of the team are as follows:

Jen researched European swords broken into four categories based on four time periods. Her study was on Bronze Age swords, Viking swords, medieval and early renaissance blades, and rapiers and small swords. She discussed the advancement of weapon making in ancient times leading up to the bronze sword as we know it, and some of the weaknesses early civilizations had to overcome. When it came to the Viking sword she discussed the superiority of blades made by the "ulfberht" manufacturer and how many European sword makers of the time tried to make fake replications without using the correct metalworking techniques. She also discussed the role of the sword and the smith in Viking culture, and how swords were revered items that were passed down in families through generations. She talked about the variation in blades throughout the middle ages. She also discussed the time of the crusades and the fact that the sword was the primary weapon of the crusaders. Finally she discussed the shift to rapiers and small

swords as well as how the swordplay for these weapons varied from previous sword styles given that the style was determined mainly by trends in fencing. She also talks about how the rapier was one of the first weapons that had separate military and civilian variations, and that the civilian variation was focused more on fashion than practicality.

Patrick did research relating to European-style polearms in four subcategories: spears and their history, from ancient times through the use of bayonets, the history of staff weapons derived from civilian farming implements, the development and impact of halberds on medieval warfare, and the history and development of cavalry lances. In the section on lances, he discussed the history and development of the lance itself, as well as the dominance of heavy cavalry during the middle ages and its decline following the development of firearms and more effective infantry tactics. He also discussed the tournaments and jousts used by knights to test their skill with the lance during peacetime. In the section on spears, he discussed the historical importance of spear-wielding infantry since ancient times and the importance of infantry formations in pre-modern warfare. In the section on farm implements as weapons, he discussed several examples of such weapon types, including scythes, military forks, and especially bills. He also discussed the laws and practices surrounding the mustering, arming, and training of peasant militias during the medieval period. In the section on halberds, he discussed their historical development and the pivotal role they played in shifting the balance of power from cavalry to infantry during the Late Middle Ages.

Ian researched various ranged weapons from around the world. His topics include the crossbow, early European firearms, the Japanese longbow and archery techniques, and African throwing knives. His research on the crossbow includes a description of the

varied uses of different crossbow bolts, types of drawing mechanisms as well as some of the social and tactical implications of the crossbow. His research on early firearms involved the various early locks, that is, firing mechanisms as well as early gunpowder. The section on African throwing knives focuses on their roles off and on the battlefield and a brief look at the physical distinction between knives from different parts of Africa. The Japanese archery section examines the role the longbow played in Japanese society, including the subtle differences between types of Japanese arrowheads. He also talks a little bit about the design of the arrows, and about archery techniques including Zen archery.

Appendix A

(Interactive game documentation)

European Swords
Game‟s Name: Time defying sword designer!

Intro text: Have you ever wondered what it would look like to mix swords from different time periods, or wanted to design your own? Now you can!

Start by choosing your blade:

Bronze: You chose a bronze blade, which is shorter and thicker than the later iron blades, since bronze is more fragile than iron.

Viking: Blade: The blade you chose is marked with the inscription +Ulfberht+. Many early Viking swords would get bent back during battle, but the swords created by the Ulfberht maker were of very high quality and were much more reliable.

Knight: The blade you chose is a double-edged blade from a knightly sword that would

have been used for both cutting and thrusting. The groove running down the blade is called a fuller and actually strengthens the weapon.

Rapier: Rapier blades like this one are narrow and intended mostly for thrusting. Rapiers were designed for civilian use in dueling, fencing, and self-defense.

Smallsword: You chose the blade of a smallsword. The classic smallsword blade has no edge at all. Its cross-section is like a three-pointed star for maximum strength and lightness.

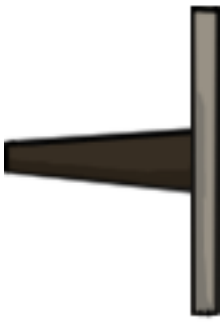
Hand-and-a-Half: The blade you chose is from a hand-and-a-half sword. The hand-and-a-half blade is designed to be wielded with either one or two hands.

(Note description text will not show up until the finished sword page)

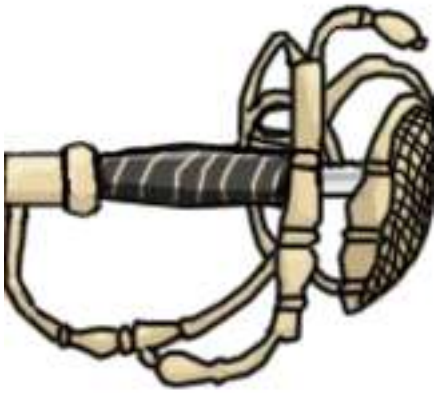
Now choose your guard and grip:

Bronze sword: You chose the hilt from a bronze sword. Bronze swords were often heavy and had most of their weight in the blade, so the short hilt shoulders provided control and a stronger grip.

Viking: The guard you chose is from a Viking sword and is rather short and stubby, making it not very good for blocking: Vikings usually blocked with their shields.

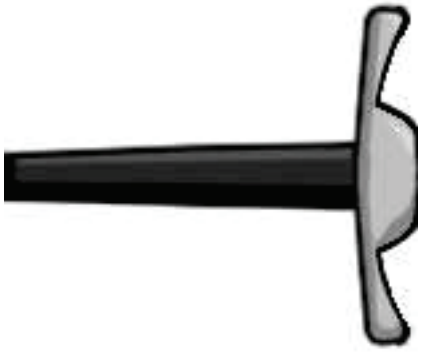


Knight sword: The guards of knightly swords have a long crossbar that makes the weapon good for defending as well as attacking.



Rapier: Grip and Guard: In the late 1400s rings and knuckle guards started being added to swords to protect the unarmored hand. By the 1500s this became the rapier hilt. Swords with rapier hilts were adapted for both civilian and military use.

Smallsword: The smallsword hilt has a knuckle-bow to protect the hand. The weapon is held with your thumb and forefinger reaching over the short crossguard to manipulate the blade itself.



Hand-and-a-half: The grip you chose is rather long because it was intended for a hand-and-a-half sword, which could be comfortably held by

one or two hands. The grip of a true two-handed sword would be even longer, measuring around 12 inches.

Finally choose your pommel:

Bronze Sword: The pommel you chose is from a bronze sword, serving mostly to anchor the sword in your hand.

Viking: There were a wide variety of pommel and hilt shapes on Viking Age swords, and segmented pommels like yours were fairly common.

Knight sword: The pommel you chose has the shape of a brazil nut, which was a common pommel shape during the age of chivalry. The brazil nut shape nests nicely against the heel of your hand.

Rapier: The pommel you chose is from a rapier. Cockle shells, eggs, cones, polygons, and spheres were common rapier pommel shapes.

Smallsword: Globe, pear, and urn-shaped pommels are commonly seen on smallswords.

Hand-and-a-half: The pommel of a hand-and-a-half sword, like the one you chose was often large, heavy, and shaped like a pear or sphere to help balance the weight of the long blade.

This is your finished sword

(If you chose a single type it will have a description from below. Otherwise it will have a mix of the text above).

Bronze Sword:

You have created a bronze sword like those used by the Ancient Greeks. Weapons prior to the Bronze Age were mostly tools made out of wood and sharpened stones. Bronze was eventually created by adding tin to copper. Early bronze weapons could not

be much longer than daggers, but around 1500 BC smiths were able to extend the dagger into something closer to a sword. Bronze Age swords were used for both combat and ritual purposes. For example they would often be deposited at the site of a victorious battle.

Viking Sword:

You have created a Viking sword like those carried by the Norse raiders of the early Middle Ages. The Viking Age occurred between the 800s and 1000s. To the Vikings, the sword was an integral part of their life and culture. It was mentioned frequently in their writing, and immortalized in sagas. The Viking sword would be passed down through a family for generations. The blade you chose is marked with the inscription +Ulfberht+. Swords made by the Ulfberht maker were some of the highest-quality swords of the time.

Knight Sword:

You have created a knightly sword like those used in the age of chivalry! The sword of this time was greatly honored, and was one of the primary weapons used by knights. These swords were used to fight in the crusades and were even part of the ritual used to make a squire a knight. They were also seen in the coronations of royalty. The sword you chose is double-edged and of medium length. It would have been used one-

handed for both cutting and thrusting. Due to its long crossbar it would have been good at both attack and defense.

Rapier:

You chose a rapier like those carried on the streets of Shakespeare‟s London. In the late 1400s rings and knuckle guards started being added to swords to protect the unarmored hand. By the 1500s this became the rapier hilt. Swords with rapier hilts were adapted for both civilian and military use. Rapier blades were mainly intended for civilian use including self-defense, dueling, and fencing. In general rapier blades are narrow and intended mostly for thrusting. They are too delicate for battlefield use.

Smallsword:

You chose a smallsword. The smallsword largely came about as a result of a new French fencing style that developed in the 1600s. The French style put a lot of value on speed leading to the development of a lighter sword. The classic smallsword blade has no edge at all. Its cross-section is like a three-pointed star for maximum strength and lightness. The smallsword was carried by civilians from the mid-1600s until about 1800. It could be used for dueling or self-defense, but mostly it was a form of gentlemanly jewelry.

Hand-and-a-half:

The sword you created is a hand-and-a-half sword. Early two-handed swords appeared in the 1200s. In the 1300s the hand-and-a-half came along as a smaller weapon that could be used with either one or two hands. The pommel of a hand-and-a-half sword was often large and heavy to help balance the weight of the long blade.

Crossbows

Game‟s name: On Your Mark

Link text: Click here to try your hand at the crossbow.

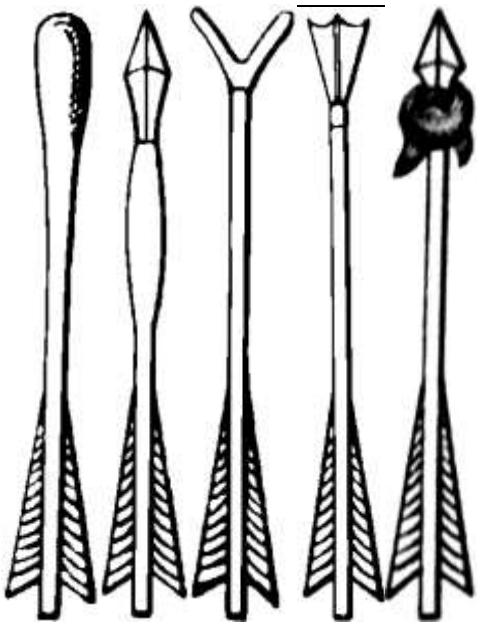
Crossbow Matching Game Specifications:

This is a multiple choice quiz. Each question, the user will be presented with pictures of the same five bolts and the target. He or she will have to click the picture of the bolt that is most appropriate, then he or she is presented with an explanation of the correct bolt. There are five bolts and five questions. The bolts are the blunt bolt, the forked bolt, the pointed bolt, the quarrel and the oil soaked bolt. The targets are a fox, corresponding to the blunt bolt; a deer, corresponding to the forked bolt and the pointed bolt, either being accepted; a footman, corresponding to the pointed bolt; a knight, corresponding to the quarrel and a ship, corresponding to the oil soaked bolt. The game tracks how many questions the player has correctly answered and tells them when they have answered all the questions.

Title: On Your Mark

Intro: Each question you will be presented with a series of bolts and a target. You must select which bolt is most appropriate for the given target.

Which bolt would you use against this target?



The Answers to the questions are as follows:

Rabbits:

A sharp bolt would ruin the pelt of a small game animal like a fox, rabbit or bird, so hunters used blunted quarrels against such creatures. Even though such a bolt would not draw blood, it carried enough concussive force to kill small animals.

Deer:

Forked bolts were used to hunt large game like deer or boars. The sharp inner edge would hamstring the animal, preventing it from eluding its hunter. A pointed bolt would be used to finish the deer off, but such a bolt could not be relied upon solely to make the kill.

Footman:

Pointed bolts were used against lightly armored enemies. They most effectively deliver the bow's force to a single point. This easily pierces soft armor and allows the full power to be delivered directly into the foe.

Knight:

Square headed bolts called quarrels were used against heavily armored foes. Because the force of the shot was not committed to a single point, it was less likely to deflect off steel.

Ship:

Bolts wrapped with oil-soaked rags were lit ablaze and fired at hostile ships to light them on fire. Such bolts were not very effective against live targets.

Upon completion, the player will get a messaged based on how many correct answers they got.

0/5 Hopefully you learned something playing through this game. If you think you did, why don't you try again?

1/5 You could have done worse but not much. Don't settle for a score like that. I'm sure you can do better.

2/5 Not bad, but I think you can do better. If you do too, why don't you try again?

3/5 Your score was pretty average. If you aren't satisfied with that, you can always try again.

4/5 You're either pretty sharp or pretty lucky. If you want to prove it wasn't just luck, why don't you try for a perfect score?

5/5 Wow! You got a perfect score! If you really want to, there's no reason you can't try again anyway.

You've completed the quiz.

Play Again!

Back to Object Page

Polearms

Game‟s name: Name that Polearm

Intro text: There are a huge variety of different polearm types, so many that remembering the names of them all can be tricky. Test your polearm naming knowledge in this quick quiz! To start, which of these three pictures matches the polearm name given below?

End text: Congratulations! You successfully matched x/5 polearm names to their pictures! Press any button above to try again and see if you can do better!

100% end text: Congratulations! You successfully matched all five polearm names to their pictures! You really know your stuff!

Link text: Touch here to play Name That Polearm!

Pike

(2546.10) Incorrect. This is an Italian bear spear from about 1550. A pike is a 12 to 24 foot spear wielded by footsoldiers in formation. A bear spear is a personal weapon with a much shorter staff, mainly used in hunting bears and other such large animals. The crosspiece below the head prevents overpenetration into the target, to keep the dangerous quarry at a distance.

(2546.15) Correct! This is an Italian pike from the 1600s. The pike is an extremely long spear, sometimes as long as 24 feet. Its length means that not only the first rank of a formation could attack, but also the second and third ranks behind them, or even a fourth. The head of the shaft is reinforced with steel bands to prevent it from being chopped off by the enemy.

(1090) Incorrect. This is a Swiss halberd from the early 1600s. The pike is an extremely long spear wielded by infantry in formations. Halberds are shorter, axe-like polearms with sharp metal spikes on the top and back parts of the blade. Halberds can be used for thrusting, chopping, or hooking the enemy, whereas pikes are purely thrusting weapons.

Bill

(2680) Correct! This is an English bill from around 1550-1600. The bill, like many polearms, is derived from an agricultural tool, in this case a pruning hook used to cut vines and small branches. It has a chopping blade with a prominent forward hook, used to unhorse cavalry, as well as top and back spikes.

(1095) Incorrect. This is a Dutch halberd from around 1625 to 1650. Halberds and bills both have a chopping blade and spikes at the top and back. The blade of a bill is long and ends in a prominent forward hook, whereas a halberd's blade is more axe-like in shape.

(2546.22) Incorrect. This is an Italian glaive from the late 1500s. A glaive is a simpler type of weapon, having a long, single-edged blade, like a bill, but lacking the forward hook and top spike. The glaive is mostly a cutting weapon, making it less effective in the usual role of polearms than a weapon without a dedicated thrusting tip.

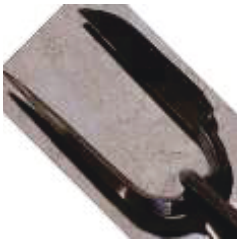
Halberd

(1089) Correct! This is a German halberd from the late 1500s or early 1600s. Halberds are versatile polearms combining the chopping power of an axe with the thrusting ability of a spear. They also have a beak on the back of the blade designed to pierce through plate armor.

(3628) Incorrect. This is a German horseman's axe from the 1500s. It is similar in form to the halberd, with a crescent-shaped axe blade and sharp beak on its back, but has a much shorter staff so that it can be used on horseback

(2653) Incorrect. This is a pollaxe from the late 1400s. Pollaxes and halberds are related weapons, sharing the characteristics of an axe blade topped by a thrusting spike. A poleaxe had a shorter haft - six feet compared to eight. This one has a cleated hammer instead of the piercing beak of a halberd. The pollaxe was designed for armored combat on foot

Welsh Bill:



(3128.4) Incorrect. This artifact is a military fork from the mid 1500s. Derived from the agricultural pitchfork, it shares the Welsh bill's design but its tines are short, straight, and mostly for thrusting, as opposed to the Welsh bill's long, slicing blade.

(1054) Incorrect. This artifact is a German military scythe from the 1700s. Also derived from an agricultural tool, it shares the curved blade of the Welsh bill. However, a scythe lacks the extra spikes and its blade is wider near the base.

(2689) Correct! This is a Welsh bill from the late 1400s to early 1700s. It has a long, curved slicing blade and the back spike is very long and angled upwards, giving the weapon a forked appearance.

Spetum

(488) Incorrect. This is a Dutch partisan from the mid-1600s. Both the spetum and the partisan have a central thrusting blade with a pair of projections at its base. A partisan's blade is shorter than that of a spetum, and its side projections are shorter too.

(1705) Incorrect. This is a northern Italian lugged spear from about 1500. It is an ancestor of the spetum and similar weapons, with a pair of projections at the base of the blade to prevent overpenetration. A

spetum's projections are sharpened on the inner edge, while a lugged spear's are blunt.

(1999.01) Correct! This is an Italian spetum from about 1550. Spetums have a single long thrusting blade with a pair of crescent-shaped projections at its base. These can be used to catch limbs or opposing weapons and inflict serious injury should an initial thrust fail to hit the target. This particular spetum is designed to fold up when not in use.

Appendix B

(Fun fact documentation)

Knightly Swords

Connecting facts:

- Half-swording is a technique used for fighting in armor. It involves gripping the sword halfway up its blade for better accuracy, and thrusting it into the gaps in the opponent‟s armor.

-Lances are not effective outside of a charge. If the enemy was too close and a knight was caught in a melee, the knight would switch to his sword.

10 standard Facts:

- A knight began training for sword fighting by the time he was 10. He was using a full-sized weapon by age 14.

-Fencing was common throughout Europe in the Middle Ages. Prior to the 1500s fencing involved not only swordplay but also training in staff weapons, daggers, wrestling, and other forms of combat.

- Though it has worn over time, the knightly sword you are viewing is decorated with crosses and hashes, as highlighted in this image. The three hashes on both sides of the cross may have represented the Holy Trinity in an attempt to bring luck to the swordsman.

- One way we have of dating the sword you are looking at is its brazil nut shaped pommel. The brazil nut and the wheel were two very common pommel shapes during the 1100s and 1200s.

- The groove running down the center of a blade is called the fuller. It was used to make the sword lighter and stronger. It was not a blood groove as many people tend to think.

- Sword scabbards at the time of the Crusades were made of leather-covered wood. The scabbard would have metal guards at the opening and the tip to reduce wear and tear.

- Medieval swords shifted from a focus on slashing to a focus on thrusting as a result of the changing armor of the time.

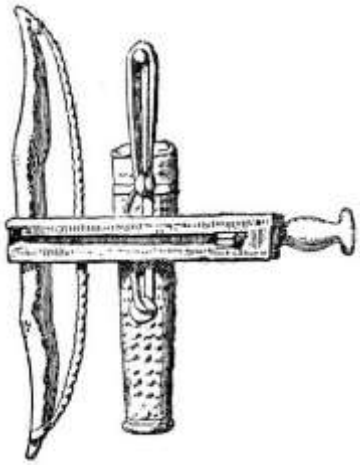
- Knights would carry a lance, a hand-and-a-half sword, and a dagger into mounted combat. On foot a knight would still carry the sword and dagger along with a staff weapon such as an axe, warhammer, mace, or spear.

-The sword was the primary weapon used by knights at the time of the Crusades but very few weapons survive from that period. The sword you are viewing was dug up from underground and is dated from around the time of the First Crusade.

- The sword you are looking at originally had a wooden grip wrapped in leather similar to the grip on the modern reproduction being shown here.

Crossbow

-The earliest evidence of a European crossbow is a stone carving in a Roman grave from the fourth century.



-Fearing that Englishmen would be unskilled with the longbow, England outlawed crossbows for a brief period from 1508 to 1539.

-Since crossbows had a slow rate of fire compared to bows, a crossbowman might be accompanied into battle by a shield-bearer behind whom he would take shelter while reloading his weapon.

-One of the more popular drawing devices among cavalry was the goat‟s foot, a hooked lever, because its compact design allowed it to be used effectively while mounted

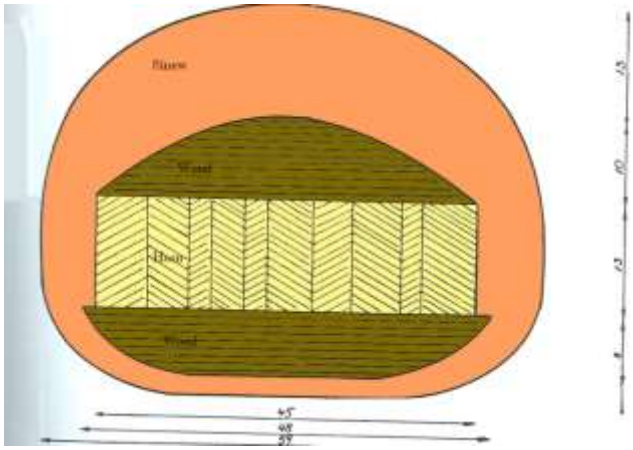
-While a longbow could be drawn by hand, most crossbows required more force than a man can generate. Crossbowmen used a variety of machines. The crannequin, a crank and gearbox, was one of the more powerful types.

- One of the main advantages of the crossbow was that it is less bulky than the longbow. For this reason it was particularly favored on ships and in castles.

-While bolt-shooting crossbows had only a single string, there were also multistring variants that shot stones or balls of clay.

- Crossbow bolts were almost universally plain in design since they were not expected to be recovered, but hunters were very superstitious. It was thought that filling a bolt with axle grease or the heart of a bat would increase accuracy.

-The core of the bow is always surrounded by a layer of sinew that makes up a third to a half of the bow‟s volume.



-According to Swiss legends, archer William Tell was forced by the cruel king Gessler to shoot an apple from his son‟s head to earn his freedom. He split it with a single bolt.

Coronel

-Jousting fell out of favor in France after King Henry II was killed by a flying lance shard in 1559.

-A knight's jousting equipment would be decorated in his colors and heraldry to distinguish him to onlookers.

-A coronel is designed for both grip and safety. The pronged design cannot slip through a helmet's eyeslit like a nomal lance tip can.

-Jousting evolved from the earlier sport of tourneying, which involved a simulated battle between teams of knights.

-Pope Innocent II attempted to ban jousting in 1139, due to the dangerousness of the sport.

-Jousting remained popular long after heavy cavalry lost battlefield relevance. It is the state sport of Maryland. (Permission for use of this image sought from Maryland Jousting Tournament Association. As of yet no response.)

Copy of permission request: I am a student at Worcester Polytechnic Institute, working on a project for the Higgins Armory Museum developing web content to enhance the visitor experience. As part of this, I have created a "jousting fun facts" page where one of several facts is randomly displayed along with a related picture.

I would like to use the photograph of the Maryland Jousting Tournament Association's charter members found on your site to go along with the fact "Jousting remained popular long after heavy cavalry lost battlefield relevance. It is the state sport of Maryland," and am requesting your permission to do so.

Australian mounted infantry executed a successful cavalry charge against the Ottomans as late as 1917, in the Battle of Beersheba.

(Sword Fact) Lances are not effective outside of a charge; if caught in a melee, the knight would switch to his sword.

(Helm Fact) William Marshal, 1st Earl of Pembroke once had his helmet so badly dented in a tournament that he needed a blacksmith to remove it.

Appendix C

(QR labels)

Knightly Swords label:

Want to find out more?
Scan this QR square with your smartphone for some fun facts about knightly swords and to design your own sword.

HAM 2036.1
The Higgins Armory, in conjunction with a student team from Worcester Polytechnic Institute, is developing a QR Code system for delivering online content for museum visitors.
We welcome your feedback as we experiment with this technology!

Crossbow label:

Want to find out more?
Scan this QR square with your smartphone for more information about the crossbow and a crossbow mini game.

HAM 2006.01
The Higgins Armory, in conjunction with a student team from Worcester Polytechnic Institute, is developing a QR Code system for delivering online content for museum visitors.
We welcome your feedback as we experiment with this technology!

Coronel label:

Want to find out more?

Scan this QR square with your phone for some fun facts about lances and to play a polearm name matching game!

HAM 2610.7

The Higgins Armory, in conjunction with a student team from Worcester Polytechnic Institute, is developing a QR Code system for delivering online content for museum visitors.

We welcome your feedback as we experiment with this technology!

Appendix D

(Biographies)

Jennifer Baulier

Jennifer Baulier is a Junior at WPI double majoring in computer science and video game development. Her interest in various sword styles and in the Middle Ages were two factors that lead her to do her IQP at Higgins Armory. She used to fence sabre back in high school and also used to practice tae kwon do. She enjoys her studies here at WPI and has already had an internship relevant to each of her fields of study. For fun and creative reference she enjoys trying out games of all types including videogames, board games, tabletop games, and trading card games. Most of her favorite video games are adventure or RPG, and the thematic genre that inspires her the most is fantasy.

Ian Fite

Ian Fite is a Junior student at Worcester Polytechnic Institute. He enjoys strategy games, science fiction and sharp steel implements. When he isn‟t flying fighter jets and wrestling bears, which he never does, he spends his time writing code and reading comics. Ian did his research on ranged weapons in order to one up Patrick who did his on hafted weapons.

Patrick Feeney

Patrick Feeney is a junior at Worcester Polytechnic Institute, studying computer science and game design. He spends much of his time herding cats, aka players, in a number of online roleplaying communities. When not serving in his capacity as a fickle god of the dice, he enjoys strategy games and complex storylines that make the audience think. He did his research on staff weapons, because halberds are so much cooler than crossbows.