Knights at the Museum

Interactive Qualifying Project

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Contents

Authorship:

Introduction to Metallurgy	Erich Weltsek
Background on the Middle Ages: Feudalism and Chivalry	
Introduction to the Sword	
The Physical Evolution of the Sword from Vikings to Knights	
The Evolution of the Symbolism of the Sword from Vikings to Knights	
Swords after the Knight	
Introduction to Hafted Weaponry	
Ranged Weaponry in the Middle Ages	
European Armor Make and Function	Derek Johnson
Horse Armor	
Maximillian Armor: Sixteenth Century to the Rise of Firearms	
European Armor: Rise of Firearms (1550) to Present	
Persia	Thomas Cieslewski
Sub-Saharan	
Sudanic	
Turkey	
Indian Arms and Armor	Jonathan Blythe
Japanese Weaponry	
Japanese Armor	
Chinese/East Asian Arms and Armor	

Abstract:

This project for the Worcester Art Museum created a sustainable and modular tablet interactive for visitors to the museum's Arms and Armor Gallery. The team conducted live surveys in order to gather the visitors' opinions, as well as quantitatively analyzing prior tablet-based surveys. These surveys showed a desire for more objects and more information. The new application allows for increased content and provides a simulated "virtual-reality" experience. This improved interactive can be updated easily and constantly with an ever-changing exhibit.

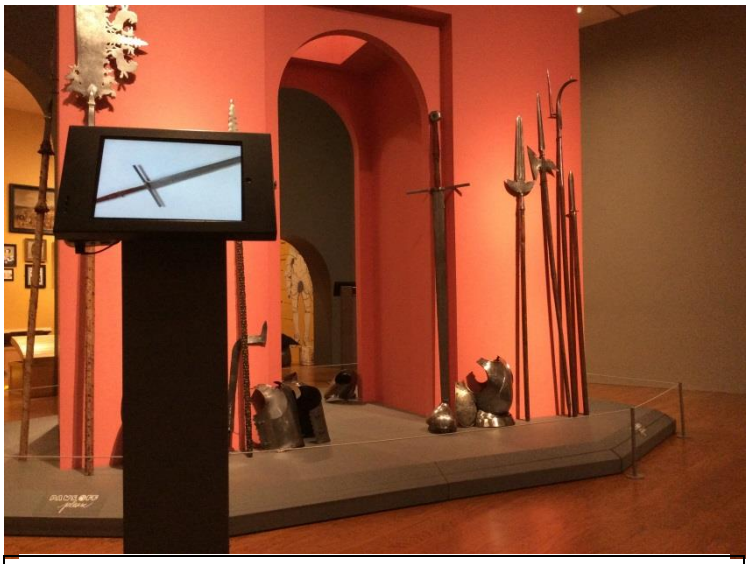
Introduction

The Triumphal Arch in the Knights! Exhibit (February 2015)

Arms and armor is as diverse over time as it is over geographic location. In the Worcester Art Museum's Knights! Exhibit one can find many diverse, unique pieces from many time periods and from around the globe. These pieces originally were on display in a historic context in the Higgins Armory, but now in their new home, they are displayed in a more artistic manner.

Born in 1874, John Woodman Higgins grew up in a fast-paced, industry-based Worcester. Over the course of his life he was fascinated by the themes of chivalry and knights. Educated at Worcester Polytechnic Institute, Higgins was primed to take over the Worcester Pressed Steel Company from his father. This made Higgins quite the wealthy man, and with part of his wealth he began to acquire many steel related objects, notably a large collection of arms and armor. In 1928, Higgins had a building erected to store his ever growing collection at 100 Barber Avenue, which eventually became the Higgins Armory. The contents of the Higgins Armory have recently found a new home in the Worcester Art Museum, located at 55 Salisbury Street. The Higgins Collection is the second largest collection of armor in the western hemisphere, trailing only behind the Bashford Dean Collection located in the Metropolitan Museum of Art in New York, New York. The Higgins Collection is made up of mostly European Medieval and Renaissance arms and armor, but also has a large variety of Asian and African objects.

The Worcester Art Museum was founded in 1898 and is the second largest art museum in New England. The museum contains roughly 40,000 pieces, including paintings, sculptures, drawings, contemporary art, et cetera. Pieces come from various locations and time periods such as ancient Greece, early America, Europe, and modern artists. As mentioned in the mission statement, the primary goal of the museum is to educate the public in arts and history. The museum is a location where the public can come experience works from past and present artists, scholars, historians, et cetera.



The Triumphal Arch in the Knights! Exhibit with tablet (February 2015)

The Knights! Exhibit is a new exhibit in the WAM as of spring of 2014. The exhibit displays objects both from the collections of the WAM and the Higgins collection. A large component of the new exhibit is the large pink Triumphal Arch. The arch itself is symbolic of the arches around the world that were used as places of celebration after victory in war. One of the most famous examples of such arches is the Arc de Triomphe in Paris, France. In the WAM, the arch has objects of many cultures and time periods strewn upon its four sides. In a similar manner to the historical arches, the Triumphal arch displays these pieces in a celebratory manner without labeling in the traditional historical museum style.

With the Knights! exhibit and its priceless objects creating the setting of this interactive qualifying project, the three main goals of this project were to: 1) research arms and armor around the world over time with a focus on the Medieval Period to establish an understanding and

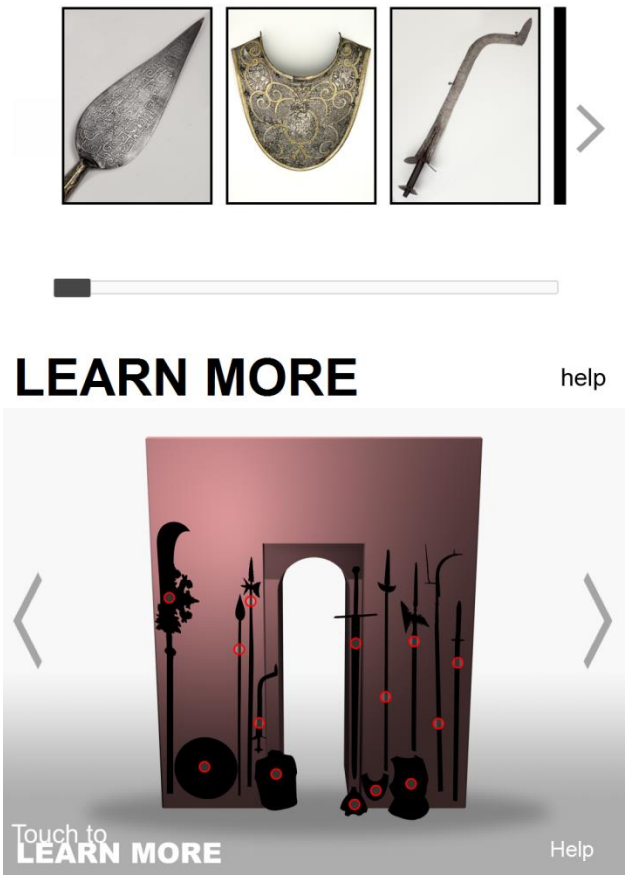
historical context for the project in the Knights! Exhibit, 2) develop and conduct a survey in the exhibit, and 3) to develop and produce a new tablet interactive for the Triumphal Arch in the exhibit. The three goals of this project aim to help the Worcester Art Museum reach its vision statement of 200,000 visitors annually and provide a "visitor-centric" experience through delivering visitor engagement. Additionally, this project is abiding by the directors vision of having the Knights! exhibit remain "clean", with little traditional museum object labeling on the walls. The information on the objects will be provided in a clean way through the iPad interactive. The new interactive allows for a vast quantity of objects in an orderly presentation while the original timeline style interactive simply did not work as a flexible platform for an expanding exhibit.

The first portion of the project to complete was a term long research component, which each member of the group produced weekly narratives. These narratives were then combined into a comprehensive document providing information on various arms and armor from around the globe with a focus on the pieces found in the Higgins Collection. The research was divided into 4 categories and each group member researched their specific topic. The topics were: European, Asian, African, and Islamic arms and armor.

The second major goal of the project was to create and conduct a survey in the context of the Knights! exhibit. The goal of this survey was to record the views and opinions of the patrons regarding the exhibit and its components (specifically the use of the interactive in the museum) to help the WAM present the collection for a broad public. Besides creating and conducting the survey, the group also broke down and organized the responses and numerical results of past surveys conducted by the museum. These surveys conducted by the museum provided general qualitative and quantitative data on the Knights! exhibit as a whole. The new survey was specific

to the arch interactive as well as other interactives in the exhibit. Again, this data was to be used in addition to the student generated survey data to help improve the Knights! Exhibit for future visitors. By the conclusion of this IQP, the information collected and refined by the group had already been used by the museum's director in his future planning of the exhibit.

The third major goal of the project was to produce a new iPad interactive for the Knights! Exhibit and to document both the new and old iPad interactive in the museum. The new interactive is a replacement for the former interactive for the Triumphal Arch. This new interactive takes a spatial, more artistic approach to the objects on the Arch, rather than the timeline approach of the former application. The application was designed with the idea in mind that the Arch would have many more objects added to it in the near future. The updated application is helping the museum: in its goal to start implementing interactive tablets throughout the museum, to modernize the exhibit that is so rich with history and created a balance between the two, and to create a clean and simple interactive that fits well with the exhibit itself. The interactive bridges the gap between the wants of the patrons (wall information plaques) and the wants of the director (clean walls with just items). The results of the surveys showed that visitors wanted more objects. With this desire, the museum



Top: Pre-existing Timeline Interactive default screen

Bottom: New Arch Interactive default screen

will add additional objects which will warrant the need for a better and more adaptable interactive such as the interactive created for this project.

Introduction to Metallurgy

The art of working with metal, metallurgy, has been performed by humans since around 4000 B.C.E. Over the course of time, the metals and the technology used in the art had drastically changed. The first metal thought to be worked with by humans was copper for decorative purposes. In the Medieval Period, iron was the most commonly used metal in arms and armor.[1] The story of iron working in begins in the Middle East, where around 2000 B.C.E. iron was first believed to be smelted. The art spread with the Hittites and later the Assyrians. The skill of iron working spread even further, eventually reaching Greece. In Greece iron was initially less used in arms and armor than bronze, because of the inferior quality of iron due to underdeveloped technology. Use of iron eventually surpassed the use of bronze due to the greater availability of iron in the environment, than copper and tin needed for bronze. This was made possible by new technology developed in the field of ironwork.

[1] Williams, 2003: 1.

"Bloomeries"

Throughout most of the Medieval Period, simple furnaces called "bloomery hearths" were used to produce iron. The raw iron ore, full of impurities, was placed within the furnace along with charcoal and other additives, where the iron ore was reduced to iron and slag. Due to the fact that the iron never actually melted, the product would be full of slag or non-metallic impurities.[2] These "bloomeries" would produce large conglomerated masses of iron and slag called "blooms" of wrought iron. This wrought iron was produced in small quantities of poor quality, full of slag, making the iron heterogeneous across the sample. These issues of quantity and quality made iron a poor choice for the creation large pieces of arms and armor such as swords and plate armor. Iron was still used in chain mail and scale armor since the many small links or scales of metal did not need to be homogeneous across the whole piece. The creation of these early iron works was an important first step towards the mass production of iron, and eventually the birth of the modern age.[3]

[2] Williams, 2003: 877.
[3] Williams, 2003: 4.

The Blast Furnace

The realization was made that larger furnaces, hotter fires, and higher carbon content in the form of charcoal was needed to produce larger quantities of higher quality iron. With this realization and technological advances, the blast furnace was born. It is thought that the first blast furnace was created around 1200 C.E. in Sweden.[4] The design was relatively simple, making the furnace larger and taller, adding large amounts of charcoal to the furnace, and providing greater blasts of air (through water powered bellows) to the flame produced hotter conditions, capable of melting iron. This process was more efficient than bloomeries, as iron and slag were separated more due to the fact that the iron was liquefied. The resulting iron is known as cast iron or pig iron, which would be used straight from the furnace in liquid form for casting objects such as gun barrels. As useful as cast iron was, it could not be forged directly in this form. A trip to the finery was needed before the metal was to be used by a blacksmith.[5] The process of fining reduced the carbon content in the metal and manipulated the iron into workable shapes, which could be used by blacksmiths. This two-step

2014.101 – Venus at the Forge of Vulcan (1606-1623). This painting depicts some great imagery of the Medieval forge. In the background water powered equipment is show, and in the forefront of the image a variety of objects are crafted out of metal including tools, arms, armor and jewelry.

[4] Williams, 2003: 882.
[5] Williams, 2003: 879-81.

process is commonly known as the indirect process for iron making, and allowed the production of iron and "high quality iron" which we now know as steel.[6]

[6] Williams, 2003: 882-3.

Techniques: Pattern-welding, Piling, and Quenching

Prior to the creation of the blast furnace, small amounts of poor quality iron made blacksmithing effective tools and weapons difficult. Techniques in the art of blacksmithing were developed to utilize small quantities of heterogeneous iron, such as pattern-welding, and the creation of scale and mail armor. All of these examples used many small pieces of poor quality iron to create larger products. In the case of pattern welding, many small pieces of iron were joined together to create large blades. Pattern-welding was widely used by the Celts, along with the creation and use of mail armor.[7]

2014.15 – Blade of a "Sax", Pattern-welded short sword. 7th century, French.

Production of harder, more durable metal was something blacksmiths of the time strove for. Experiments with various techniques of getting more carbon into the iron to improve its hardness were performed. A technique called "piling" was performed by taking a known piece of high quality iron (steel) and incorporating it into to the blade of a weapon to improve its qualities. It is believed that this technique of piling eventually gave birth to the aforementioned technique of pattern-welding.[8]

Another way the quality of the steel could be improved was through the technique of quenching blades in cold water, which is now well known to increase the hardness of the steel. Full quenching was not used often during the early part of the Middle Ages because of the

[7] Williams, 2003: 12.
[8] Williams, 2003: 9.

unpredictable quality of iron prior to the invention of the blast furnace. Uncontrollable reactions could occur, where blades would sometimes come out harder, but often at the risk of becoming brittle. Slack quenching, or quenching in other liquids such as oil were used for the same reasons as full quenching, by slowing down the rate at which the steel cooled. Slack quenching, due to the slower cool down, would allow for some increase in hardness at a lower risk of making the metal brittle. Due to this less risky trade off, slack quenching was frequently used by Early Medieval blacksmiths, but many blacksmiths still avoided the risks of any kind of quenching, and did not use this technique.[9]

[9] Williams, 2003: 17-8.

Background on the Middle Ages: Feudalism and Chivalry

Feudalism and chivalry are relevant to the topic because they help apply a context to warfare and consequently arms and armor of the Middle Ages. Feudalism can be most easily described as a government based on land ownership. Typically the feudal system has three parties involved: lords/land owners, vassals, and peasants. The peasants work the land in exchange for protection by the vassal. The lord gains benefits in the form of taxes and goods from the peasants and military service from the vassals that they provide the land to.[10] This system of feudalism essentially enslaved the common man and bound them to the land owner. Based on the system of feudalism the vassals and lords made up the majority of the military. The constant struggle for land amongst land owners and ability to send vassals to war led to a period of constant, private warfare. The church declared the Peace of God in 975 to try and remedy these private wars amongst land owners. When this attempt at ending private warfare seemingly failed in 1025 due to lack of support, the Truce of God was declared in 1027 which demanded feudal lord support. This truce put restrictions on when battles could be fought, including certain days and seasons.[11] These restrictions in part led to the development and growth of chivalry through setting standards for how warfare was conducted and the morals behind it.

Chivalry was a code of warfare that was followed by knighted individuals. Some basic tenents of chivalry were: to be a good Christian, that women, children and the elderly had no place in war, to be valiant and brave, and to not break a pledged word. These ideals were based in Christian scripture, but exceptions were made for the infidels and enemies of the church.[12] Looking past the opposition to the tactics of total warfare and pillaging, a lot of overlap of ideals occur

[10] Thompson, 1931: 252.
[11] Thompson, 1931: 258-9.
[12] Contamine, 1984: 270-5.

between Viking ideas of warfare and chivalry, such as maintaining an oath and being heroic in battle. This last connection could be why the descendants of the Vikings, the Normans, embraced the idea of chivalry so fondly. This comparison between chivalry and Viking ideas can be logically explained by the fact that the Vikings were the last link between the earlier Germanic cultures (Franks, Goths, Angles, Saxons, etc.) and "civilized" Medieval Europe, which developed out of the aforementioned Germanic cultures.

Introduction to the Sword:

Unlike other bladed weapons like the axe and knife, which served other uses such as cutting wood or slicing food, the sword was a tool originally made to serve one purpose, warfare. The swords of the Medieval Period did what they were designed to do, and did it well. Swords served uses outside of the battlefield, eventually they became symbols of wealth, power and even had a role in religious ceremony.

The sword can essentially be broken down into four components: the blade, the cross-guard, the grip and the pommel. The blade of the typical European Medieval sword had two cutting edges which met at some form of a point, with some having a more dramatic taper than others. The cross-guard provided the user some form of protection from sliding their hand along the blade, along with giving the sword its characteristic silhouette. The grip was the place where the sword was held in the hand. These grips varied in length depending on the type of sword and were either simply wrapped with leather, or were highly decorated. The last component of the sword, the pommel served three main purposes, to provide weight to the back of the sword to balance the blade, to help secure the weapon in the hand and to look visually appealing. A wide variation of pommels across time and location, ranging from simple to extravagant, illustrate the multifaceted function of the pommel. [13]

[13] Oakeshott, 1997: 57.

The Physical Evolution of the Sword from Vikings to Knights:

A fitting place to begin the journey of the sword during the Middle Ages is at the start, around 1000 C.E., nearing the end of the Viking Period. A hack and slash style of combat is thought to have been used during this time, from poem and saga evidence. Enemies were generally lightly armored, be it with mail or scale armor, or would have no protection besides a shield. Swords of this time were designed to be effective against such a foe, being one handed, and having a broad, flat, double edged blade with a slightly rounded tip. This blade design seemed to favor powerful slashing attacks over thrusting attacks. [14]

The pommels and cross-guards (the hilt) of the Viking period varied greatly, but general stylistic patterns emerged. Sir Mortimer Wheeler in 1927 classified the hilts of Viking aged swords into 7 Types. Ewart Oakeshott in *The Archaeology of Weapons* added two additional Types to this hilt classification.[15] As it will be seen, the pommel and hilt styles of the Viking Period do not simply go away as the Middle Ages roll on, but they evolved into styles of hilts used by knights.

2014.45 - German "Hand-and-a-half" sword (1350-1425).

[14] Oakeshott, 1996: 142.
[15] Oakeshott, 1996: 131-7.

As knights in plate armor became a more common sight due to the advent of the blast furnace, the old hack and slash style of combat became obsolete. Slashing attacks would simply glance off of the steel plate armor, and would be highly ineffective. Thrusting attacks were favored, to penetrate in-between joints and layers of plate armor.[16] Due to this change in combat, blade types also had to adapt. More slender tipped blades were used. In addition, due to the advent of full plate armor, shields were no longer needed by knight for protection. The most popular sword of the time was still the typical one handed long sword, but the lack of a shield allowed fully armored men to carry larger swords and around 1400, large "hand-and-a-half" and two-handed swords became popular.[17] A typical "hand-and-a-half" sword had a blade similar to a normal sword of the time, but had a longer grip of around 7 inches, which is what gives them their name. The longer grip allowed the sword to be used either with one hand or both hands, making the weapon very versatile in combat. The powerful two-handed sword was just a larger version of a typical sword, with a total length of around 5 feet.[18] The Worcester Art Museum houses a few great examples of these larger swords, including a German "hand-and-a-half-sword" (2014.45) and a German two-handed sword (2014.57). The Museum also holds an example of a long sword

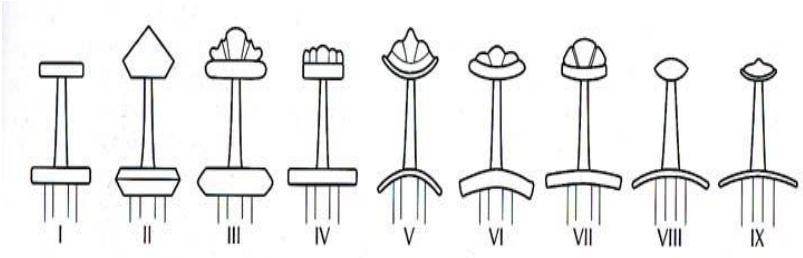
2014.57 – German two-handed sword (around 1300).

2014.59 – German Sword (1050-1150)

[16] Oakeshott, 1997*:* 68.
[17] Baker, 2003: 38-9.
[18] Oakeshott, 1997*:* 60-1.

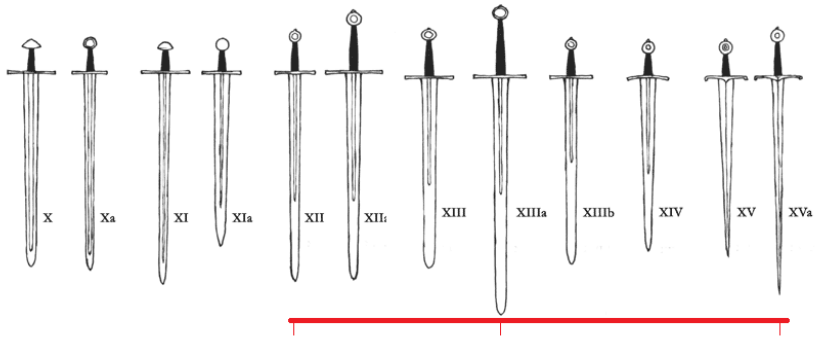
that was clearly in the Viking style from the middle ages, the German Sword dated 950-1150 (2014.59).

Hilt styles were just as variable during the height of the Middle Ages as they were in the Viking Period. Many of the hilt styles from the Viking Period actually stayed around, or slightly evolved during the Middle Ages. An example of this can be seen in the German Sword (2014.59) in the Higgins Collection. The sword would be classified by Oakeshott as a Type X hilt, having a brazil-nut shaped pommel and a straight cross-guard, which is extremely similar to a Type VIII Viking sword. The only difference between the two hilt types is that the Type VIII has a curved cross-guard, where the Type X is straight.[19]



Wheeler's typology of Viking Age sword hilt types associated with British find-places, from R.E.M. Wheeler, *London and the Vikings* (London, 1927), fig. 13, p. 32. VIII - IX. Oakeshott's extension of the classification, from R. Ewart Oakeshott, *The Archaeology of Weapons* (London, 1960), fig. 57, p. 133. Drawing by Lee A. Jones.

http://albion-swords.com/swords/wheeler.htm



http://www.worksofrichardmarsden.com/historyofthelongsword.htm

[19] Oakeshott, 1996: 203.

The Evolution of the Symbolism of the Sword from Vikings to Knights:

In Viking culture, the sword was a status piece, as well as an effective weapon. A sword was an expensive object to purchase simply because of how much quality iron and steel were needed to make the sword compared to the materials needed for an axe or spear. Due to this expense, only the elites of society could afford such weapons, so the common folk were stuck using the multi-purpose axe. A great deal of care was taken with these swords and Viking swords were often engraved or inlayed with precious metals, and their scabbards decorated.[20] It is no surprise that these expensive, highly decorated swords were used in ceremonious occasions. Viking chieftains would reward men of great service to them by giving those men rings of gold or silver. During the ceremony of this reward, the chieftain would present the ring to the recipient on the tip of his sword.[21]

As seen with the similarities of weaponry, ideals and an intermingled history, it should not be surprising the sword had a symbolic meaning to knights in Medieval Europe. Chivalry made up the code and conduct a knight was to live and die by. To solidify this fact, the sword, the knight's main weapon, played an important role in the knighting ceremony. In the knighting ceremony, the sword would be blessed and would subsequently be used for the ceremonial blow to the knight's shoulder dubbing him a "knight of God".[22]

[20] Oakeshott, 1996: 239.
[21] Oakeshott, 1996: 201.
[22] Contamine, 1984: 278.

Swords after the Knight:

The sword did not disappear with the knight with the rise of ranged weapons. The sword remained as diverse as it was in the centuries before. Short swords, daggers and knives had consistently proved to be effective side arms of the knight, and this use carried on. After the knight, the sword's function can be said to split into two, personal/decorative use and military use.

Swords after the Knight- Personal Use:

The rapier is defined by its long, slender and flexible blade designed for thrusting attacks. The swept hilt of a rapier was often highly ornamental in nature. Around the 16th century, fashion of the time deemed the rapier an important and essential accessory for any gentleman to wear.[23] The rapier was often paired with short swords or daggers, notably the quillion dagger. The dagger was used to tie up and defend enemy attacks.[24] The rapier further evolved into the smallsword which remained popular in some countries until the 19th century.[25]

2014.49- Smallsword (English, around 1790). Currently on display at the WAM. A great example of the ornamental nature of some smallswords/rapiers.

Swords after the Knight- Military Use:

In the late Middle Ages the flamboyant Landesknecht, a band of German mercenaries in the 15th and 16th centuries used a variety of weaponry, generally a weapon of longer reach, ranging from two-handed swords, pikes, halberds to name a few. One weapon that was carried by nearly all Landesknecht was their side arm, a type of short sword called a katzbalger. The katzbalger proved effective when the mercenary's weapon broke or they could not swing their long swords

[23] Edge & Paddock, 1988: 148.
[24] Edge & Paddock, 1988: 149.
[25] Coe et al., 1993: 58.

due to spatial confinements. [26] Along the same lines of ineffective weaponry at close range, it was common practice for those who used ranged weapons including bows, crossbows and guns to carry a knife, dagger or short sword to use in case an enemy was able to reach them.

A style of sword that's use increased after the knight was the sabre. The sabre is a single edged sword with a long, curved blade that can be used both on horseback and on foot. The sabre is heavily influenced by Eastern style swords, which can be clearly seen by the curved blade and the hilt features.[27] The sabre proved to be extremely effective on horseback, and Eastern European armies, notably the Hungarians were using sabre wielding cavalry in the late 1600's.[28] The sabre remained in use on the battle field up until the 19th century.[29] To this day, the sabre still holds a ceremonial function, being carried by members of military, notably the US Marines.

[26] Edge & Paddock, 1988: 149.
[27] Coe et al., 1993: 86.
[28] Coe et al., 1993: 87.
[29] Coe et al., 1993: 86.

Introduction to Hafted Weaponry

The sword was by far not the only weapon utilized in Medieval Europe. Many varieties of hafted weapons were used in combat. A hafted or staff weapon is a weapon in which a head, be it of metal or of some other material is attached to a longer staff or pole. The benefits of the hafted weapon are found in the increased length of the weapon, which provides the user a longer reach and greater leverage. This allows the user to provide more powerful blows at a longer distance from the enemy. Some of the more common hafted weapons were variations of the spear, axe, and halberd, but many other types of hafted weapons were used. Each of the aforementioned weapons evolved a unique battlefield role, and some even served in a ceremonial context. It should be noted that not all hafted weapons were designed strictly for war. Quite a few hafted weapons such as the bill, fork and scythe evolved directly from the common farm tool they shared their name with, while axes and hammers also have tool counter parts.

It is thought that the spear was one of, if not the first hafted weapon used by humans. Its simple design of a sharpened tip on an elongated pole allowed early man to increase his reach in hunting and fighting.[30] The spear was used from prehistoric times well into the Medieval Period. Around the 14th century the spear began to be used less frequently than other types of hafted weapons such as the halberd, as penetrating attacks alone were proving of limited use, especially against plate armor.[31]

[30] Waldman, 2005: 7.
[31] Waldman, 2005: 9.

The Winged Spear

One of the more common styles of spears that were used up until the spear's effectiveness decreased, was the winged spear. The winged spear typically had a long wide blade of about 10-12 inches long and around 2 inches wide at the base, which could be used both for thrusting and slashing. The spear obtained its nomenclature from the two wing-shaped protrusions near the socket. This style of spear was thought to have been used since as early as 3000 B.C.E. by the Sumerians. It should not be surprising that the winged spear was used during the Middle Ages by both the Vikings around 1000 C.E. and the Scots in the battle of Bannockburn in 1314 C.E., with little variation between the two. These two examples are most definitely not the only examples of the use of the winged spear during the Medieval period, but are certainly two of the more famous uses of the time. This type of spear typically had a long wide blade of about 10-12 inches long and around 2 inches wide at the base, which could be used both for thrusting and slashing.[32] The Higgins Collection has one such example of a "Winged" spearhead (2014.481) dated to around 700-1000 C.E.

2014.481 – "Winged" Spearhead (700-1000)

[32] Oakeshott, 1997: 22-3.

The Pike

Another variation of the infantry spear is the pike. In comparison to the winged spear, the pike had a smaller head of around 6 inches in length set upon a much larger shaft of up to 18 feet long. The pike was purely a weapon for thrusting attacks. The pike was used by the Greeks as early as 300 B.C.E. but disappeared in use until it was reintroduced by the Swiss around the 15th century.

2014.273 – Pike (1600-1625) from the Higgins Collection. This pike has the typical traits of a pike, a small head and long haft.

During this time the infamous Swiss pike-men seemed near unbeatable in their formations of multiple ranks of pikes. The pike was superior at resisting cavalry charges due to the great length of the weapon and the technique of planting the butt end of the shaft on the ground.[33] The reign of the pike ended with the increasing use of black powder weapons.[34]

[33] Ashdown, 1967: 324.
[34] Oakeshott, 1997: 23-5.

The Lance

The knight's lance is also another variation of the spear. The tip of the lance was similar to that of the pike. The steel tip of the lance sat upon a long tapered shaft that was typically around 10 feet long.[35] During the later Middle Ages, around 1400, the lance evolved to have a vamplate and a carved out grip. The vamplate was an additional piece of metal used to protect the hand. The longer thicker handle and carved out grip allowed the user to rest the end of the lance on a bracket attached to the breastplate of his armor which helped distribute some of the weight of the weapon to the body, and increase balance and control.[36] The lance was commonly made of ash wood, with reinforcing strips made of steel at breaking points. Knightly lances were often flamboyantly decorated with brightly colored pennons and flags which had tails or 'flies' attached. These flags are thought to be symbols of authority and ranking, much as the modern military uses medals to denote rank.[37] The lance proved to be a devastating weapon on horseback, but was nearly useless on foot due to its length and weight.[38] This is where knights would utilize their side arm which was generally a sword.

2014.668 – Lance Tip of Coronel Form for the "Gestech" (German Joust).

The lance was not exclusively used for warfare. Jousting was a sport that nobles enjoyed participating in. The lance used was altered to partake in this gentleman's activity. The steel reinforcements were removed from the lance, allowing it to break when it struck a fellow jouster, and the tip was also changed. The jousting tip, or coronel was a blunted crown shaped tip with

[35] Oakeshott, 1997: 33.
[36] Oakeshott, 1997: 34-5.
[37] Edge & Paddock, 1988: 30-31.
[38] Oakeshott, 1997: 37.

three points that was designed to increase the gripping power of the lance to unhorse an opponent rather than impale them.[39] A coronel jousting tip (2014.668) can be seen in the Higgins Collection. This head is of German or Austrian origin, dated to around 1500.

[39] Oakeshott, 1997: 35.

Axes and Hammers

The pollaxe and warhammer were more often found in the hands of foot soldiers than mounted troops. This is not to say though, that these weapons were not used by the knight. The axe and hammer, much like the spear, originated before history was recorded. These tools were created by lashing a stone (blunted or with and edge depending on the use) to a wooden handle to provide extra power for chopping or hammering.[40] The effectiveness of these tools as weapons led to further improvement and evolution to become deadlier weapons. The Vikings alone used many variations of the axe as a weapon, including those of various haft length, and various head shape. One of the more infamous head shapes that was heavily used by the Vikings was the "bearded" style. This style of axe has a long sweeping beard on the bottom of the head, which allowed for the user to hook many parts of the opponent, including their shield to disarm them, or to sweep a leg to put them to the floor. A bearded head was equally effective on both a long or short haft. Another widely used axe style was the "Danish" great axe. The "Danish" style was of a long two handed axe, with a broad head. This style of axe was used both by the Vikings and European knights on foot.[41]

2014.675 – Head of "Bearded" Battle Axe located in the Higgins Collection. This axe head dates from 1100-1350 from Northwestern Europe. This timeframe puts the head out of the Viking Period, but the head is "a derivative of the Viking type".

[40] Oakeshott, 1997: 42.
[41] Oakeshott, 1997: 46-7.

The axe continued its evolution, and the pollaxe as it is known was thought to be created around 1400.[42]A pollaxe consists of a head that is a conglomeration of three different weapons, the spear, the axe and the hammer, set upon a haft of about 5 feet in length. On one side of the head is the axe, the other side has a hammer or spike, and on the top is a spear like tip. This allowed the pollaxe to be used in many different ways, to slash, stab and bludgeon the enemy, allowing the weapon to be used by brute strength or precision.[43] The Worcester Art Museum is in possession of a highly decorated, but relatively common style of pollaxe (2014.81). This pollaxe has a blade, spear and hammer portion, rather than a spike. Similar to the pollaxe, pollhammers and warhammers evolved. The difference between the pollhammer and warhammer is the length of the haft. The pollhammer has a haft similar in length to the pollaxe, where the warhammer has a haft length of around 2 ½ feet in length. A warhammer, very similar to the poll axe, has three weapon types in one: a hammer, spike and spear. The hammer and spear were used in the same manner as the pollaxe, but the spike was used to penetrate armor using a strong swinging motion rather than the thrusting motion the spear head requires.[44]

2014.81 – Pollaxe (late 1400's) from Northern Europe.

[42] Waldman, 2005: 155.
[43] Waldman, 2005: 156.
[44] Oakeshott, 1997: 52-3.

The Halberd

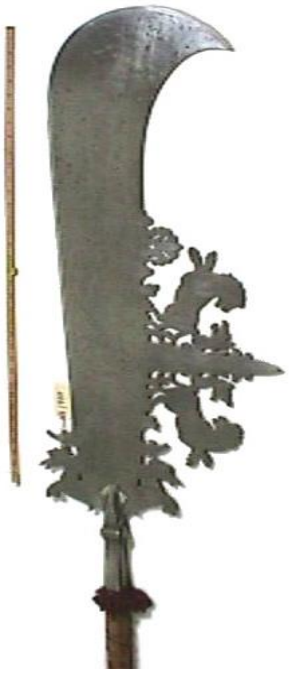
The halberd, much like the pollaxe, is a combination weapon. The halberd is both a thrusting and slashing weapon, with an axe or knife like blade on one side, and a spear-like protrusion on the top. This multifaceted head is mounted on a pole of around 5 feet in length.[45] Occasionally a beak is fixed to the opposite side of the blade.[46] An example of a moderately ornate halberd in the style of the 16th century (2014.167) can be seen in the Higgins Collection. This halberd has many features of the later halberds of the 1500s with a slightly crescent shaped blade for slashing, a long spear tip for stabbing, and a beak on the back to complete the head, and a frilled collar around the base of the socket.[47] Prior to the 1400s, halberds were attached to the haft by eye loops, but this piece is attached with the more modern style of a socket on the bottom.[48]

2014.167 – Halberd (1600-1625), Italian.

[45] Oakeshott, 1997: 26.
[46] Waldman, 2005: 17.
[47] Waldman, 2005: 105-6.
[48] Waldman, 2005: 17.

The Glaive

The glaive is a very similar weapon to the halberd. The glaive is a cutting and thrusting weapon just like the halberd, but the differences lie in the blade shape and haft length. The cutting edge of the glaive is convex and has a straight, often decorated back edge. This blade is attached to a haft that is longer than the haft of a halberd, typically around 6 ½ feet in length. The glaive was seemingly favored by the Italians, and its use spread rapidly in the late 15th century. As its use spread, the glaive evolved a more artistic and ceremonial purpose. The Venetians took the ornamentation of the glaive to the next level by wrapping the haft in velvet, attaching colorful fabrics in the form of tassels, and by engraving and etching the blades extensively. Eventually the glaive took a ceremonial role rather than a combat role, where the glaives got too big and stylish to function as a weapon. These fancy glaives were still carried by guards as a social statement.[49] The halberd also adopted a ceremonial function, but paled in comparison to the artistic extremes Venetian glaives achieved. An ornamental glaive of an Italian palace guard (2014.122) is on display in the Knights! Exhibit in the Worcester Art Museum, and stands out from the other hafted weapons on the Arch of Arms. As it can be seen, the blade of the aforementioned glaive looks terribly clumsy due to its highly ornamental nature and would most likely make for a poor weapon.



2014.122 – Ornamental Glaive of an Italian Palace Guard (1700's), Italy.

[49] Waldman, 2005: 107-113.

Ranged Weaponry in the Middle Ages:

Much like the spear, ranged weaponry in the form of the bow has been used since prehistoric times. Ranged weapons such as bows, crossbows and guns played important roles in warfare in the Middle Ages. These weapons' capability of firing projectiles over large distance allowed the users to cause massive physical and psychological damage to an advancing enemy block. When deployed on the flanks of an enemy, these ranged weapons were extremely effective in stopping an advance of troops on horseback by firing at the unprotected sides of the animal, causing the rider to be grounded. During the Middle Ages, advances in technology allowed more complex weapons in the form of crossbows and then guns replace the simple bow. The prevalence of guns eventually led to a change in the way war was fought and won, not by men in heavy armor with a sword or hafted weapon, but by lightly armored men wielding guns.

The English War Bow:

The bow developed from early humans' needs to hunt from a longer distance than a spear could be thrust or thrown. Styles and composition varied by location and time, the simplest and earliest used design being the longbow. The longbow is a single "stick" of wood that is cut to length and shaped to have a "D" shaped cross section.[50] Early Neolithic cave paintings display the use of some of the earliest longbows bows for hunting animals. "Otzi the Iceman", a mummy from the Copper Age that was found preserved in the Alps is another great example of early longbow use.[51] "Otzi" was found with a yew longbow and in addition had an arrow lodged in his shoulder which is speculated to be the cause of his death. It is clear from both cave painting and "Otzi" that the bow was clearly used for hunting both wild animals and humans alike.

The longbow essentially had not changed from this basic "D" shape and was used by the Saxons and Vikings. It was not until the extensive use by the English that the longbow evolved a derivative that is known as the war bow. All war bows are longbows, but not all longbows are war bows. The longbow and war bow differ in that the war bow evolved to be longer and thicker to increase the power and range. This change came to be through extensive tactical use of the longbow and the desire to reach the strength and distance achieved by early crossbows.[52] It is difficult to put definitive measurements to war bows and longbows because thickness of the staff, the length of the staff and the material the staff is made of all effect how the bow performs. One conclusion that is safe to make is that the war bow was always taller than the person shooting it. The war bow is often called the English war bow due to the military success the English had with the bow. The English war bow was so effective that it had decided battles by itself, most notably

[50] Soar, 2004: X.
[51] Soar, 2004: 9.
[52] Soar, 2004: 58-9.

the battles at Crecy in 1346 and Agincourt in 1415. In both of these battles the English were outnumbered by the French, but due to effective tactics and the use of the war bow, the English were victorious.[53]

The bow itself is nothing but a stick without arrows. The arrow has three basic parts: the shaft, the fletching, and the head. The shafts and fletching were fairly constant arrow to arrow as seen from the arrows recovered from the Mary Rose shipwreck. Arrow shafts were just long enough to provide between 28 and 30 inches of draw length. This measurement is taken from the nock, or where the string and arrow meet, and the base of the shaft, where the socket of the arrow head meets the shaft.[54] The fletching was of grey goose feathers with linen thread securing the feathers to the shaft. Arrowheads were highly varied and specialized for a specific function. The two most common groups of arrowheads were the broadhead and the bodkin.

The broadhead was among the first arrowhead designs used by man being originally made of stone and eventually iron. The overall design of the broadhead cuts deep into flesh and causes uncontrollable bleeding. Some broadhead variants had two large barbs to make the removal of the arrow even more painful and difficult. Mainly used for hunting, this was type of head was favorite used by the Vikings, and proved deadly against unarmored infantry.[55]

The bodkin was mainly used for armor penetration, which was due to the pyramidal shape of the bodkin head. Initially, the bodkin was used to pierce chainmail by both getting between links to piece the flesh, or by pushing the links into the flesh. As plate armor began appearing on the battle field, thicker and heavier bodkins were designed to penetrate the solid armor. The heads

[53] Soar, 2006: 1-8.
[54] Soar, 2006: 69.
[55] Soar, 2006: 107-111.

of these so called “quarrel type” bodkins closely resembled the tip of a crossbow bolt, because it was witnessed how effective crossbows were against armored opponents.[56]

[56] Soar, 2006: 114.

The Crossbow:

For some reason, possibly due to the materials from which war bows, longbows and arrows were made, not many complete examples survive. On the contrary, many examples of crossbows from the medieval period still exist, and are better understood than the war bow. This is due to the complex construction of these weapons, along with the artistic value they present, and thus have been cherished over time more than the simple war bow.[57] The rise of use of the crossbow as a weapon in Europe can be traced back to 1066 when Norman invaders brought the weapon to England. From England, the weapon proved incredibly effective and the wounds inflicted by the weapon so grotesque that in 1139, the church declared that the weapon should not be used against a fellow Christian.[58] The crossbow was the favored ranged weapon in Europe up until 1460. Around 1290, the crossbow was replaced as the favored ranged weapon by the war bow in England.[59] The advantage of the crossbow lies in its strength, range, its ease of use. The war bow was able to compete with the crossbow in strength and range, had an increased rate of output of projectiles, but all of this came at the cost of many years of training. The crossbow could be picked up by a common man and be used effectively.[60] When steel limbed crossbows came into use, the crossbow surpassed the strength and distance that could be achieved by a war bow.

[57] Payne-Gallwey, 2007: v-vi.
[58] Payne-Gallwey, 2007: 3.
[59] Payne-Gallwey, 2007: 4.
[60] Payne-Gallwey, 2007: 10.

A crossbow bolt, also called a quarrel, is the projectile used by crossbows. These bolts were as varied as their relative the arrow. Bolts were shorter, had a thicker shaft, and had heavier heads. All of these aspects of the bolt allowed it to more easily penetrate plate armor. This penetrating power was further increased by varying the head types of the bolt. The typical and most effective bolt against plate armor was a four sided pyramid shaped head.[61] The Higgins Collection is home to a few crossbow bolts such as 2014.53.1 a crossbow bolt from the 15th century. As can be seen from the following picture, crossbow bolts sometimes did not have flights made of feathers, but flights made of thin pieces of wood.

2014.53.1- Crossbow Bolt, Europe, 15th

[61] Payne-Gallway, 2007: 18-9.

Early Guns and Powder Weapons:

Gunpowder was a creation of Chinese origin that reached Europe through trade most likely with the Arabs. With gunpowder came its uses in weaponry, such as explosives that were used by the Chinese, along with the potential to fire projectiles. The earliest evidence dates European guns to 1326.[62] What made black powder weaponry so effective was the speed that the solid projectiles could reach, which translated into penetrating power. Many variations of guns existed during the Middle Ages. These variations amongst many other factors, were of barrel length, barrel diameter and ignition system. In the very late portion of the Medieval Period, a few different firing mechanisms were created, making the gun even easier to use.[63] Early guns were inaccurate due to the lack of rifling (spiral carving) in the barrel, and had long reload times, but much like the crossbow, the gun's effectiveness lay in its strength and the fact that a common man could use a gun with very little training. Due to the effectiveness of projectiles, most notably the gun, the effectiveness of armor decreased, and a regression in its use was witnessed. This essentially led to the plate armored knight as a military unit to become obsolete. In addition to the knight disappearing from the battlefield, siege warfare was also dramatically changed with the advent of the cannon, leading to the demise of the castle. With two major symbols of the Medieval Period, the knight and castle disappearing, the Middle Ages is commonly said to end around the year 1500.

[62] Blair, 1962: 39.
[63] Blair, 1962: 41-8.

European Armor Make and Function

The function of armor has remained consistent throughout the course of history. Armor has always been created to protect the wearer from injury, specifically from enemy weaponry. However, armor always has to balance protection versus maneuverability because the wearer must also be able to use his or her weapon. The evolution of armor follows closely with the evolution of arms and weaponry because, as weaponry evolved and became more lethal, armor evolved to counteract the new weaponry.

The Age of Mail, starting as early as the 10th century, saw the rise of mail armor over the previous fabric and leather armors for use in the Crusades and other wars.[64] Mail armor was a flexible, light armor comprised of interlocking iron rings. The armor protected against both slashing and low velocity piercing weaponry. Mail was quite effective in protecting the wearer from glancing blows and deflecting most weapons. The armor was worn over thick fabric armor for extra padding along with a coif, which was a close fitting hood that left the face exposed, and a conical, open bottom helmet called a pot.[65]

Obj # 2014.835

There are no surviving examples of mail armor from the beginning of the Age of Mail due to the high surface area and rust,[66] but this piece (Obj # 2014.835), which is from the 17th century, is a very close to early mail was made the same way from its introduction all the way to the 17th century in

[64] Stone (1999) p 24
[65] Blair (1959) p 24
[66] Pfaffenbichler (1992) p 5

Europe.[67] Mail like this offers a glimpse at how the armor was created. Starting off as a billet of iron, the metal was hammered flat into a sheet. Links were then punched out to be the appropriate size and then punched again at the ends for the rivet to go through. Another way to make the rings was to draw out the metal into a wire and then flatten and pierce the ends for the rivet.[68] There were also closed rings that were welded together at the ends. Rows of closed would alternate with open (riveted) rings to make the full piece of armor.

Around the mid-1300s, plates of iron began to be made to reinforce the mail armor. The period between 1277 and 1410 is known as the Transition Period and saw great advances in metallurgical techniques and armor creation.[69] Previously, armorers used wrought iron, which was high in grain-like impurities called slag, and were unable to produce large, plates due to the grain of slag weakening the piece. By the end of the 14th century, plate armor replaced mail as the main defensive armor type.[70] Iron, around this time, had been being converted into steel, a process most likely to have been a fortuitous accident due to early furnaces using carbon based charcoal and increased the carbon content of the iron.[71] This steel was harder than iron, offering better defense against even high velocity projectiles from bows, crossbows and even early firearms.

The armorers in Italy and Germany by the end of the 14th century had established themselves as the chief armorers in Europe with a rivalry lasting until the end of the age of armor. The armorer's guilds in the cities of Milan and Innsbruck were where the bulk of armor was made and where many technological advances took place. Among the advances was the quenching

[67] Pfaffenbichler (1992) p 56
[68] Ffoulkes (1912) p 44
[69] Stone (1999) p 24
[70] Pfaffenbichler (1992) p 9
[71] Ffoulkes (1912) p 38

process. Quenching is a process where heated armor is rapidly cooled in a liquid, usually water or oil, to lock carbon within the steel molecule structure, adding toughness to the metal, but making it brittle. The faster a piece was cooled, the harder the metal. Tempering is where the plate is heated back up and quenched again to reduce the brittle attributes of the armor. The process required a master armorer, such as those located in Italy and Germany, to know the exact temperature and rate of cooling to get a proper plate. The armorers in Germany generally used the full quenching method while the Italians used a process called slack quenching, the same as quenching just with intermittent breaks in the process in order to avoid the need to temper, which allowed them to produce armor at a quicker rate.[72] The armorers in Milan were so fast in producing armor, records indicate that in 1427, they were able to outfit 4000 cavalry and 2000 infantry units with armor in just a few days, an unfathomable achievement especially when one takes into account just how much went into a piece of armor.[73]

Plate armor was made in generally the same manner as weaponry of the time. The armorer would receive sheets of steel from their supplier and then cut it to size and hammer it over anvils, called stakes, specifically designed for a specific plate such as a cuirass. The metal was usually worked cold and heated when necessary for flexibility, called annealing.[74] Hammermen, the armorers forging the plate, either used a multitude of hammers or a water powered tilt-hammer to make the form of the plate. When the plate was done being shaped it was quenched and passed to the millman for polishing and then the locksmith for fasteners and hinges.[75] High-quality armor

[72] Pfaffenbichler (1992) p 64
[73] Pfaffenbichler (1992) p 13
[74] Pfaffenbichler (1992) p 62
[75] Blair (1959) p 188

was tailored specifically to the individual to match the wearer's body and fit snugly while not impairing movement.

Obj # 1980.35

By the 1500s, armor had reached its pinnacle and rendered the wearer nearly impervious to attack, but armor, by this time, evolved as not only protection but also art and a status symbol. Even in 1708 during the decline of armor usage, armor maintained its status symbol, being used as a portrayal of elegance, wealth, and power in paintings such as this one (Obj # 1980.35) depicting Charles-Auguste d'Allonville.

Armor, especially higher quality armor, went through many different artists in order to decorate the pieces. Gilding, adding gold designs, was heavily used in the mid-16th century to add decoration to a suit of armor. A goldsmith would apply a varnish containing mercury onto the surface, place gold on top of the mercury and heat the plate to allow the mercury to fume away leaving the gold adhered to the plate. Another decorative technique was bluing. Seen in the helmet below (Obj # 2014.48), bluing darkened the metal to an almost black and protected the outer metal from oxidation. The process required an expert armorer to get the temperature just right across the piece to get an even color. One of the most heavily used decorative techniques was etching. An etcher would cover the plate in an acid resistant varnish and

Obj # 2014.48

scratch away the design with a needle. The plate was then dipped in an acid, allowing the acid to cut into the metal. Once removed, the plate was cleaned with turpentine and the design blackened with a mixture of lamp black and oil.[76] From 1550 to around 1610, parade armor was also used and was heavily embossed, hammered from the reverse side to show a design with depth.

The firearm's effectiveness on the battlefield eventually lead to the decline in armor usage and creation. Armorers started producing thicker and thicker steel plates in order to prevent bullet penetration. However, thicker plates equated to heavier pieces of armor, making a suit very uncomfortable to wear to battle when one must be unencumbered. By 1650, plate armor had nearly waned away completely. Armorer workshops in Milan dwindled from twenty-two in 1560, to nine in 1571, and then a mere four in 1624.[77]

Today, suits are still being made for interior decoration and reenactment, but plate armor has lost its function of protection. However, armor is still being used today to protect its wearer. Made out of modern materials, helmets and body armor are worn by soldiers for the same purpose knights wore plate armor long ago, protection.

[76] Pfaffenbichler (1992) p 67
[77] Pfaffenbichler (1992) p 9

Horse Armor

Throughout the course of history, armor has always been focused on the protection of the man wearing it, but a mounted soldier's horse was almost just as important and needed to be protected. Equestrian armor had been in Europe during the time of the Roman Empire until its collapse. After the Roman collapse, horse armor ceased to be used or made until the late 11th or early 12th century.[78] Horse armor progression followed very closely with the progression of human armor after the widespread use of mail after the start of the 12th century.

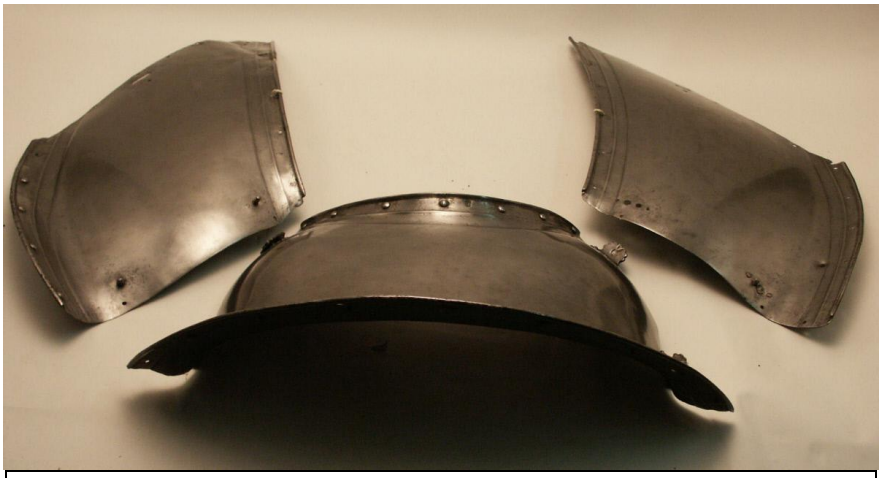
The Age of Mail, between 10th and 13th century, showed technological advances that carried over into the creation of horse armor. Horse mail comprised of a mail protective outer layer and a padded, quilted fabric under coat to prevent chafing and for extra protection. By the 12th century, horses also wore surcoats, heraldic fabric over mail, the same as their riders did. The surcoat usually went down to the hooves of the horse and offered light protection.[79] By the mid-1200s, shaffrons, armor intended to protect a horse's head, were being produced of leather and mail.[80] Only a few items from this age exist because the mail offered much more surface area to rust away.

Following closely with the evolution of armor for men, around the 14th century, horse armor began using plates to protect vital areas. The armor resembled the coat-of-plates with small plates being sewn into a fabric outer layer in order to provide the horse with protection as well as mobility.[81] There is strong evidence from an armory inventory that cuir-bouilli, boiled or hardened

[78] Pyhrr (2005) p 8
[79] Pyhrr (2005) p 9
[80] Stone (1999) p 171
[81] Blair (1959) p 184

leather, breastplates for horses were in use in 1266, predating the introduction of a solid breastplate for human armor.[82]

By the 13th century, horse armor with plates had become a common sight on the battle-field, but it was not until the 15th century that full plate armor, called a bard, was created. The bard consisted of a head protecting shaffron, a neck protecting crinet, a chest and front flank covering peytral, side protecting flanchards, and a rear crupper. By the 1500s, horse armor had caught up with the craftsmanship and quality of armor for men.[83]



Obj # 2014.14.1-3

Obj # 2014.20

A peytral covered the horse's chest area from attack and usually had front flank sections that hinged as well. The peytral above (Obj # 2014.14.1-3) clearly depicts the hinge system as well as one of the other key features of the piece of armor, which is the flaring edge. The edge allowed for mobility in exchange for added protection. Other peytrals had additional forms off the sides to protect the rider's legs, allowing

[82] Pyhrr (2005) p 9
[83] Pyhrr (2005) p 14

for the use of 3/4 armor. Peytrals were also used for show and parade in the 1500s, which explains a piece like the peytral on the left (Obj # 2014.20) with its decorative holes cut into the plate.

Obj # 2014.75

Another vital piece of equestrian armor was the shaffron, which protected the head of the horse. As one of the earliest pieces of horse armor, the shaffron went through many different iterations. For the majority of history, shaffrons covered the front of the head from forehead to snout and to just below the eye.[84] Other iterations included half-shaffrons like the object to the left which protected just the forehead of the horse. In the 1500s, shaffrons for the tournament sometimes covered the full head of the creature along with the eyes in order to prevent a horse from shying away during a joust.[85] Like most other pieces of the armor, the shaffron was decorated to the same extent the wearer's armor was. This Maximilian shaffron (Obj # 2014.75) is a fine example of Gothic fluting and roping, reflective of the Maximilian style.

Obj # 2014.73

Decoration of horse armor was exactly the same as that of regular plate armor. Etching, gilding, and embossing were quite common and almost always matched the rider's armor. The shaffron gained a spike, such as the one depicted on the shaffron to the left (Obj # 2014.73) , in the 1400s purely for decoration.[86] This shaffron also shows a heraldic device on the forehead and some gilding with the gold strips. Embossing was

[84] Blair (1959) p 186
[85] Pyhrr (2005) p 14
[86] Pyhrr (2005) p 13

particularly prevalent in the creation of horse parade armor which included items to make a horse look like a dragon or some other mystical being.

The final key component to horse armor was the war saddle. Weighing between 21 and 33 pounds, the typical wooden saddle was built high around the pommel and cantle for both balance and protection.[87] This saddle (Obj # 2014.76) shows the height of both the pommel and cantle. These extremely high areas protected the rider's abdomen while in combat with additional plate armor but also adding height to a potential enemy infantry swing in order to hit the rider. The height also supported the rider's back, allowing for the rider to recover and balance more effectively if struck. The saddles were reinforced with steel plates, and, in the late 1500s, began to extend downward to protect the rider's leg. These new plates were properly called saddle steels.[88] The saddle steels assisted in the transition to 3/4 and eventually half armor because the rider would be sufficiently protected by the saddle.[89] Subsequently, the rise of firearms led to a drastic decline in both man and horse armor. Horse armor quickly was discarded to allow for faster cavalry soldiers.

Obj # 2014.76

[87] Hyland (1998) p 6
[88] Hyland (1998) p 6
[89] Pyhrr (2005) p 16

Maximillian Armor: Sixteenth Century to the Rise of Firearms

Plate armor as many modern people would envision it is actually a style of armor called Maximilian armor after Emperor Maximilian of the Holy Roman Empire, who ruled during the time of the style's prevalence. Plate armor dates back all the way to the fourteenth century and was originally fairly basic, providing protection for vital portions of the body. As time went on, metal working became more efficient and advanced enough to allow tougher metal to be made with more intricate parts. By the sixteenth century, armorers started developing stylized suits of armor, leading to the Maximilian era. Out of all the armorers in Europe of this time period, the armorers of Milan, Italy and Innsbruck and Nuremberg, Germany were regarded as the most skilled craftsmen with Innsbruck even being the court workshop for the Holy Roman Empire.

Maximilian armor, at its core, is the result of the pinnacle of plate armor technology combined with heavy decoration and additional pieces intended to protect the wearer during tournaments. The decorated armor was primarily used for pageantry and tilting (a word for the joust).[90] The armorers were so skilled that they were able to make the wearer nearly invulnerable during tournament play by reinforcing areas, adding mobility to others and so on.

Obj # 2014.1164

The decoration on some Maximilian armor could get a bit extravagant at times but generally consisted of fluting. Fluting is a series of parallel ridges and grooves hammered into the metal surface

[90] Ashdown (1967) p 275

and was thought to have also increased the strength of a metal plate. The fluting added a new aesthetic to armor, playing off of new light and shades.[91]

Obj # 2014.12

The Maximilian style was a derivative of the Gothic style from the area of Germany. The Italians also followed the style to a degree during this period, but their armor was more minimalistic than the Gothic style, making use of only minor fluting which was much more shallow or flat and more use of etching to add decoration. As seen in the difference between the Italian half-suit of armor (Obj # 2014.12) and the German Joust armor (Obj # 2014.1164), both from the 1500s. The Italian suit has no visible fluting but has heavy use of gilding and etching while the basic Gothic armor is clearly fluted, especially on the helmet.

The helmets of Maximilian armor can be broken up into two main groups, helmets intended for tilting, or jousting, and helmets intended for the battlefield. Helmets for battle consisted of a lower bevor and visor to increase field of view and lacked some of the more prominent decorations such as plumes and sometimes roping or even flutes. An example of a field helmet can be seen with this helmet at the Museum (Obj # 2014.11). At first, the salade was a more common choice than a close helmet for battle because it offered superior protection on the neck.[92] For tournament use, the close

Obj # 2014.11

[91] Riggs (1915) p 59
[92] Ashdown (1967) p 282

Obj # 2014.1124

helmet had a raised bevor and visor to protect the wearer's eyes better. Because of the raised viewing hole, known as an occularium, the wearer had the best view of what was directly ahead while leaned over and looking slightly up, the position taken while jousting. The helmet above (Obj # 2014.1124) is a mix of both field and tournament. The bevor does not quite come high enough to warrant the wearer to look upward to see anything but has some angle to it. The bevor has other qualities which are seen more in a tournament as well, including being asymmetrical. The left side of the helmet would be thicker to protect the wearer from a lance blow, since the tournament combatant was always on the left side. There are also features such as a breath and visor lifting pegs on the right, since it was safer to put such devices out of the way of a blow. This helmet also has some of the hallmark Maximilian decorations such as the roping around the large center crest as well as extensive etching. The etching includes scenes of different figures and a plethora of flower symbols also found on the large rivets holding the bevor on. The helmet became

the focus of defense for jousting eventually, leading to it being bolted directly to the cuirass and being extremely heavy.[93]

Obj # 2014.80

The armor for the body during the mid-1500s following the Maximilian Era also became developed more for tournament than combat just as the helmet did. Originally, combatants would fight in their battle suits, but as the sport grew, the equipment evolved. The armor to the left (Obj # 2014.80) was both tilting (jousting) and battle armor, but mainly for battle. This piece was made in the later Maximilian years but still held many of the original design aspects of the style, including the elaborate etching, roping, and the flanged shoulder plates. This suit would have been used for some tournament play, but mainly for battle, as it only has a few attachment points and other tilt specific features.

The armor previously mentioned (Obj # 2014.1164) is one of the iterations of armor that would have been used specially for the tilt. The helmet is bolted directly to the cuirass, there is a pauldron to protect the arm just above the lance, and there are many holes around the suit to fasten additional shields or other attachments. One advancement that is also viewable on this armor is the lance rest with both a lock in front of the arm and a plate in the back to help the combatant to properly couch the weapon and maintain accuracy. The lower half of the armor was also generally

[93] Riggs (1915) p 65

ignored for tournaments simply because hitting there were simply against the rules or, in the case of jousting, there was a physical barrier that prevented the blows.[94]

Around the time of the mid-sixteenth century, the beautiful and artistic suits of armor evolved a more decorative and decadent form called parade armor. Plates lost their strengthening ridges and were of poorer workmanship and metal. Superficial traceries, etchings, stamps, and gilded metals began to ornament the armor more and more, leading the goldsmiths and other artisans to do more work than the actual armorers.[95] All the while, plate armor for battle became thicker and heavier to combat the growing threat firearms posed on the battlefield. The workmanship of leg armor, specifically, became so bad or so heavy that it was generally discarded from most suits of armor leading to the half suit.[96]

Obj # 2014.1161

Infantrymen also received plate armor during this time period. Specifically, pikemen began wearing many variations of richly etched cabasset helmets and were defended by cuirasses and a few other pieces of armor, all of which had become thicker than prior armors to be bullet-proof.[97]

The half armor period at the turn of the seventeenth century saw the eradication of most plate armor. Complete suits of armor were rarely worn and viewed as disadvantageous in terms of discomfort afforded for protection. Armor also lost its interest as an object of art since it became valued for its weight in metal to stop a bullet.[98] Many 17th armors

[94] Riggs (1915) p 65
[95] Riggs (1915) p 70
[96] Riggs (1915) p 70
[97] Ashdown (1967) p 304
[98] Riggs (1915) p 95

were made of wrought iron and were significantly less strong.[99] The suit to the right (Obj # 2014.1161) was made for an early cuirassier, a cavalry trooper who usually had both a sword and two saddle holstered pistols, but the suit weighed about thirty pounds more than a full suit of armor from the early sixteenth century and just wasn't practical. Armor for the general infantryman had been greatly reduced, either to just a helmet or none at all.[100] The age of plate armor was brought to a close due to technological advances of firearms, but armor still held a very important role in a warrior's life beyond the widespread use of firearms.

[99] Pfaffenbichler (1992) p 65
[100] Ashdown (1967) p 319

European Armor: Rise of Firearms (1550) to Present

The technological developments in the area of firearms spurred on the rapid retirement of plate armor on the battlefield. The rich history of plate armor stretching back as far to the 12th century was eradicated in a mere hundred years. The knight and other similarly armored troops were the pinnacle of the battlefields with nearly impervious armor, deadly weapons, and years of training, but the firearm allowed for untrained soldiers to efficiently kill much tougher opponents, including knights in full plate armor, making the gun the most effective weapon on the battlefield in the late 1500s.[101]

Obj # 2014.116

Present in Europe since around the 14th century, firearms had been present but not used often until improvements on gunpowder and rifling. Dating as far back as the mid-16th century, firearms had been regarded as the most powerful weapon on the battlefield. A process known as proofing was used by armorers to authenticate the protective qualities of their armor from common weapons of the time.[102] Around the 1550s, armor of proof, such as the shield to the right (Obj # 2014.116) were beginning to be used with firearms. Armorers succeeded in producing bulletproof plates, as evidenced by musket shot dents in many plates, but at a cost of severely increased weight and lower craftsmanship.

In the 17th century, wrought iron was being used for armor production. Unlike steel, wrought iron could not achieve its toughness through hardening and was simply made thicker to

[101] Blair (1959) p 143
[102] Pfaffenbichler (1992) p 64

bring the piece to proof. Thicker plates meant much more weight and a decreased desire to wear the armor.[103]

On the battlefield, the benefits of protection were outweighed by the drawbacks of physical exhaustion, lack of mobility, and general discomfort felt by the wearer. As such, full suits were worn only by the most conservative. Most troops wore either 3/4 or half armor which both took unnecessary pieces off the suit. 3/4 armor protected the wearer to the knee and was worn by heavy cavalry, such as a cuirassier. Half armor protected the wearer down to the waist and was worn mostly by either light cavalry or infantry, such as pikemen.[104]

Obj # 2014.1093

Pikemen of the 17th century wore an open helmet called a morion or a pot with a distinctive crest and curving brim as well as a cuirass and a padded cloth armor known as a buff coat.[4] The morion, such as the one to the left (Obj # 2014.1093) are associated with the Spanish conquistadors but were used throughout Europe as common infantry helmets. Pikemen were used as protective units for less armored troops, such as musketeers who wore a morion or other similar helmet and simple fabric armors similar to a buff coat. Infantry continued to wear just fabrics until the present day when modern ballistics vests became widespread.

Obj # 2014.1161

[103] Pfaffenbichler (1992) p 65
[104] Blair (1959) p 144

The cuirassier was a heavy cavalry unit of the early 17th century who wielded saddle-holstered pistols, a sword, and a variant of a war hammer. The armor to the right (Obj # 2014.1161) was typically what was worn and weighed a little over 72 pounds, 30 pounds over a typical Maximillian era full suit of armor. The armor's weight proved to be too much for heavy cavalry as well, leading to the 18th century carabinier.

Obj # 2014.90

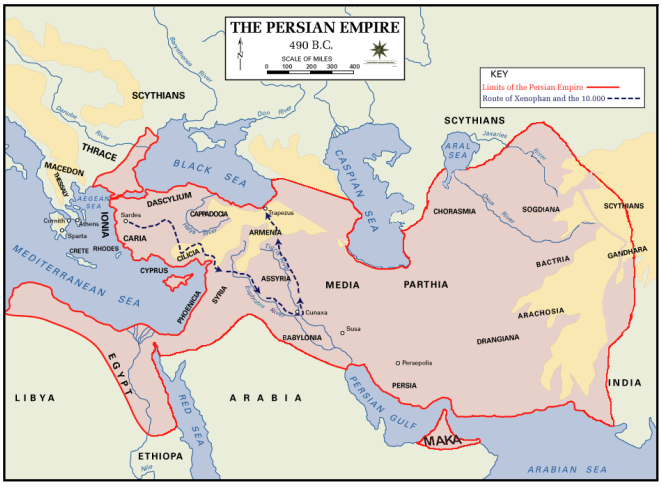
The carabinier was the cavalry for the French in the 18th to the end of the 19th century. They wore an ornate cuirass and a morion like helmet with feather plumes. The suit (Obj # 2014.90) is an example of what a carabinier would have worn.

By the mid-19th century, armor had largely gone out of use in battle. The gun and cannon had rendered armor obsolete with soldiers vying for mobility over superior protection. However, plate armor did not simply discontinue. In World War I while nearly all soldiers wore metal helmets, some troops wore a cuirass but were quickly discarded with due to trench warfare. The helmet quickly became standard military equipment for militaries all around the world. As part of the development of the modern helmet, John Higgins, the creator of the collection, helped create prototypes to protect soldiers based off of medieval design such as the helmet to the right (Obj # 2014.2). The Swiss Guard in Vatican City also wear some pieces of plate armor including morions as well as the occasional cuirass. Armor is also worn for ceremonial purposes in modern times. Plate armor has moved from a protective function to a showcasing and display function such as the collection located at the Worcester Art Museum.

Obj # 2014.2

Persia

The Persian Empire was one of the first empires in the world. A very powerful influence to the medieval world, being the first to control all governments of the known world. The empire stretched from India all the way to the Nile River in Egypt, even covering some of Europe. During the rule of King Darius of Persia, the first human rights charter was written, allowing people to have freedom of religion, to not be discriminated upon. These human rights were not accepted in most of the known world. In the Persian Empire a religion called Zoroastrianism. Zoroastrianism is monotheistic, believing an eternal afterlife of pleasure or torment dependent on judgment of a supreme being after death. Many modern day religions such as Islam, Judaism, and Christianity were all based off of Zoroastrianism. Persians developed a standardized system of measurement, one of the first to do this. They developed the first successful standardized coinage system, implemented a taxation system revolutionizing the economy.



Map of Persia

The Persian Empire's army was its most devastating feature. An elite force of ten thousand men, plus their horses were used in battle. This number of troops never fluctuated since every male was required to serve, each one replaceable. Boys were trained in riding, archery, hand to hand

combat, and mounted combat, so when they came of age they could be ready for war. The Persians were notorious for their disciplined well-trained army that could dominate any opposing force.

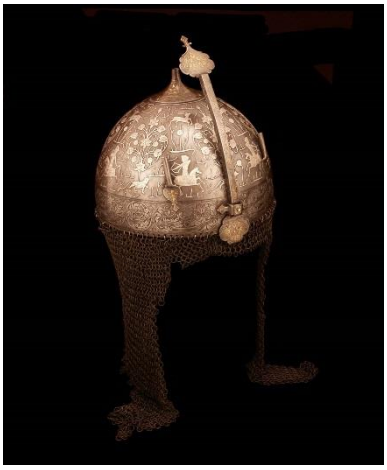
Scabbard, Persian

Persian forces had some of the strongest weapons of the era. Soldiers would carry a sword or bow, while the horse mounted cavalry also used swords. [105]The swords used by Persians were unique. They had long curved blades with one cutting edge. The back of the blade was a bit thicker and occasionally was grooved. The blades are often found with gold or designs etched into the side, dependent on the maker of the sword. Persian blades have a unique shimmer comes from the way the swords are forged. The sword had dark and light wavy bands up the blade, this was achieved by using steel ingots with a high concentration of carbon. The hilt of the blade was generally steel, although higher end swords had hilts made of ivory or bone. The scabbard was commonly leather, decorated with jewels or metal bands. Some soldiers carried bows for long range combat. The bow was based on the recurved Turkish bow, except wider, and had more of a curve. The bow would be decorated with etchings near the grip of the bow. The arrows that went along with these bows were relatively low quality. The arrows were not always straight and the fletching were low quality feathers that caused the arrows to have a

Sword, Persian

[105] Coe 1989: 76, 86, 138, 143, 144

small range and they would not fly very straight. The Persians rather relied on having several archers that shoot into a group of people, so there would be no need for high accuracy archery.



Helmet. Persian

Persians also had very well crafted armor. The cavalry and foot soldiers both had unique sets of armor. The cavalry was very heavily armored with a helmet and lamellar armor, with plate or lamellar armor for the horse. The foot soldiers wore a lighter armor, with helmet and shield. The helmets worn were a tall cone shape, with chain mail attached to the rim, the face cut out, draping onto the shoulder. [106]The cavalry's torso was covered with a large plate on the chest and back, with two thinner plates on the sides, a plate on the forearm and back of the hand, and one small plate on each shoulder. These plates were connected with chain mail, which extended to the waist and up the arm to the wrist, leaving the hand exposed. Connected to the waist was a skirt made of chainmail. The legs were covered in a plate on the front and back of the thigh, the knee, and a plate on the shin, connected with mail. Leather boots were often worn under the mail for comfort. The horse had scaled armor on each side, with an opening on the front and back so the horse can run. The horse also wore a chest plate and a plate on the face of the horse with holes cut out for the eyes. The foot soldiers wore lighter armor, a helmet similar to the cavalry, a tall cone shape, mail draped onto the shoulders, with the face cut out. [2]There is also an adjustable nose piece that can extend down to the chin, which helped defend slashing attacks to the face. The armor worn was usually lamellar

Shield, Persian

[106] Robinson 1967: 19, 23-25, 26, 33-36, 40, 41, 47

armor, similar to the cavalry, except the plates were lighter, allowing for easier movement. [107]The soldiers also carried shields. These shields were round and concave, made of steel, with leather cushioning behind the shield for comfort. The armor worn by Persians was so similar to that of The Turkish it is often difficult to differentiate the two.

[107] Robinson 1967: 19, 23-25, 26, 33-36, 40, 41, 47

Sub-Saharan

The Sub-Saharan region covers central to eastern Africa and the Congo region. This region was trade based, most of this trade due to the abundance of salt and its ease of access to the Nile River. [108]Salt was a very valuable resource that European counties and the Americas needed. This gave eastern Africa to gain lot of power over other countries. Africans also had access to soft ivory which would be used for carving. A very expensive good, with strong demand from all over the globe. These African goods would be traded for metals, weapons, and other goods. Sub-Saharan Africa also played a very important role in slave trade until the 19th century. Arab Muslims would raid African villages and sell the people captured into slavery. The slaves would be sold to parts of northern Africa, Asia, Europe, and eventually The Americas. Slavery turned into one of the main sources of economic growth for many Arab Muslims, and some African tribes.

Map of Africa (1813) by John Thompson

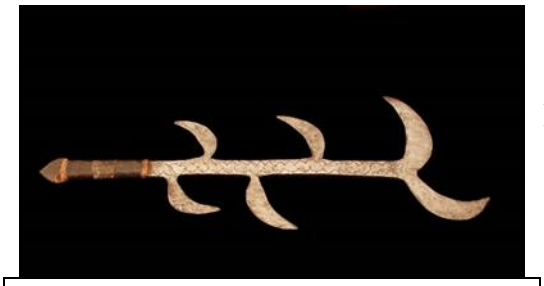
Sub-Saharan Africa was at a disadvantage during combat with Europeans. During the 19th century most Europeans were using firearms which was far superior to the swords and knives that the Africans would use. Due to trade in the area most Africans were able to get weapons or metal from Europe. Africans usually use swords and throwing knives, occasionally spears or bows, or even barehanded. These weapons were made of iron, brass or copper, found with plant material or animal parts used. African tribesmen often fought barehanded, especially in poor

[108] Beachey 1967: 269-290

regions. These tribes that fought mostly by hand had no other choice in defending themselves. The tribes were target for slave trade. The attackers would be able to overpower the defenseless Africans. The Africans started to develop a fighting style that allowed them to overcome weapons and render their attackers weaponless, which would allow the fight to be more even.

Kondo (sword), late 19th–early 20th century

[109]African blacksmiths, were thought to have supernatural powers. The blacksmiths would partake in rituals such as eating unclean animals, and prayer in order to give his weapons mystical powers. The blacksmith would use metalworking techniques found in Europe, some African Blacksmiths even mastered most difficult techniques such as wire drawing and casting. Although Africa had a limited supply of metals until European ore was imported. The weapons crafted with the "imported metal" were seen as ceremonial weapons. Africans thou did prefer using local ore because of its magical properties.



"Throwing knife", "f" group, possibly early 20th century

The spears were simple, constructed of a single piece of wood, tipped with an iron point. The bows were also very generic, a single piece of wood, with some sort of cloth fiber or plant material for the string. These bows were used with wooden arrows either sharpened or tipped with bone, rock, or metal, although the arrows did not have fletching in order to make the arrows stable in flight.

[109] Spring 1993: 204-217

Musele ("bird-headed" ceremonial knife), "circular" group, 18th century

One of the most iconic weapons found in Africa is their unique throwing knives. There are two main types of throwing knives, the "f" group or the "circular" group. The "f" group was given its name due to the resemblance to the letter "f". These knives were a long thin strip of iron, abut 30in long. Halfway up the main shaft there is a protruding blade, the top half of the blade was usually curved and widened. The grip was typically bare iron, leather straps, or wood. This knife was carried on the upper back near the shoulder. When thrown, the "f" knife would make a distinct hum through the air. Enemy soldiers would raise their shield in order to block the knife, but it was designed to up and gets the enemy with a second blow, the shield was no match for this knife. The "circular" blade group had a blade that radiated from the center point of the shaft. The blade of this knife was typically around 12in long. When a circular knife as thrown, enemies could attempt to block it with their shields, yet the knife's design allowed it to catch the edge of the shield, swing around, and hit whomever was behind the shield.

[110]The swords used by African's were influenced heavily by Europeans. The swords used varied, but mostly single edge with a blunt tip or double edged with a pointed tip. Soldiers would carry these on their hips with some sort of sheath. Swords were widely used in ceremonies, or carried by high ranking, respected men. These swords were very ornate, with intricate designs on the blade, handle, and sheath. The most ornate swords were found with the leaders, rulers, or chiefs of the region. Weapons were also used as a form of social

Shôtel (sword), 19th century

[110] Spring 1993: 204-217

status. A warrior with expensive weaponry will be seen as someone who comes from a wealthy family and therefore has power.

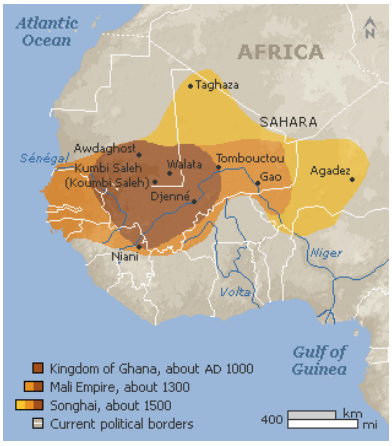
African shield, 19th century

Sub-Saharan Africans did not carry much amour with them, relying heavily on their unique fighting style. The warrior would traditionally have some sort of shield, yet they would rely heavily on their swiftness. The shields carried are very unique to the region due to their shape. The shield was large, concave, rounded on the top and bottom. The shield was large, covering two-thirds of the wielders body. [111]The shields were usually made of wicker, wood, or leather. [112]Because of its light make up the warrior was able to remain light on his feet in order to evade incoming throwing knives or other "missile" type weapons. The shield was not as rigid as shields developed elsewhere. Because it was less rigid, the shield could defend the circular blade throwing knife since it would not latch to the edge of the shield and swing around.

Sub-Saharan Africa played a huge role in trade. This trade brought steady and reliable economic growth. This growth also brought conflict with Europeans and Arab countries. Africans had to develop weapons and amour in order to defend themselves against superior weaponry.

[111] Spring 1993:204-217
[112] Hood Museum 2014: 2-7

Sudanic



Current map of Africa including Sudanic States from AD 1000 to the 16th century

[113]The Sudanic States of Western Africa were leaders of the trading industry throughout Africa for centuries. Ghana was the first wealthy kingdom of The Sudanic states. This state was founded by the Soninke people around A.D. 700. Ghana became very wealthy due to its gold availability and trade route control. Ghana Empire continued to control until the 11th century, when it lost power, soon to become the Mali Empire founded by Sundiata Keita, who was considered a hero of Mali. Mali continued to gain wealth through trade route and gold field control as Ghana did. During the 14th century Mali had one of the greatest rulers Mansa Musa who put Mali on the map by going to Mecca with gold and thousands of men. Musa brought back Islamic scholars, government officials and architects which allowed Mali to boost their educational system with libraries and universities, and introduced Islamic influence to the area. This Muslim influence of the area resulted in the religion to start practicing Islam. Later during the century when Mansa died Mali began to collapse. The Mali Empire was too large to be protected by other kings and began to collapse. Soon to be taken over by the Songhai Empire, which was once a state of Mali but then declared independence. Songhai, ruled by Sunni Ali, began taking over. The Songhai Kingdom eventually grew to be larger than the Mali Empire. When Sunni Ali died his son became ruler. Soon after a group of Muslims led by Askia Muhammad overthrew Ali's son. Askia declared the nation's religion to be Muslim and

[113] Thornton, J.k. 1999: 99-139

also emphasized studying mathematics, and sciences. The Songhai Empire became the largest trading empire in West Africa during the 15th-16th century using the Nile River as one of the main sources of trade. Then was ended by the Moroccans, with their guns, the Songhai Empire had no chance of defending themselves. The Songhai Empire then only existed as a series of military camps. This ended the Sudanic Trading Empire of Ghana, Mali, and Songhai.

The Sudanic Empire, specifically The Songhai Empire, during the 1600-1700's used iron as one of the main metals in their arsenal of weapon. Weapons from this area were heavily influenced by trade with European and Islamic countries, Weapons crafted usually had markings or style similar to what was found in those countries. Due to Arab countries being so close most influence they influenced weapon design more so than Europe did. The infantry were usually armed with some sort of smashing weapon (clubs, hammers, etc.), bows, or spears. The spears carried by the infantry doubled as a thrusting and throwing weapon. The bows that were used were often very weak, a one-piece bow with an average draw-weight of the 40 pounds. The arrow tips were iron tipped, often laced with poison from the West African plant, Strophantus hispidus. The arrows were about one foot long and they would carry approximately 50 in their quiver. The arrows used were not very accurate since they didn't have feathers so the archers would often fire as many arrows as they could, often several arrows in one shot. The cavalry, riding horseback, into battle with a sword, battle axe, or

Kaskara (sword), Sudanic Region, 19th century

Scabbard, Sudanic region; background shows example of chain mail and cloth amour

a broad blade spear. The swords carried by the cavalry were called kaskara. [114]The kaskara was usually iron forged, around 3 feet long, double edged, and a spatulate tip. The double edged sword served as a slashing edge, and the tip could be used for a blunt force attack. [115]The battle axe had an iron forged blade, sturdy enough to slash through chain mail. The broad blade spear was iron tipped, typically between 5 and 6 feet. The spear was used as a javelin for long distance or used for thrusting, sometimes the cavalry would carry several in a quiver attached to the saddle. [116]Although the Sudanic weapons seem rather low-tech during a period when Europeans had firearms, Sudanic warriors still were able to defend themselves rather well against the Europeans when they had the numbers and the proper tactics.

The Sudanic amour worn by both riders and horses were typically quilted amour. These heavy garments were generally cotton cloth filled with capok, a fluffy material from a silk cotton tree. The riders often wore iron chain amour along with the heavy quilted amour. The horses were occasionally fitted with iron breastplates. The chainmail and breast plate was most effective against slashing attacks, while the quilted amour was effective against blunt force trauma and arrows. The helmet typically worn, was several rags sometimes covered with chain mail, brass or tin.

[114] Spring, C. 1993: 204-217
[115] Hood Museum 2014 2-7
[116] Spring, C. 1993: 204-217

Turkey

The Ottoman Empire, was also known as the Turkish Empire. Ottoman were one the small Turkish states during the Mongol rule. They expanded into Eastern Anatolia, Central Europe, the Caucasus, North and East Africa, the islands in the Mediterranean, Greater Syria, Mesopotamia, and the Arabian Peninsula in the 15th, 16th, and 17th centuries. They rose to the height of their power in the 16th century. The weaponry advancements of the Ottoman Empire caused them to easily conquer their opponents. The Turks were often at war with Persia disputing borders of territories. By the end of the 17th century and early 18th century, the Ottoman Empire was in decline because of the Treaty of Karlowitz which caused The Ottoman's to lose much of their empire in Central Europe.

The Ottoman Empire used armor that was unique to its region and was some of the most advanced armor of its time. The amour worn was lamellar, made of chain mail and plate armor. The chain mail was made of short segments of metal bent into rings and interlocked with all surrounding chain links. The chain mail was used in every piece of the amour worn by Turkish warriors.

Ottoman Helmet, 16th century

[117]The helmets worn were a conical shape, coming to a point on top. The helmet was usually made of several plates laced together, the edge of the helmet had chain mail attached all around the helmet, with holes cut out for the eyes, and a piece of metal coming off the helmet covering the nose. There would also be a cloth worn on the head for comfort. The helmet was decorated, the more detailed the helmet the

[117] Robinson 1967 (55, 57, 61, 62, 64, 69, 70)

more expensive it was, showing how important or how much power the person or family had. There could be copper or silver decorations, or it will have an animal skin pattern punched into the metal.

Front of amour, Ottoman Empire, 16th century

The body armor worn was constructed similarly to the helmets. It was constructed of chain mail with plate metal attached. On the torso, plate amour was on the chest and back attached by the chain mail. There was either one large plate on back and front or it was several strips of metal attached together. The torso only went down two thirds of the arm ending with the forearms. The forearms and hands were covered with splints linked together with chain mail. [118]Below that, a skirt coming off of the torso was a lamellar amour, strips of metal linked together by chain mail. The legs were covered by a piece of metal covering the thigh, knee, and shin. The plates were held in place by chain mail and fasteners wrapped around the leg. This amour was often decorated with jewels or metal ornaments.

Horse amour (Shaffron), Ottoman Empire, 15th century

The horse amour was made in the same manner as all other amour. [1]There were several strips of metal fastened with chain mail or leather fasteners. There would be one larger piece on the horse of the nose, there were holes cut out for the eyes. The horse amour was often edged with silk or other decorative material.

[118] Robinson 1967 (55, 57, 61, 62, 64, 69, 70)

A lighter version of amour was worn in a more civilian setting. [1]This amour was a shirt made up of chain mail and covered in fabric. The fabric was on both sides of the chain mail so there was minimal discomfort while wearing. This amour was worn more day to day since it did not look like bulky, uncomfortable amour. These amours were heavy due to their all metal make-up, but it allowed the wearer to have a greater range of motion which put them a step ahead of their enemies.

The Ottoman Empire had a similar arsenal of weapons to every other empire in the region, including axes, swords and bows. They also had horse-mounted cavalry. The axes had a long shaft, with a blade on top. The grip made of wood, ivory, or metal would be riveted on. At the top of the axe a blade would come off of one side, counterbalanced with a hammer or point off the other side. The swords used by the Ottoman Empire were very similar to Persian swords. [119]The handle is a flat piece of metal with ivory, silver, or wood, sometimes even coral accenting. The blade is long and curved, weighted towards the tip which allows it to be a very useful cutting tool. The blade also had decorations such as an etching of a quote from the Koran.

Sword (Yataghan), Ottoman Empire, 19th Century

[119] Stone 1961 (79, 130, 676-677)

The scabbard used for the sword was made of wood, with leather, silver, or velvet for decoration. It was carried on the belt, either it had a small loop to attach it to the belt or it was worn in the belt. When going into battle the user would drop the scabbard. The scabbard did not need to be carried into battle, if the warrior was successful and won the battle he would be able to recover his scabbard, but if he died in battle it did not matter if he had his scabbard, he did not need it anymore. The cavalry carried a slightly altered blade. This sword was long, slightly curved and slightly broader than the sword carried by foot soldiers. [120]The blade was double edged, except, the on the back of the blade, approximately 8-10 inches from the top, starts tapering to a point. The point allowed the sword to be an effective cutting tool as well as a thrusting weapon. The hilt would have a grip of wood, horn, metal, or ivory, and would be shaped very similar to how a pistol grip would look.

Scabbard, Ottoman Empire, 19th century

Composite Bow, Ottoman Empire, 18th century

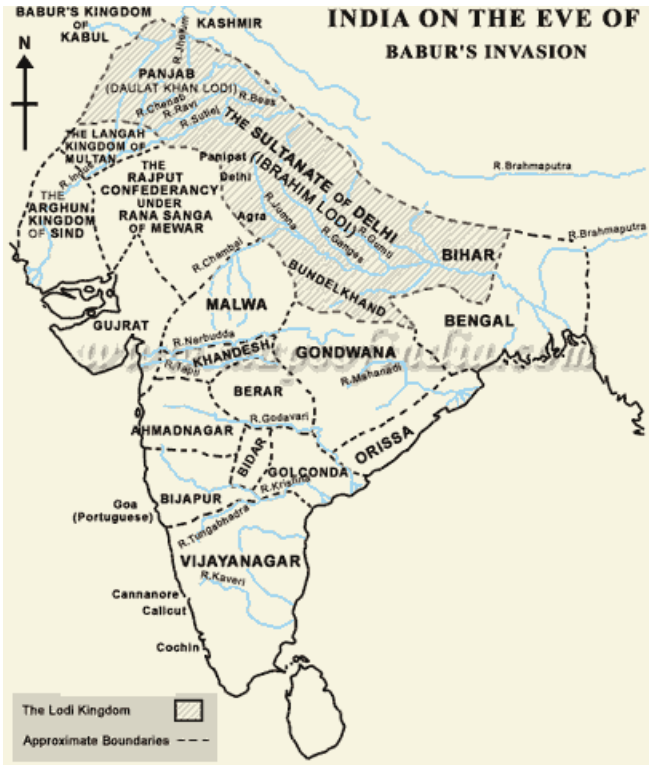
One of the most important weapons produced in the Turkish region was the bow and arrow. [121]The Turkish bow was one of the first composite bows created, a recurved bow, which allowed the archer to fire arrows with more speed with less effort. The bow was gripped to allow for comfort during use. The Ottoman Empire designed these bows to shoot very light arrows at a very high speed. These advanced weapons kept the Ottoman Empire in power for centuries.

[120] Stone 1961 (79, 130, 676-677)
[121] Stone 1961 (79, 130, 676-677)

Indian Arms and Armor

History and Influence

For many centuries, the Indians were without armor except for the shield. It was not until other cultures came either through trade or warfare that the Indian people began to adopt forms of protection above and beyond the shield. As time went on, India began its use of mail and plates, leather and fabric, and plate armor. Each iteration was adjusted in order to compensate for constant invasion. The armor designs and defensive styles drew much upon the Romans, Greeks, Persians, Turks, Egyptians, et cetera. Eventually a substantial amount of influence was delivered through trade.[122]



Map of India

One of the earliest influences came during the Greco-Roman era when Alexander the Great invaded in 327 BCE. This brought the legionary officer look to Indian warriors. This armor was of a scale sort with leather straps hanging from the shoulder and waist. This influence was strongest in north-western India.[123]

[122] Robinson, 1995: 89
[123] Robinson, 1995: 89

Persian culture had a vast influence throughout India. Indian armorers were generally trained by Persian smiths. The Persian influence translated into decorative styles with butted mail with patterns of brass and copper riveted rings. Pieces were also decorated with texts from the Qur'an. The combination of iron and brass represented the meeting of the muddy waters of the Ganges and dark waters of the Jamna rivers in north-eastern India, thus this style was called Ganga-Jamni. A different type of mail of Persian descent, incorporates sheet metal for every other ring in order to reduce wear on the armor. Armorers would typically have a section of mail covered in smoothed brass so that they could sign the piece, signifying the maker.[124]

The Sāssānid influence only affected the north-western part of the country while the other regions still held the old Indian style. For the centuries after this, there was no real development in armor on the side of the Indian people. When the invading armies of Arabs, Turks, Persians, et cetera arrived, their influences then took hold and armors were created to best defend against these new and more developed invaders. The Arab armies brought mail and the iconic conical helmet while the Turks and Persians brought their form of mail as well as lamellar armor. To the Indian armies, lamellar armor was still very advanced. Deciphering a piece of armor's origin has become more difficult. The oldest surviving pieces show their influences from Persia and the Sindh pieces, although of Arab origin, have a style which are so similar that it is hard to tell one from the other.

The oldest surviving pieces consist of mail, plates, and lamellae, and although of Indian make, reflect a direct influence of the Turks, Persians, and Egyptians. Indian plate armor is very simple with usually no more than six plates in the front of the body. The typical plate armor consists of mail and four rectangular plates in the front while the back is denser with overlapping

[124] Robinson, 1995: 98-99

plates. The examples of these armors, which still are in existence, show much wear, meaning that they were worn for great periods of time. While the main purpose of these armors is to protect the wearer during combat, time and effort were also put into the decoration. Brass or iron fretted borders are added to the lamellae adding to the decorative quality of the object. More elaborate pieces with more layers of lamellae were worn by officers rather than the common soldier.[125]

Plate and mail armor was developed more in Sindh and Kutch (north-western India). These plate armors were accompanied by helmets of similar design. The front of the helmet is flat mail with two eye holes cut out so that the wearer can see.[126]

The overall area covered by the plates is greater than before, leading away from the Turkish style which usually had more mail than plates. Used primarily for cavalry, the legs were uncovered in the back for a more comfortable riding experience. Sindhian gauntlets also differed from the Persian style in that they were more tube shaped with removable pins that latched the piece to the wearer's forearm.[127]

Armors of Persian, Sindhian, Turkish, et cetera typically had alternating lamellae plates of either brass or iron that were decorated and engraved. They were either overlaid on top of the existing armor or simply attached. Indian helmets, designed to complement these armors, were made of metal plates that were connected by mail. This way of creation paved the way for varying shapes and sizes of plates used. The diversity in helmets was mainly due to regional differences in India.

[125] Egerton, 2001: 52-53
[126] Robinson, 1995: 95
[127] Robinson, 1995: 95

Most common of all armors was the ever-present mail coat. Like that of the Sindh style the northern Indian cavalry of Deccan had armor that was primarily mail so it could be light for riding horses. The helmets were designed to match the style of the armor as a whole. A flat triangular piece of mail covered the face of the rider but did not have eye slits cut out because the mail was not lined like the rest worn, so it could be seen through. A turban was used as a liner. As a whole, the helmet was an excellent defense against a sword.[128]

Egerton, 2001: 53

Before the mass use of mail, leather was the main form of armor used. These pieces are more of Greek and Roman descent. Decorations of patterned borders and floral designs frequently appear on the armor. The most intricate forms of leather armor was the Indian cuirass. The cuirass is covered in blossom and leaf design. Underneath would be worn embroidered velvet cloth. More common was the style brought from Mongolia and Central Asia. This armor was completely cloth with multiple layers of velvet and cotton. The outermost layer too was covered in a floral pattern. The overall armor borrowed from the ideas from the styles of the Persians, Turks, and Arabs. Fastenings were made of ornate gold or silver lace buttons and loops as a decorative way to keep the armor together.

Another common form was a velvet and leather armor that included large plates on the front and back. The difference from other plated armors was that there was no mail between the

[128] Robinson, 1995: 97

plates. Looking back at the origins of the Indian defensive style, this was a vast difference in protection. The suit included a helmet, vambraces, high protected boots, and hand guards. This style is primarily from the Rajputana in central-southern India. The Gujarat region became the Rajputana region during the Muslim period during the 11th century. The style again emerged from Persian style. This defense became common, being worn by many soldiers of India as well as around central Asia.

In Hindu India, leather or velvet covered in scales was also very common.[129] Like many other armors, scale armor had Turkish, Mongolian, and Arab origin. The scales were made of metal, leather, or horn. The helmets for these suits also were scaled in a similar fashion. Many helmets used by the Indians had plumes of feathers sticking out from the top. Surviving examples have two to three plumes.

Later in history, around the 17th century, India was more influenced by trade rather than invasion. The first European influence came from Portugal and the Netherlands before the English and French began their trade. Nonetheless, the more common versions of plate armor are those of Indo-Persian style.

Full suits of armor of the Indo-Persian design began with the Mughal Empire beginning in the middle of the 16th century and continued through the 18th century. Plate armor suits spread throughout the north-west to the Deccan. Some of the earliest Persian style helmets are intricately decorated. The pieces had Qur'anic inscriptions with a long nasal guard with leaf-shaped ends. However most armor did not have decorative inscriptions and if they were included they would be

[129] Robinson, 1995: 99

seen on the nasal of a helmet or a small part of armor. Helmets of the same time period were covered in floral chiseling and false damascene.[130]

Armor of India was rarely ornamented with true damascene. Persian works and Indian arms generally were decorated with gold hammered into the patterns cut into the metal. Gold koftgari, which was wire, was hammered into small cuts made in the pieces. The damascene style usually was made into patterns of leaves, petals, and other floral designs.

[130] Robinson, 1995: 108

Helmet

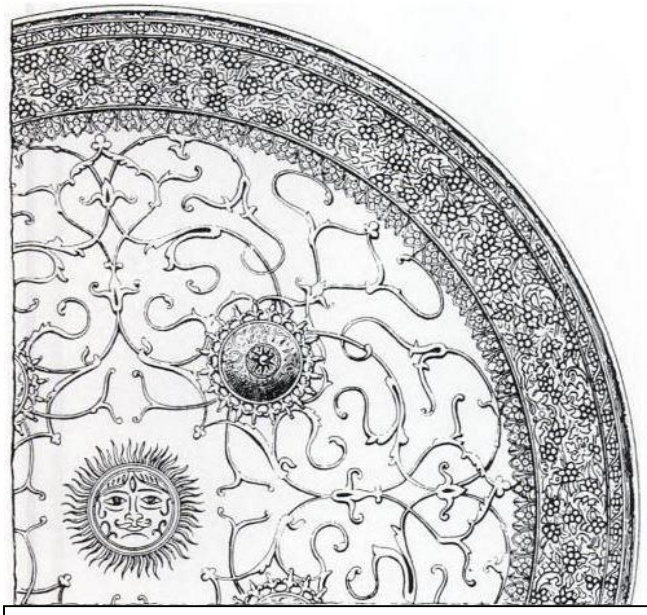
2014.71 Persian Helmet

With the plate armor from Portugal came new and improved helmets of a similar Portuguese style. The helmets consisted of a metal bowl shaped structure either coming to a point or shaped like a turban. At the front of the helmet sits a large nasal guard that, like the two parts of the breast plate, was usually hinged onto the helmet. The Russian helmet in the museum is very similar to the Indian style of helmets because the early Russians too drew from the Persian design after their invasion of Russia. The attached nasal was common throughout all of India, very large nose pieces were more common in southern India. Soldiers with Persian style helmets generally did not have a fastening for the nasal in the lower guarding position but did have a hook or pin for the raised position.[131]

The Persian helmet too is similar in design to the Indian helmet with mail hanging around the sides. The mail used usually consisted of brass rings or a brass and copper combination. Soldiers wore coats of mail similar to that of the helmet. Oval helmets were worn by the Sikhs in India in order to house hair in a bun. These helmets too had mail, an attached nasal, and plume tubes.[132]

[131] Robinson, 1995: 105
[132] Pant, 1978: 48

Shield



Egerton, 2001: 49

The oldest form of defense used in India, as mentioned, was the shield. The original shields were very simple in design. They were shaped like a rectangle with a curved top. Circular shields too were very common in the less advanced sections of India. These were of leather and created from buffalo or rhinoceros hide. These hides were the primary shield material until the 17th century. Rhinoceros hide was the most sought after hide because of its strength and durability. The surface of the shield was occasionally left to look like the hides that they were crafted from but most were decorated in one way or another. Those of Sindh and Deccan are some of the most beautiful, covered in the stereotypical floral design.

Shields were made to be light, with some very rare exceptions. Smaller shields were created for cavalry in the shape of a bell. In northern and central India, small fist-shields were used for parrying blows. The shield had horns on it and in some instances blades were attached for the same purpose. Later on during the later Mughal Empire, steel shields were introduced.

Another form of shield used were parrying shields. They were small and round with had two blades sticking out of two ends. This form of shield was used for quickly blocking as well as jabbing at opponents. This combined with short swords were pretty effective in close quarters.[133] This shield was called a madu or maru.[134]

Egerton, 2001: 27

[133] Pant, 1978: 89
[134] Robinson, 1995: 115

Arms

When looking at the Worcester Art Museum collection, there is a distinct form of weapon from India in the Knights! exhibit. The Indian pata or gauntlet sword has a very distinct design. The pata was created during the Mughal Empire starting in the late 16th century. The earliest patas were more basic.[135] On either side of the forearm were splints connected with hinges and mail. Attached on the right hand side was a curved blade. As time went on, patas were created with a gauntlet. The 17th to 18th century pata in the exhibit consists of the gauntlet defense with a decorated and damascene gold finish. The 16th to 17th century pata is of more conservative design with a knuckle guard that does not extend all of the way down the forearm. Both versions are very common weapons. The double-edged blades used were broader at the fist, almost being the width of the wearers knuckles and then become more slender as the blade comes down to a fine tip.

The pata was used either in conjunction with a second pata (one in each hand) or with another weapon such as a spear or axe. The thrusting ability provided by wearing the weapon provided soldiers a strong offense against cavalry. When properly trained in its use, a warrior wielding a pata could do significant damage to his adversaries.[136]

From collections all around the world, patas from southern India are common. The artwork is very intricate with chiefly animal engravings or embossments. The likeness of an elephant with the trunk as the blade are common. The gauntlets themselves are of Indian make but the blades attached were seldom of the same origin. European blades were sought after due to their strength and double-edged cutting abilities. The pata on display in the museum is an example of a European blade being utilized.

[135] Stone, 1999: 484-485
[136] Rawson, 1969: 46

The Indian punch-dagger in the museum, also known as a katar, is one that is very characteristic of India.[137] This weapon is unique to Southern Asia, primarily to India. The renown of this weapon is close to that of the katana in Japan. Nobles and elite warriors were known to have one of these daggers at their side. Before the 17th century, katars were made in a similar way to the pata in that there was a guard placed above the hand to protect the wearer but as seen but later versions that guard was removed. The blades were often made from broken swords or purchased or traded from the Europeans. Indian sculptures of warriors often have a katar at the waist of the figure. The katar was a prized possession for those who wielded one. Not only were katars used by warriors but also during ritual worship.

2014.34 Jamadhar (katar) 18th century

[137] Elgood, 2004: 145

Art

When people think of arms and armor they focus more on the history of the pieces. When looking at the pieces in the Worcester Art Museum for a better understanding of other pieces, one needs to include the art aspect as well. Styles changed slowly in India. These changes mainly were caused by foreign influences. After the dark ages came the Mughal Empire. Most decorative pieces from India are from the time period after the Mughal emperors took power. As seen through the Indian cuirass, the Greeks had a large influence in north-west India. Not only did their influence spread into the armor of India but also temples and sculptures from Bengal.

The various patterns vary slightly throughout India. In some cases it is very hard to decipher the differences and decide where the pieces came from. Some designs are better indicators than others. The floral design was not the only one that could be seen. Animals and men were also frequent patterns added to pieces. In the north, more effort was put into these figures to make them appear as life-like as possible while in the south the figures are more rudimentary and conventional.[138]

Shields were perfect media for large decorations. Steel shields could be damascened with gold for depictions of tigers, trees, lizards, et cetera. The sun and moon are rooted deep in Indian tradition. Each is a representation of ascendance. The Persians are of the sun and the Mughals are of the moon. Such distinctions also help an observer deduce the part of India from which the piece originates.

[138] Egerton, 2001: 47

Worcester Art Museum Collection

2014.42.1 Breastplate to Baktar 17th to 18th century

The breastplate cuirass from the 17th to 18th century in the Worcester Art Museum collection is of the European style, mainly like that of the Greek bronze cuirass from 3rd century BCE. Breastplates in Europe during the 3rd century had either a flat front with a slight curved upper part or distinct breast muscle embossments. They also have a flange at the waist or thicker rounded edges for the neck. Being of Indian make, the cuirass at the Worcester Art Museum does not have these different edges and has the distinct breast muscle on the front as well as trapezius muscles in the back. The entire piece has a front as well as back plate that hinge together. The piece does not have a lot in the way of ornamentation but other versions can be found that contain a more elaborate design of floral or leaf-like engraving.[139]

2014.33 Pata late 16th century to 17th century

There are various forms of the pata in the collection. The one in the picture to the left is of a simpler design from the late 16th century to the early 17th century. The blade is of European make as was the custom with later patas. Rather than the entire forearm being

[139] Robinson, 1995: 106

encased in the weapon, the pata has splint-like pieces of metal on either side of the hand and a curved piece of metal covering the back of wearer's hand. This was used in the same way as the more elaborate patas but used a more conservative design. The two cross bars below the covering of the back of the hand were where the user gripped the gauntlet.

2014.60 Zulfiqar 1600s

Another notable weapon in the exhibit is the Zulfiqar sword with the split blade at the end. The end of this blade is a saw-tooth design. The sword has a single edged blade with gold floral design and golden calligraphy. This sword is a sword given by the archangel Gabriel to Mohamed.[140] The Zulfiqar is purely a ceremonial and religious weapon. The hilt of the sword is of the Hindu basket style.[141] [142] The hilt has a knuckle guard and a thin pommel at the bottom.[143]

2014.29 Nandaka, Sword of Vishnu 17th century

The sword of the god Vishnu the Preserver, called Nandaka, is a famous and historical sword. Swords like this come from south-west India and are of strong religious importance. This

[140] Stone, 1999: 685
[141] Rawson, 1969: 37
[142] Stone, 1999: 352
[143] Paul, 2005: 62

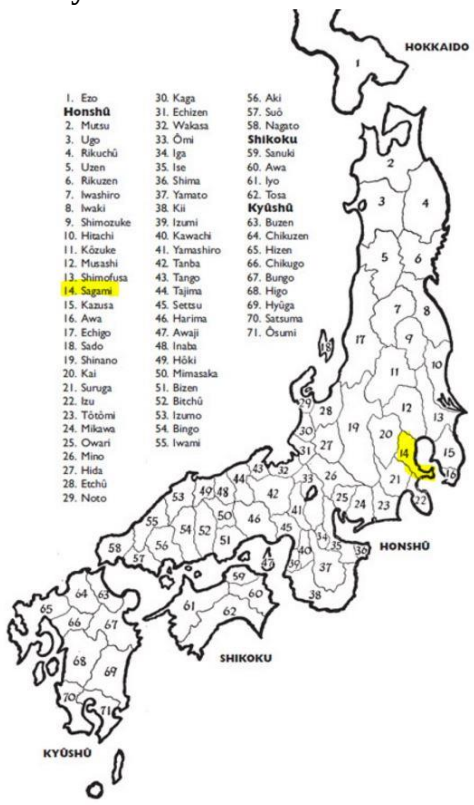
sword was for ritual. The sword is of the Vigayanagara empire style of around 1012.[144] This style has emphasis on changing direction in a blade with strong marked angles. This is more for display over function. Nayar temple swords are of the same style as the Nandaka. The hilt is of the Indo-Muslim style with a bent disk as the hand guard and cupped disk for the pommel.[145]

[144] Elgood, 2004: 79
[145] Paul, 2005: 24-25

Japanese Weaponry

Ancient Japan generally brings to mind the samurai and a samurai's weapon of choice, the katana. The samurai class arose during the Heian Period between 794 CE to 1191 CE. It is believed that the first katana was made by famous sword smith Amakuni Yasutsuna around 700 CE. Legend has it that he and his son were asked to create a sword that would be unbeatable in battle and when an attempt failed, he made it his mission to create the best sword possible. This unbreakable and deadly weapon was the katana.

History



Map of Japanese Provinces, Yumoto, 2008: 22

Centuries after the first emperor came to power in Japan around 284 BCE, the art of sword making came from Korea and China. These smiths did not create katana style swords but rather straight swords. The transition from straight to katana took a long period of time. During the Nara period, 650 to 793 CE, swords still were still being developed but did not show much progress until a military needed to be formed and armed. With the various changes in power of the clans led to the rise of samurai clans. Communications with China began to end because Japan no longer felt the need to rely on another country. In the late 8th century, samurai sword making was most successful and abundant. The Mongol invasion between 1274 and 1281 brought the need for more swords to be manufactured. A school of smiths

was created in the Sagami Province which is where the sword making craft was perfected.[146] Over time, other schools were created and each held their own secrets.

Even later the Sengoku Period of 1467 to 1574 warranted the production of more swords. Wars raged between the poorly organized governments to try and put power in the hand of one clan. Invasion attempts into China and Korea occurred twice under Emperor Toyotomi Hideyoshi, in 1592 and then again in 1597. Although the invasions failed, soldiers needed to be armed and thus sword making flourished. During the Tokugawa period, 1603 to 1867, Japan shut out the rest of the world and kept to themselves. This resulted in a class system and a strong sense of strengthening culture and the art of sword making. Shortly after this period, swords were prohibited from being worn as Japan began to adopt the way of life as introduced by the western part of the world.[147]

[146] Yumoto, 2008: 24
[147] Yumoto, 2008: 26

Common Weapons

When landowners began to gain power and replace the central government, samurai were hired to fight and protect the provinces for the landowners. With the rise in numbers of samurai also came an increase in warfare between landowners. Mounted warriors were the norm and the bow was the weapon of choice until the end of the Kamakura period in 1333.[148] At this time, foot soldiers were growing more common. Mounted warriors were still used in battle and were used to combat the threat of foot soldiers.

In addition to the bow, mounted warriors also had a four foot long sword called a tachi.[149] This weapon was similar in construction to the katana with a curved blade, tsuba, et cetera. A longer blade was needed in order to reach men on the ground or even other mounted warriors. With the fighting on the ground beginning in the early fourteenth century, the long tachi was not ideal so the katana became very useful.[150] A close quarter situation was better handled with a shorter blade than a longer one. For defense against horses, warriors frequently used naginatas, which were long spears with blades curved even more than those of the katana or tachi.[151] The thrusting abilities and reach of a naginata allowed for better defense as well as offense for a warrior on foot.

Paired with a katana, samurai had the right to also carry a shorter sword called a wakizashi.[152] Together, these weapons sat in a samurai's sash at the waist. Although this right was

[148] Ogawa, 2012: 21-23
[149] Yumoto, 2008: 24
[150] Robinson, 1995: 186
[151] Ogawa, 2012: 34
[152] Ogawa, 2012: 44

permitted to samurai, those who held some status were allowed to carry a wakizashi as well but without a katana.

Parts of the Katana

The sword is made of various parts that as a whole make the katana complete. First and foremost is the blade itself. The blade is a one-edged cutting surface optimized for swinging. The lower part of the blade is called the tang and this is where a smith marks his name, the date, the location of forging, the owner of the sword, et cetera. Looking at a sword's tang is the best way of identifying the origin and some history behind the weapon.[153] To protect the user's hand, a hand guard or tsuba is added made of steel, copper, silver, et cetera. Each tsuba is designed specifically to each sword. If a sword is themed, like the wakizashi in the Worcester Art Museum, one can see the theme throughout multiple parts of the sword. A spacer is placed between the tsuba and the blade called a habaki which can be plain, like on the museum's katana, or more ornamented, like on the wakizashi.

The handle of the Japanese sword is of generally the same thickness throughout and made of wood. The wood is wrapped in skins or taped with cloth cords. Wrapped within the cords is a menuki or hilt ornament. Like the tsuba, the menuki was custom to the sword as well as the owner of the sword. Finally on the bottom of the handle sits the kashira or pommel. The design of the kashira too matches that of the tsuba and menuki.

[153] Yumoto, 2008: 74

Making

The making of the katana is a very fine art perfected over many years. When Japan fought constant civil wars, the sword was worn constantly and became a part of the warrior's daily attire.[154] Around 900, excellent samurai swords were created and little has changed since then with the style. The iconic katana can be found in the museum as seen in the picture.

2014.40 Suishinshi School Katana, late 1700s-early

The location of a forge was determined by amount of ore needed, charcoal for forging, water supply, and the climate of the area.[155] The blade was made from steel forged from iron ore or iron sand. A smith would fold and hammer the hot metal many times in order to create the strongest piece possible. When folding the metal, the smith would make sure that no dirt or other impurities were present in order to prevent the blade from breaking in battle. The grain of the blade refers to the pattern created during the many folds, typically six to fifteen times. The goal was to get the carbon content to 0.6-0.8 percent which is a high-carbon steel.[156] These grains are seen on the lower half of the blade and can display various patterns such as wood or curved lines. The katana in the exhibit has a plain pattern which shows no grain. These patterns do not show right away during forging but appear after the blade is finely polished by a professional polisher.[157] No

[154] Yumoto, 2008: 25
[155] Yumoto, 2008: 30-31
[156] Ogawa, 2010: 30
[157] Ogawa, 2010: 31

grain is very common with the time period in which the Suishinshi katana was created, 1530 to 1868 or New Sword period.

During blade forging, many other variables were taken into account. If a sword was too sharp, it would break going against armor and if the steel used was too soft, it would bend.[158] In the early days of forging, smiths would gather and forge the ores used on their own. This would yield stronger blades because the smiths would invest time in refining the ores to the perfect consistency. This process took much time of course, but time was traded for strength and durability. Around 1450, steel was produced in large quantities through the use of steel mills. Although this hastened the process of getting the precious ores needed, this time period led to a decline in sword quality. Then after 1600, imported steels were used for blade production.

After the process of folding is complete, the smith would cover the blade in a clay and charcoal mixture which is then baked into the blade and then quenched after reaching a proper temperature.[159] The coating was used to control the quenching process. The removal of this layer yields a pattern on the edge of the blade.

Many processes are used in the time a katana is created. Each process is completed by a different person. One to two men would create the blade. Separate artisans would be responsible for the crafting of the tsuba once the blade was finished, creating the kashira, creating the menuki, and yet another would be responsible for polishing the blade to its final luster. Together each craftsman would help create a perfected and useful weapon.

[158] Yumoto, 2008: 99
[159] Yumoto, 2008: 100-101

Arms in the Worcester Collection

The Worcester Art Museum holds a large collection of tsuba. This is a significant collection because it contains a variety of styles not only within the individual tsubas but also including those on the katana and wakizashi. Historically and artistically speaking, the museum has a lot to offer.

2014.103 possibly Owari School tsuba mid 1500s-early 1600s

2014.107 Nanban School tsuba 1700s

Some pieces are very plain and contain nothing more than geometric patterns like on the tsuba on the left. Others have more intricate designs like dragons breathing fire as seen on the tsuba on the right.

The tsubas in the collection come a variety of time periods, smith schools, locations, et cetera. The left tsuba is possibly from the Owari School which was located in the Owari Province of Japan. The other was created in Nanban School which developed from a period of art in Japan during the Edo period of 1603 to 1867. Other tsubas in the collection come from the same time period and art movement.

2014.62 Osafune, Norimitsu Wakizashi
Muromachi Period (1392-1573)

The wakizashi in the exhibit is a well preserved example of the Japanese short sword that was worn in addition to the katana. The weapon was shorter than the katana and measures around two feet in length. The wakizashi has a floral pattern designed into the tsuba and kashira. The flowers are white and seem to be representative of the cherry blossom. The menuki is in the likeness of flowers and leaves to match the other parts. The habaki is inlaid with jewels to add to the elegance of the entire piece. The floral designs presented are not engraved into each respective component but rather are laid atop the parts. The time and delicate manner in which these patterns must have been added are admirable.

The last piece currently on display is the katana. The katana has a geometric pattern which is simpler than that of the floral style of the wakizashi. The menuki is a bird resting on what looks like a pumpkin or other gourd type vegetable. The habaki and tsuba are both plain metal without any design. The top ridge of the blade is low backed which means that the top comes to a shallow point compared to a higher point, rounded, flat, et cetera. The curvature is also a more shallow curvature and the tip is a medium curved edge or fukura-tsuku. The temper lines at the cutting edge, created by the clay mixture, are a large circle pattern towards the tip meaning that it covers the tip and doubles back at the top part of the blade.[160]

[160] Yumoto, 2008: 57

The school from which the katana originates was located in the Musashi Province created by Suishinshi Masahide during the New Sword period beginning in 1750.[161] He perfected his art by studying the old masters. His work resulted in spreading the knowledge of ancient methods used in sword crafting.[162]

[161] Yumoto, 2008: 100
[162] Ogawa, 2010: 186

Japanese Armor

History

2002.189 Yukimori: Faith in the Third Day Moon 1886

For many years after the Japanese empire was created around 284 BCE until the influence of the west came in 1542 CE, Japanese armor held to its Chinese and Korean roots and did not take much influence from other countries. This was true up through the 5th century. During this time, lamellar armor was introduced and was the main form of armor until armor was no longer worn. Style varied throughout the centuries but the same lamellar look was maintained until stronger armor was needed due to the introduction of guns by the Portuguese in 1542.[163] Even after this time, the Japanese still maintained the style of armor that is distinctively Japanese.

Right after the first emperor in 284 BCE, warriors were those hired by the Japanese government for the military. These warriors were loyal servants to the emperor and were given land for defending Japan. Gradually a warrior class came into existence which was connected to the provinces and the governors of those provinces rather than the central government.[164] From there, the provinces and clans gained power. The private estates eventually gained enough power

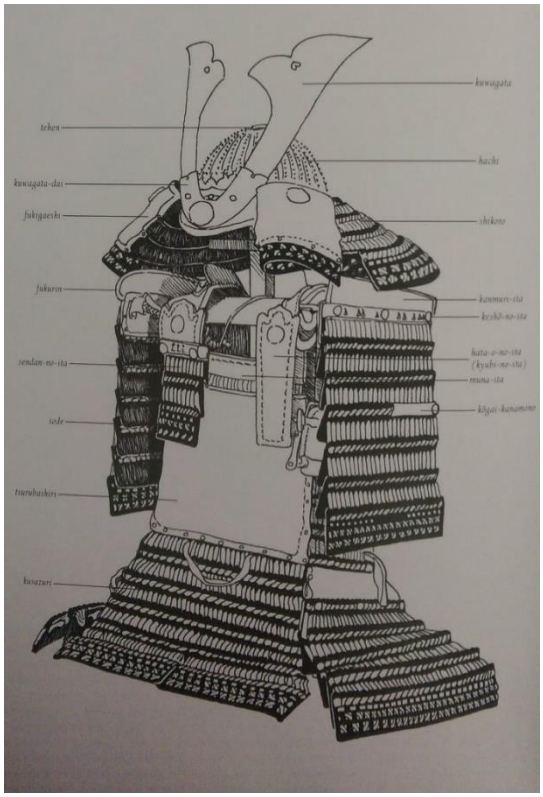
[163] Robinson, 1995: 191
[164] Ogawa, 2010: 31

to control the lands rather than the central government itself. With this new control came privatized armies made up of samurai.[165]

[165] Ogawa, 2012: 32

Armor

The basic form of Japanese armor consisted mostly of lamellar plates of iron covered in leather. This was the case up until the introduction of guns as previously mentioned. During that time, large iron plates were substituted for the typical lamellar. The lamellar style of armor was called keikō which was a more flexible armor. This armor varied slightly over time in make but continued to have the same layered protection.[166] A typical suit of armor was made up of over one thousand lamellar plates. Due to the division into various sections, multiple craftsmen worked together to complete the entire piece. The lead craftsman who was in charge of putting everything together was called the katchū-shi.[167]



Ogawa, 2010: 310

In order to protect the armor from wear as well as from water, the layers were lacquered to seal the armor. Water exposure would cause the leather to soften and weaken the armor.[168] The lacquer also covered up any imperfections in the armor.

The plates that made up the armor, sane, were tied together with lacing called odoshi. Odoshi came in a variety of colors and were not limited to one color per set of armor either.[169] Around 1467 when plate armor was introduced, the same lacing style was still used to attach pieces

[166] Ogawa, 2010: 37
[167] Ogawa, 2010: 42
[168] Robinson, 1995: 173
[169] Ogawa, 2010: 41-42

together. This method did not last very long though because the amounts of holes that were needed to lace the pieces together were a source of weakness.[170] Leather was the primary material used for lacing sane together but around the 14th century, silk braids started to be favored for their richness.[171]

After armor became obsolete with peace and the introduction of firearms, wearing of armor became more of a status symbol than protection. The wealth that went into the armor was a direct representation of the owner's importance.[172] Rich colors were used for the purpose of showing this status. For example, the color purple was used to represent men of rank. The only issue with colored silk was that the dyes quicken the rate at which the silk rotted. As for crests and clan seals, they were printed on the chest plate, shown in crests on helmets, or even attached as flags, sashimono, on bamboo shafts. The shafts were then attached the back of the wearer's armor with the use of brackets. The flag would either bear the badge of the wearer or that of his lord.[173]

In addition to the cuirass or dō, shoulder guards as well as leg guards were worn. The shoulder guards were of large lamellar construction but grew smaller when lighter and smaller armor was wanted. A capping plate was added at the top of the shoulder guard in order to prevent the shoulder guard from striking the wearer's neck.[174] The leg protection was a skirt style of four sections. The sections covered the front, back, right, and left sides of the wearer. It was good protection for the upper thigh of a rider on horseback.[175] Thigh protection was not introduced until

[170] Robinson, 1995:190
[171] Robinson, 1995: 182
[172] Bottomley, 2002: 19
[173] Robinson, 1995: 198
[174] Robinson, 1995: 178
[175] Robinson, 1995: 183

the second half of the 13th century.[176] Similar skirts were worn by foot soldiers but theirs were lighter and a little smaller to allow for better and swifter motion.

[176] Robinson, 1995: 181

Helmet

2014.694 Helmet late 18th century to early 19th century

Before the Nara period in 646, helmets were of simple construction. The design was a direct influence from those of China. The helmet consisted of horizontal rings riveted together to form a bowl shape. Around the back of the neck was a flat neck guard made of lamellar plates similar to those used in the dō. The early Heian period of 794 brought about a distinct Japanese flair to the Chinese version. The bowl shape was still used but was strengthened by the use of vertical plates surrounded by horizontal plates riveted in place.

The neck guard of these helmets consisted of five curved laminations that curved out on either side of the face called the fukigaeshi. This was to protect the wearer from sword or arrow attacks.[177] A hole was put in the top of the helmet called a tehen no ana, which was added so that the wearer could put his hair through the top.[178] This allowed for a snugger fit of the helmet for the wearer. As time went on, warriors started to wear their hair differently, resulting in less use of the tehen no ana. As the evolution of helmets progressed, the hole was slowly made smaller until it was just decoration rather than something of practical use.

[177] Robinson, 1995: 177
[178] Ogawa. 2010: 37

Although the fukigaeshi was intended to protect the wearer's face, other means of protection were used by samurai. A face mask called men gu, was made of lacquered iron. Two types of masks were the mempo and hoate; a nose piece was used with the former and not used with the latter. Those with a nose piece generally had the ability to remove the nose section through the use of turn buttons. The reason to remove the nose was to allow for better vision by the wearer. Some men gu existed that covered the wearer's entire face with one solid mask called so men. These were very uncommon though because the wearer could not see clearly.[179] The average warrior only wore a solid chin piece called a hambo. Its main goal was to tie the helmet to the chin more tightly as well as add a little protection.[180]

1910.47.3 Do-Maru Gusoku early-mid 18th

Another use of the men gu was intimidation. A full mempo would be intended to intimidate the wearer's enemies. Various facial expressions were used depending on the owner. Some were calm meditative faces while others were more aggressive with bared teeth. The aggressive form often was accompanied by facial hair added from either yak or boar hair. Most surviving pieces are more demonstrations of the craftsman's skills rather than practicality.

The most distinctive part of the samurai's helmet is the crest called maedate. These maedate were more personal devices. Although many were simply suns or half-moons as seen in the first picture, many were very elaborate and were made into the likeness of beasts, demons, antlers, et

[179] Bottomley, 2002: 17
[180] Robinson, 1995: 193

cetera.[181] They were made of lacquered wood or simple silhouettes of metal which allowed for the designs to be more elaborate.[182] The original maedate were simple horn patterns or demons on the front but as smiths' skill increased, so did the complexity of the piece.

[181] Robinson, 1995, 199
[182] Bottomley, 2002: 17

Foot Soldiers

Until the 10th century, battles were generally fought on foot.[183] Foot soldiers wore a variation of keikō called haramaki. This form was smaller and lighter which allowed for quicker movement. The use of the four foot long tachi sword was switched to the use of the shorter katana for easier movement in close combat. The haramaki also needed to allow the warrior to move easily in close quarters. Reduction in weight was very important to the samurai, thus neck guards were made to be closer fitting to the neck, shoulder guards were made smaller close fitting protection on the upper sleeve, and lamellar plates were made smaller.[184] The smaller sane resulted in a need for more used to optimize protection but a lighter weight was still achieved.

1901.59.1598 Act XI, Scene 6,
The Ronin Marching to the Temple Sangaku-ji

Horseback

Samurai at first were mainly on horseback with bows and arrows. Samurai were the wealthier warriors in society who could afford some of the best armor.[185] Riders wore yoroi which was the armor's designed for mounted combat. The yoroi was introduced in the Heian period beginning in 794 and is the most common type of early armor.[186] This form of armor consisted of

[183] Ogawa, 2012:32
[184] Robinson, 1995: 191
[185] Ogawa, 2012: 22
[186] Ogawa, 2010: 37

the usual components such as helmet, cuirass, leg guards, and arm guard. Due to the heavy use of the bow, samurai on horseback only used arm protection on the left side as to promote easy movement when drawing back an arrow. Doeskin gloves were worn by all samurai but those worn by riders also had additional padding on the inside of the right thumb for drawing a bowstring.[187]

1901.290 Kajiwara Genda Kagesue on Surusumi 1773

Cuirasses were covered in a layer of leather called tsurubashiri or bowstring path which stopped the string from catching on the layers of lamellar.[188] In the early 12th century, a solid iron plate was added to protect the exposed armpit due to the lack of arm protection for the drawing arm.[189] The entire cuirass slipped over the wearer's torso with an opening on the right side. A separate plate was attached to enclose the armor around the warrior.

[187] Robinson, 1995: 180
[188] Ogawa, 2010: 37
[189] Robinson, 1995: 181

Clothing Under Armor

The earliest warriors during the founding of Japan simply wore every day clothing under their armor. As armor became more decorative, so did the clothing underneath. Special robes called yoroi-hitatare made of silk were adopted as a more formal addition to the armor. Common infantry wore kimono and either full length pants or even short loin cloth. Samurai had their own variant called kosode which were close sleeved kimonos.[190]

[190] Robinson, 1995: 208-209

Worcester Art Museum and Higgins Armory Collections

In the Worcester Art Museum, there is a helmet in the likeness of a sea conch from 1618. This piece is the perfect representation of the replacement of practicality with the demonstration of one's skills. Around the 17th century, helmets such as the one from the exhibit, called kawari-kabuto became more common. The elaborate creations were often three dimensional representations of landscapes, animals, and in this case a conch shell.[191] These helmets were generally made of wood or papier-mâché and covered in gold leaf or some other coloring. Another example of the shell style helmet can be seen in the Tokyo National Museum which is in the likeness of a type of marine snail called a turban. These pieces were typically used for decoration but some warriors did don them in battle as a way of representing their deeds in the similar manner as the maedate.

2014.89.1 Helmet 1618

In the Higgins Armory Collection, there is a mempo piece with the removable nose piece. The bracket attachments can be seen on the cheek right below the eye. This piece has the more ferocious design. A mustache and goatee are also present with animal fur. Attached to the neck of the piece was also a throat guard which was

2014.705.1 Mempo late 18th century to early 19th century

[191] Ogawa, 2010: 40

not uncommonly added to the mempo. Coming from the late 18th to the early 19th century, this piece could have been used as defense but was more likely used as an art form and status symbol for the wearer.

Chinese/East Asian Arms and Armor

Armor

Map of T'ang China

The earliest armor used in China was hide. There were two primary forms of hide armor, kia and kiai. Kia was coat-like while kiai was scaled armor; both often made from rhinoceros hide. The amount of layers of hide used was dependent on the kind of rhinoceros.[192] There were two forms of rhinoceros and the main distinction between the two was whether the animal had one or two horns. More layers were used with two-horned because the ancient Chinese believed that the armor would last as long as the rhinoceros lived. A one-horned rhinoceros was thought to have lived around two hundred years while the two-horned rhinoceros only one hundred. Due to the difference, one-horned rhinoceros hide was believed to be tougher.[193]

Rhinoceros hide became scarce during the T'ang Dynasty between 618 and 905 CE. After this point, buffalo hide was used. Even sharkskin armor was created. Evidence shows that even the Mongols used this form of hide. Shark and ray skin armor was used in China as well as neighboring countries. These hides were generally too brittle for practical use. Instead, they were often used as a veneer supported by rhinoceros or buffalo hide.[194]

[192] Stone, 1999: 355
[193] Robinson, 1995: 126
[194] Robinson, 1995: 128-129

Paintings from the T'ang Dynasty often show armors that are a combination of scale, hide, and lamellar where lamellar is used more for thigh protection.[195] Scale armor has the appearance of scales like a fish made of iron or hide while lamellar armor is layered strips of iron or hide. During the early centuries of the current era the transition from hide armor to lamellar armor took place. This armor covered the wearer from shoulder to waist and joined over the shoulder. Proof of this armor exists through the finding of paintings and stucco warrior statues found in Chinese Turkestan. Iron lamellae plates were often used because if its strength. A more common lamellae material used in the more primitive parts of Asia on the Chinese borders was rawhide. Rawhide was strong, lightweight, and easy to create for use in armor. The Southern Chinese way of lacing the lamellae together was by connecting the laces from top to bottom which allowed for a strong tie but the lace was more vulnerable to being cut.[196]

Banded armor was a leather or iron lamellar armor that was colored. The style of armor was similar to that of a Roman legionnaire or Japanese armor of the sixteenth century. This style consisted of horizontal plates laced together in a band pattern. Evidence of this armor in paintings shows the armor painted blue or red accompanied by banners for the wearers clan, family, emperor, et cetera.[197]

[195] Robinson, 1995: 140
[196] Robinson, 1995: 137-138
[197] Robinson, 1995: 150-151

Mail armor was not commonly used for the Chinese military. When mail was used, it was most likely acquired through trade with Europe. Introduction of mail to China could also be attributed to Persian-made mail being traded to the nomad tribes of central Asia then passed on to China. Being mainly acquired through trade, smiths did not manufacture mail often but when they did, it was generally used by important officers. The skill needed, cost of creation, and lack of interest in armoring common soldiers with mail deterred China from making mail in large quantities. A variation of armor that was meant to resemble mail was created by primitive tribes of East Asia. Rather than metal rings, Japanese or Chinese coins were pierced and tied together upon a leather backing. Alternately, metal washers were also used instead of coins.[198]

Armor of Coins on Cloth

Robinson, 1995: 146

Brigandine armor was that of cloth and plates. The plates were riveted within the cloth. The origin of this armor is believed to come from the wearing of coats over armor by many warriors. This was done to add beauty to bland armor. This form of armor was a simplified version of lamellar armor because it did not require the intricate lacings between plates. Instead the plates were riveted together, as was the way of Chinese and Korean brigandine armor. The K'ien-lung

[198] Robinson, 1995: 145-146

period of 1736 to 1795 began the end of plate backed cloth as armor. Armor in general was slowly going out of use. Instead a uniform was used by the Chinese military.[199]

During the T'ang period, paper armor was introduced but was not until the Sung period from 960 to 1279 CE. Paper armor was a cheap and easily manufactured defense for garrisons of warriors. This armor was mostly favored in southern China on the coast as way to outfit soldiers defending against Japanese raiders. Both Japan and China admired the paper armor produced in Korea because the craftsmen in Korea were able to make a very strong and durable paper armor. Ten to fifteen layers were sewn together and the final product could even protect against arrows. After the invention of gun powder and then fire arms in China during the 9th and 10th centuries, paper armor was put to the ultimate test and was able to stand up against musket balls.[200]

[199] Robinson, 1995: 146-149
[200] Robinson, 1995: 151-153

Helmet

The earliest known helmets come from the Shang Dynasty from 1558 to 1050 BCE. These helmets were made of bronze and excavated from the tombs of warriors of high rank. The design of helmets changed with time. Helmets introduced by the Mongols were rounded and had feathers or animal hairs that came down the sides of the warrior's face. This style of helmet was adopted across China.[201] With lamellar armor came another form of helmet that matched the lamellar style. The helmets were made of layered plates often made of leather. As body armor adapted, so did the helmet. The lamellar form of helmet can be considered the true origin of the Chinese and Korean helmet shape. [202]

The helmet in the museum is from the 19th century and is a later form of the Chinese helmet. It is made of iron with a fitting at the top for a plume tube that once held horsehair. Gold accents were added to the helmet on four sides for decoration purposes. Helmets of this time period were used mainly for ceremony rather than for practical use.

2014.43 Chinese Helmet, about 1800

[201] Robinson, 1995: 127-128
[202] Robinson, 1995: 135

Shield

Shields were of great importance to the Chinese military. Infantry shields were originally made of wood. Infantry used long rectangular shields. If not made from wood, shields were made of rhinoceros hide like hide armors. To preserve the shields and prevent warping, the leather was lacquered. The primary color used was red lacquer was used because red was considered the color of war. Being the color of blood, it was used to put fear into an enemy.[203]

[203] Robinson, 1995: 154, 155

Arms

The arms in early China did not change much over time besides what Europe brought. The most common weapons used were the straight sword, spear, and bow and arrow. Iron and steel were used when manufacturing weapons.[204] Ores were put into a furnace and covered in two layers of hot coals. After heated and formed to the desired shape, the metal was cooled by dipping the blades into containers of oil.

The sword and scabbard in the Worcester Art Museum is a late 19th century officer's saber. At this point in Chinese history, armor was no longer used for defense and instead the military wore a uniform. The officer saber was more of decorative piece rather than practical use. The pommel is covered in engravings of dragons throughout. The metal fittings of the sword are made of brass. The scabbard that the sword fits with is made of wood and covered in ray skin. Just like the armor with ray skin, the scabbard is covered for decorative purposes. This style of sword is of older design that was used by cavalry and infantry alike. This type of sword was first introduced in the Ming dynasty from 1368 to 1644.

2014.55.1 Chinese liuyedao, end of 18th century

[204] Egerton, 2001: 143

Survey Data

Methods:

The survey was conducted by two student surveyors (Thomas and Erich) with six clipboards, pens, and copies of the survey. The survey was conducted for the most part by the main entrance/exit of the exhibit to catch people when they were finished with their time in the exhibit. Adults ranging from college age to seniors were asked to take the survey. No minors or tour groups were given the survey. Based on the number of surveys received and observed foot traffic in the museum, the most successful day to conduct surveys seemed to be on Saturday around mid-day.

Date of Survey	Day of Week	Time of Survey	Number of Responses
10/30/14	Thursday	11:00am-1:00pm	5
11/08/14	Saturday	11:00am-1:00pm	14
11/16/14	Sunday	11:30am-1:30pm	6
11/23/14	Sunday	11:30am-1:30pm	9
12/15/14	Sunday	11:30am-1:00pm	1

Observations:

1. People seemed to not know where the exhibit started and ended, so they were confused by what exactly the Knight's exhibit contained. I think it is pretty clearly marked, but others I guess do not.

2. People seemed to not want to fill out entire survey. This could be time reasons, or just not feeling like answering 9 questions. I have no clue what, if anything we could do to fix this, or what do we do with incomplete surveys.

3. Standing outside the large glass doors seemed to have better results. This allowed me to catch people who I knew were finished in the exhibit, rather than standing by the Arch and assuming they were finished when they left the "Sword Loop" area. Also, People seemed to feel awkward and/or rushed when taking the survey near the Arch. This may have played a role in the incomplete surveys (the 3 incomplete were from near the Arch, the 2 completed were taken outside the exhibit).

4. On a few cases people orally stated their dislike of batman while we were handing them the survey.

5. Similarly, a few people (notably one mother with a young daughter) was upset that because of the Guns without Boarders images, she was uncomfortable even bringing her daughter in the room surrounding the exhibit to see the swords. She made it clear she was unhappy due to lack of a curtain/door that she could not enjoy the swords and guns surrounding the film.

6. The survey conducted on 11/23/14 was the first conducted with the Child Soldiers video exhibit. This replaced the Drug War video. We also noticed a warning on the walls before the video exhibit, which we never noticed before.

Executive Summary of Survey Responses

1. **What did you like best about the exhibit? (1-3 items, more if you want)**
    - Objects (armor, swords)
    - Description plaques (more information)
    - Better layout/easier to see displays
    - More batman/superheroes
    - More interactive and "touch me" things like the gauntlet.

2. **What did you like least about the exhibit? (1-3 items, more if you want)**
    - The use of pink on the horse near the staircase
    - Poor layout/flow of the exhibit
    - Lack of history/background behind the pieces
    - Guns Without Boarders pictures (too gruesome, not kid friendly, no curtain)
    - Batman (notably his eyes)
    - Difficulty in finding descriptions of the objects on the arch
    - Seemingly unhappy guards
    - That only a small percent of armor is on display from the Higgins Collection
    - That objects were just leaning on the arch ("what are they?", "what are they for")

3. **Was there anything that you felt was missing from the exhibit that you would recommend adding?**
    - Reenactments/videos of how the arms and armor was used
    - Stories/history of the time
    - A description of metallurgy/armor making
    - Description of the effectiveness of armor in battle
    - Armor other than that of men and horse (armor for dogs, women and children)
    - Imagery of battles (paintings/woodcuts)
    - People to explain the pieces of the exhibit or the exhibit as a whole

4. **What object(s) particularly interested you and why?**
    - Armor (for its intricacies in gilding and etching, along with the amount of work that goes into its design and creation)
    - The old books in the play area
    - A variety of arms and armor, notably guns, swords and helmets (for visual appeal and function).

5. **Did you notice the audio spots? If so, what was your response?**
    - A large number of were simply answered "no". Some survey takers followed that common response with: the spots were quiet, confusing, unnecessary, or that they simply did not notice the spot at all.
    - Positive responses included that they were well placed.

6. **How did you feel about Helmutt the Dog?**
    - Majority of the responses had positive feedback or were indifferent to Helmutt.
    - He was commonly described as cute and great for children (promoting interaction).
    - One negative response was that he could be less "cartoony".

7. **Did you use the iPads? If so, what was your response?**
    - The general positive feedback to the iPads was that they had additional information.
    - The negative comments were more varied with: unresponsive, slow, could have more than just a written response and hard to navigate.

8. **Did you go into the Helmutt's House interactive area? What was your response?**
    - In general kids liked the area.
    - There should be more toys (swords, helmets, etc.).
    - The interactive area was underwhelming, only storybooks are currently there
    - Area is too close to the Guns without Boarders exhibit.

9. **Do you have any further comments?**
    - Wide range of responses, which is expected with the broad nature of the question.
    - Generally positive in nature.
    - "Enjoyed it" and "informative" were common responses
    - A significant amount of people left this question blank or restated responses to other questions.

Survey Responses

1) What did you like best about the exhibit? (1-3 items, more if you want) (35/35)

- Armor
    - Different types of Armor and Artifacts (large variety)
    - Armor + weapons integrated w/ art from their own time and place
    - I liked the different suits of armor and the paintings
    - Swords, batman, lances, detail of armor
    - The actual armor suits and the paintings
    - The way the armor was displayed easier to understand how it fit together
    - Seeing the engraving in the armor up close
    - The armor

    - Full suits of armor
    - I enjoyed the full suits of armor as they embodied the craftsmanship
    - Ornate armor design, armor, swords
    - Seeing items (art, the protection) that actual people used so long ago
    - The craft
    - The armor shown from different countries
    - Amazing swords + armor + head gear
    - Beauty of the swords considering the weight of the suits of armor
    - The full knight outfit
    - The hand of armor
    - 360 presentation of the helmets, integrated artwork with armor, flow of exhibit
    - Recognizing the violent purpose of the beautiful items is remarkable and wonderful. Batman's armor is a fun touch, your labeling and installation are very visitor friendly
- Paintings
    - Seeing items (art the protection) that actual people used so long ago(pg15, Nov 8)
- Batman
    - Batman
    - I loved batman, I also liked the exhibit of gun violence together coin the history of guns
    - Swords, film, batman
    - Recognizing the violent purpose of the beautiful items is remarkable and wonderful. Batman's armor is a fun touch, your labeling and installation are very visitor friendly
- Display
    - Description plaques
    - The way it was laid out + presented
    - Layout of descriptions
    - The displays were easy to see, every detail was easy to see
    - The weapons and the electronics descriptions using a tablet was helpful
- Glove (and other inter-actives)
    a. I like the idea of armor glove that you can touch. Really get a feel of what the armor is like.
    b. Try on gauntlet, swords
    c. The hand of armor
    -
- Guns
    - Armor + weapons integrated w/ art from their own time and place
    - I loved batman, I also liked the exhibit of gun violence together coin the history of guns

2) What did you like least about the exhibit? (1-3 items, more if you want) (29/35)

- Gun violence
    - Guatemala photos
    - Pink arch… drug gangs
    - Not a fan of the war films
    - Batman's eyes were intense, photography was upsetting
    - Not a clear flaw didn't it ended and went into the gun exhibit turn around or elevator
    - The gun violence photos wish the disclaimer was more profound so no children would not intentionally walk in the room
    - The Mexican gun/violence display was to graphic for an exhibit they draw children and not artistic
    - African kids at war
    - inner room pictures
- Arch
    - The wallpaper with murder scenes is too much, don't beat us over the head with violence. The pink color is awful, like a wall of peptol bismal
- Batman
    - Batman's eyes were intense, photography was upsetting
    - Batman seemed unnecessary or at least could have been tied in better with other more contemporary/knight imagery
    - Batman, tall spears, swords, standing against the arch, not attributed. What are they? What are they for?
    - Batman
    - The batman figure was gratuitous, setup/ position of paintings and armor were disjointed, what did one have to do to work the other
    - Batman, music
    - Batman costume-seemed out of place
- More pieces
    - that the collection is very limited and that only 5% of the armor is on display
- Helmutt
    - Children's area seemed to detract (distract)interest away from the rest of the exhibit, it was jarring compared to the rest, batman figure would have been more reasonable if the armor history included more modern body armor- seemed out of place here
    - the strange kids corner (lions)

3) Was there anything that you felt was missing from the exhibit that you would recommend adding? (25/35)

- Stories/History
    - stories about armor being made and how it was used
    - examples of use and commentary on the armors effectiveness- photo/image of armor on horses
    - a little more history, how the items were used, if they were battle or ceremonial pieces
    - more background about the make of the weapons
    - it's a bit much, but maybe include a video or picture which further explains how the armor was used
    - Images of battles referencing the specific armor
    - More detail about artwork on helmet why a bird figure?… etc
    - See #1, you could also add a surgery of the times exhibit and explain the worlds that would be connected, how they would be traded
    - I didn't notice signage on any of the larger weaponry (even a single name/ rough date) adding this (or making it more obvious) would be nice
    - I would like more inter-active text on the walls particularly about stylistic differences between countries, craftsmanship as in how things are made, etc
- Reenactors
    - Good reenactors with useful knowledge like at Higgins
- Armor
    - examples of use and commentary on the armors effectiveness- photo/image of armor on horses
    - ladies armor
    - dog armor
    - Armor for dogs
    - Horse w/ armor
    - More Asian armor
- Batman
    - More than just batman other dc or other comics would have connected although it was funny to have him in the knight exhibit

4) What object(s) particularly interested you and why? (28/35)

- Intricate armor
    - Intricate armor
    - Armor; the amount of work that went into the design
    - I liked the chest plates because they looked small since people were smaller back then
    - I love the armor depicting Christ crucified on the breast plate
    - Breast plates interesting to the detail and how small people were
    - Armor to see the intricate details
    - the breast plates, very intricate design and quality

    - the engraving in the armor
    - the armor, details were interesting, I never knew there was so much detail
    - armor with detail are engraved in the armor
    - full suits- the intricacy is amazing, and the ability to see construction techniques is wonderful
- Swords
    - Swords child would not allow for more time
    - the swords
    - although the swords were frightening, they were also intriguing
    - Swords- different shapes designs
    - Swords- impressed with the beauty
    - Wedgewood sword
    - Shayres- weigh of the swords. interesting
- Helmets
    - Comparisons of the different headgears'
    - the helmets
    - helmet
    - helmets
- Horse armor
    - the head gear for the horses
    - I liked seeing the armor for the horses and the variety of the swords, I never knew Wedgewood worked on swords
- Guns
    - the guns, I didn't know they existed in the 1500s

5) Did you notice the audio spots? If so, what was your response? (23/35)

- Informational
    - nice addition to hear and see the exhibit
    - I absolutely loved them but they may need to be louder, for older people
- Yes
    - yes, confused at first but informational
    - liked "chorus of anvils" by verdi
    - I did notice but time was limited
    - yes we did not use them
    - yes very well placed could be more information
    - yes liked the music
    - I absolutely loved them but they may need to be louder, for older people
    - I notice them, didn't use the,. Thought was a great idea
    - Yes but didn't think it was necessary
    - Only when my husband showed me
    - Yes- I liked that they were there

- Volume issue
    - never heard them
    - yes, needs to be a bit louder
    - I thought someone was talking in another room LOL
    - yes, talking was too loud + music didn't match time range
    - I absolutely loved them but they may need to be louder, for older people
- Confusing
    - yes, confused at first but informational
    - yes, very well placed could be more information
    - yes, but too late, could use explanation
- Music from different era
    - yes, talking was too loud + music didn't match time range

6) How did you feel about Helmutt the Dog? (31/35)

- Great
    - I like him, good way to promote interaction
    - Cute
    - Great addition for young children
    - Very cool so that small children can get involved
    - The kids liked putting the hand in the armor glove- helmutt had no influence on my kids coming
    - He is cute, helmutt teaches us to go to the library
    - Loved the area for kids, great to get them involved
    - Cute idea
    - Good for kids
    - Good for children
    - Cute, nice for kids
    - good character
    - nice ideas for the children
    - it was funny and cute and a great way to make kids feel at home
    - Great idea to engage people/younger audience
    - small children might like him
    - great to get children's attention
    - I loved helmutt nice reminder you really do want to touch a little
    - Liked the gauntlet; didn't notice helmutt much
    - Cute! I <3 your partnered w/ mutts to make the arts more approachable
    - Didn't pay attention other than try on gauntlet
    - Interesting, but made the exhibit comical
    - It's cute for kids
- Unnoticed
    - Confusing exhibit

    - didn't see him
    - Didn't notice
    - Didn't notice
    - Did not see it
    - Didn't pay attention other than try on gauntlet
    - Very juvenile
- Negative (older people with no use for helmutt)
    - Confusing exhibit
    - Id prefer him less "cartoony"
    - not sure he serves a purpose but he's very cute. The info he gave was kind of hidden and not easy to see
    - Very juvenile

7) Did you use the iPads? If so, what was your response? (12/35)

- Useful
    - Great
    - Yes
    - Yes, I like the additional info
    - I used the i-pads to learn about batman and it was very cool
    - great for additional info
- Bad
    - Yes, they are slow, unresponsive to touches, prefer to get a good set of text pamphlets
    - Some (don't really like them)
    - yes fun but could use a bit more interaction other than written response
    - didn't use (although I did notice them)
    - What pads

8) Did you go into the Helmutt's House interactive area? What was your response? (15/35)

- Great interactions for kids
    - yes, good for kids
    - yes, very interactive for children
    - I just looked into the area and I liked it, so the little kids can get involved
    - Yes its great
    - Yes, I like the pictures on the wall, my daughter liked the bean bags
    - Just peeked ;)
    - No but looked in liked the descriptions of the armor
    - my son loved it
    - if this refers to the play space I think it's a great idea
    - Noticed it. Good idea to engage young audience
- Bad
    - Underwhelmed. Too near the drug-war exhibit and just storybooks, nothing to do

    - I did not sure about the bleeding lion portion
    - yes, briefly the bleeding lion painting may be too much for little ones
- Neutral
    - no- did not appeal to me as an adult

9) Do you have any further comments? (11/35)

- Exhibit
    - believe that the armor should have a permanent location in the museum
    - enjoyed it
    - very interesting
    - very interesting exhibit
    - Great
- More of collection 3/35
    - great to be back after all these years, saw Warhol's soup cans the first year here
    - I would really love to see this exhibit to expand to include more of the collection, it is expansive and engaging if done correctly
    - nicely done, looking forward to see some more items
- Nice young men doing survey
    - young men doing the survey were nice
- Videos 2/35
    - the videos of central America are an important part of the exhibit
    - I liked the fact that there was a discussion written and slideshow about violence and ramifications

iPad Interactive

Idea Lab Hogarth

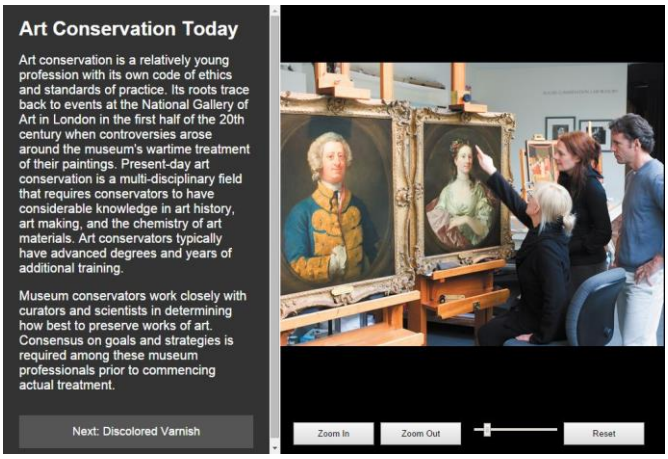
The interactive consists of one main page which serves as a menu as well as division of the sub-slides that make-up the entire interactive. The entire interactive consists of forty-one total slides. Each sub-page contains a paragraph of information, a picture, and a citation for said picture. The nature of this interactive is to show a specific artists works as well as the museum's techniques for restoring art. The zoom feature of the slide show as well as the options in the open menu are what make the presentation interactive.

-description on the left hand side of the screen which describes the image on the right hand side

-allows for zoom in and zoom out to fully experience the images presented

-this slide is a good start to the exhibit that it is representing

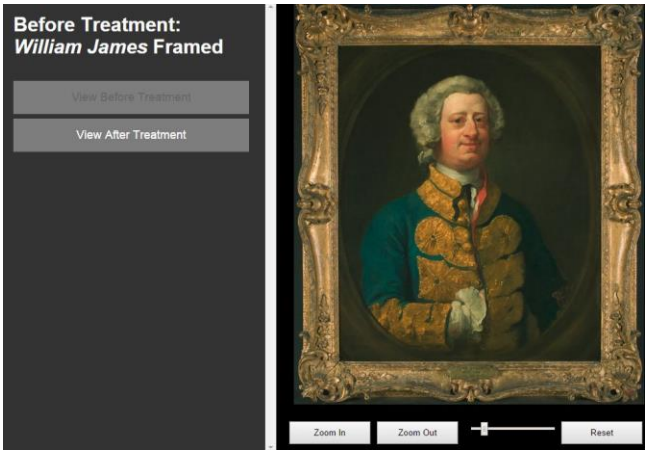
-simplicity is helpful to keep observers reading and viewing



-Good introduction to what is occurring at the museum with the pieces for the artist

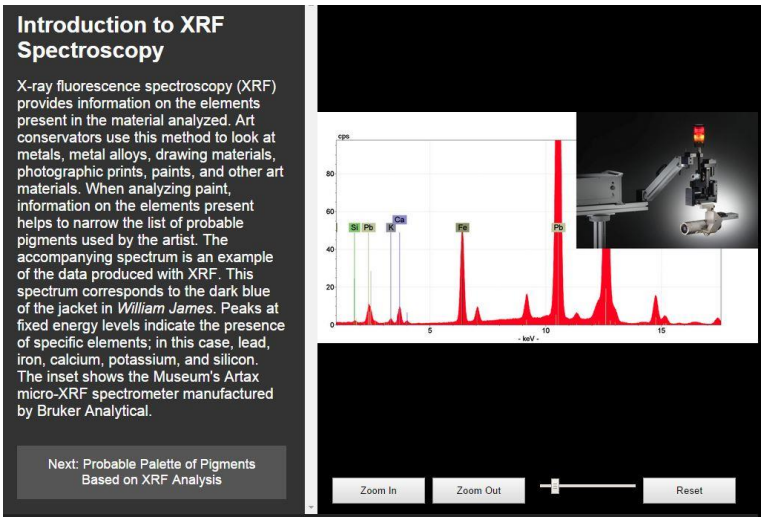
-simple like the other slides to briefly tell the observer what is going on at the museum

-references artwork that was previously shown in earlier slides to maintain continuity



-interactive left hand column allows for the user to see the effects of restoration

-slide follows the slides featuring the restoration process to see a final product as well as the beginning



-slide links art and the science behind restoring

-shows methods used to restore and fully understand the defects in the original piece

Overview:

This interactive works on simplicity to allow the user to learn about the pieces without being to flashy or difficult to use. The text presented is long on many slides which may deter users from reading the full slide or even going through the entire interactive. The interactive is long with many slides which does not allow for multiple users to interact in short periods of time. The zoom feature is very interesting because it allows the users to look closely at the pieces just as the museum staff look closely at the pieces to restore them to a better condition.

Orantes

The interactive consists of one main page that acts as a main menu in addition to seven primary pages that divide the interactive into different sub-groups. The entire interactive consists of eighteen total slides. The sub-pages go into more depth with regards to their overall sub-group, i.e. Introduction, Story of the Orantes, et cetera. The purpose of this interactive is to explain the reconstruction of broken Orantes statues as well as educating the observer about Orantes statues in general. The selection of sections option, the puzzle, and the coloring pages are what make the slide show interactive.

-interactive opening window which allows for users to select which slides they want to view

-simple design with either sliding to each option or selecting on the menu

-interactive puzzle which allows users to “help” construct the broken statues

-gives feedback when the puzzle is complete

-gives multiple difficulties for the puzzle aficionados

-hard to get back to the home menu

-there is also a painting option

Introduction

The large and striking terracotta statues displayed in this case were discovered in underground tombs at Canosa, a town in present-day southeastern Italy that was heavily influenced by Greek culture in Antiquity. Canusium—as this town was called in Antiquity—flourished from the fourth to the early third centuries BCE.

-intro slides are very boring in presentation

-not very engaging with paragraphs

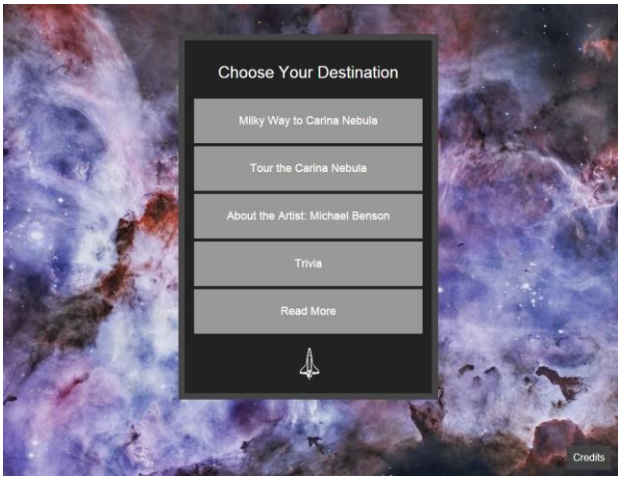
-short and simple slide show to keep observers engaged

Overview:

Multiple options for user interface help draw varying crowds of observers. Overall the interactive is well done. The introduction needs work since it spits out a lot of information in a paragraph that observers may not want to take the time to read. Perhaps the information should be put into simple bullet points. The puzzles and coloring sections allow for kids as well as adults interact and have fun while learning about the pieces.

Nebula

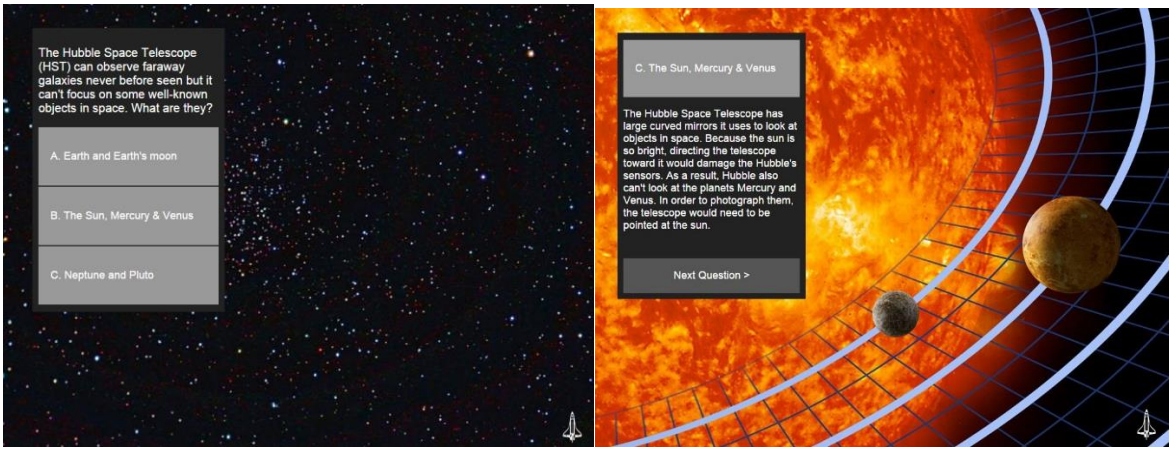
The interactive consists of one main page which serves as a menu as well as division of the sub-slides that make-up the entire interactive. The entire interactive consists of thirty total slides. The sub-pages refer to the groups in which they are placed such as the Milky Way, Tour the Carina Nebula, About the Artist, et cetera. The purpose of this interactive is to teach the user about the Hubble Space Telescope as well as the universe while testing their knowledge to see how well the interactive teaches. The main menu and the trivia quizzes are what make the slide show interactive.



-clever word use with “choose your destination” with space ship icons and space

-interactive menu to easily select where to go in slides

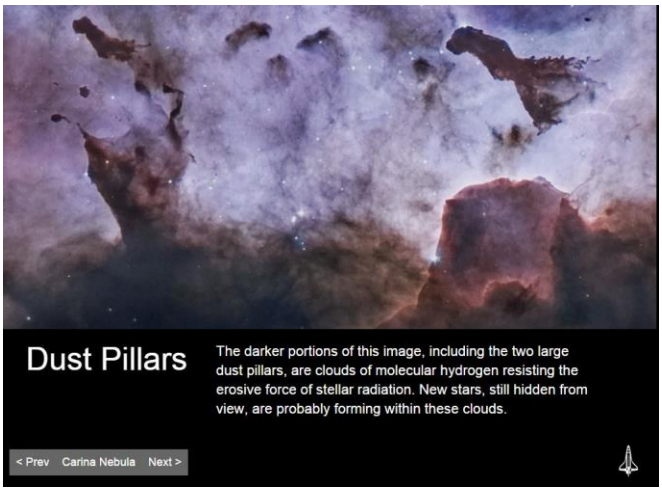
-multiple types of slides to attract different people without throwing all of the information into once slideshow



-trivia questions to fully engage users after learning about the subject

-quickly shows the correct answer and explains in more detail about the answer

-easy home button in the bottom of the screen so that users can choose other parts of the interactive



-shorter paragraphs but can still be bulleted for quicker reading

-less slides to present the info quicker

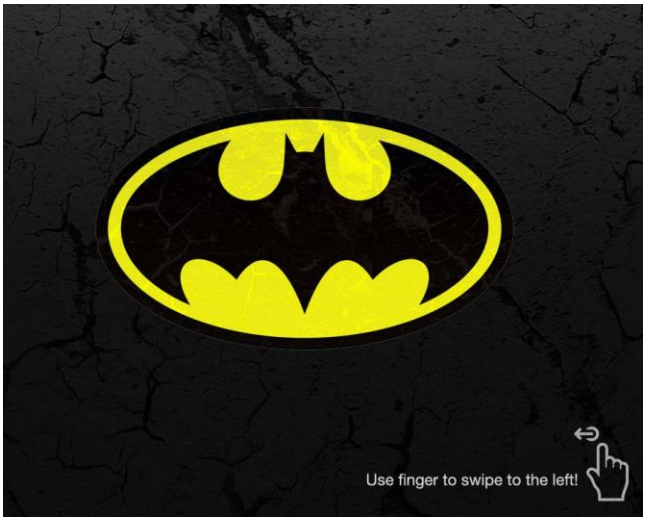
-pictures engage and fascinate to fully submerge viewers into the topic

Overview:

Simple layout which allows for users to quickly and effectively learn and interact with the slides. The interactive teaches as well as tests the knowledge of the user in a fun and cool-looking way. The images used throughout the interactive are engaging and well selected to fit the slides they are assigned to. The home button is simple and always present so users can jump right back to the main page to interact with something else.

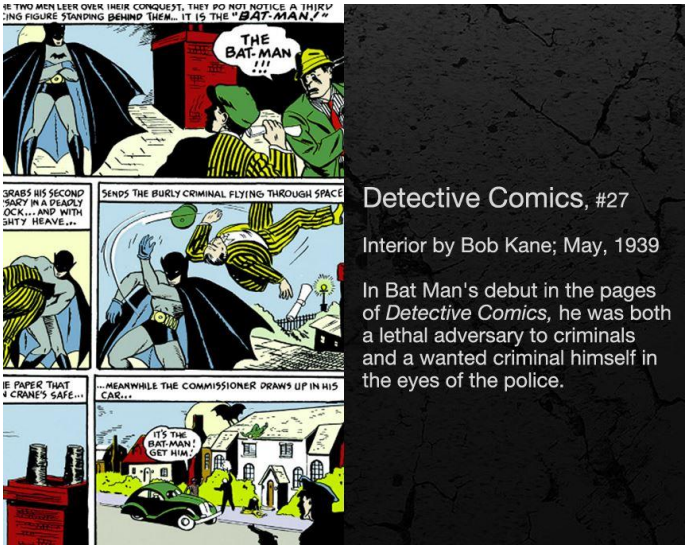
Batman

The interactive consists of eleven pages. The majority, besides the beginning and end, consist of half picture and half text. The text is the citation as well as a background sentence or two about the image presented. The purpose of the interactive is to quickly and efficiently explain how Batman pertains to knights. Moving from slide to slide is the only interactive part of the slide show.



-simple opening so users know what they are learning about

-explains how to interact and go through the slides on the tablet



-brief explanation of Batman comics with description of the style of comic at that time

-shows examples of the comics in a quick way

-text is short and simple to help readers get through the slides quickly

-quickly brings the user to the beginning so that the next user can easily start the slides

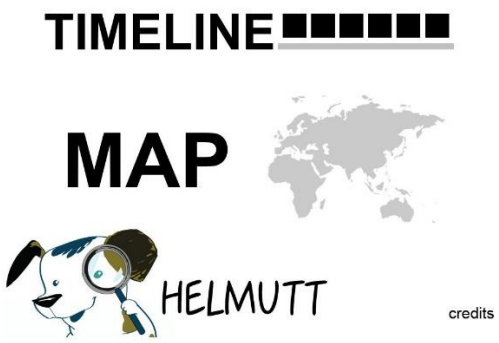
-Batman symbol starts and ends the slide show

Overview:

The slide show is very simple and does not present much information. Simplicity in the design is good to an extent because it allows for many users to go through and read without using the interactive for too long. The histories behind the issues of comics are presented shortly and shows an image of the comics. The slideshow is almost boring in the simplicity.

Helmutt Tours

The interactive consists of one main page which serves as a menu as well as division of the sub-slides that make-up the entire interactive. The entire interactive consists of around sixteen total slides. The helmet section consists of nine sub-pages that have a picture and text explaining each piece. The map and timeline pages are single pages with pop-up interactives. The overall purpose is to explain the history behind the helmets in the Knights of the Round Table. Selecting what part of the slides is what makes the slide show interactive.



-simple in design so users know exactly what they are selecting

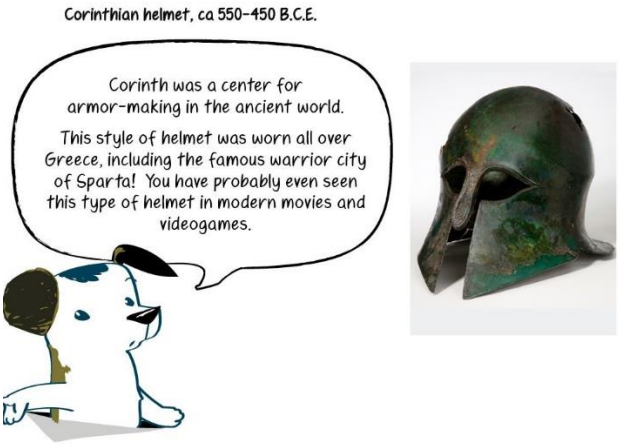
-no color or appealing imagery

-Helmutt is a good touch because he frequents the exhibit in other locations

-explains who Helmutt is

-references helmets in the exhibit

-easy selecting option to learn about each helmet



-shows image of the helmet described for better understanding

-gives time period of the piece

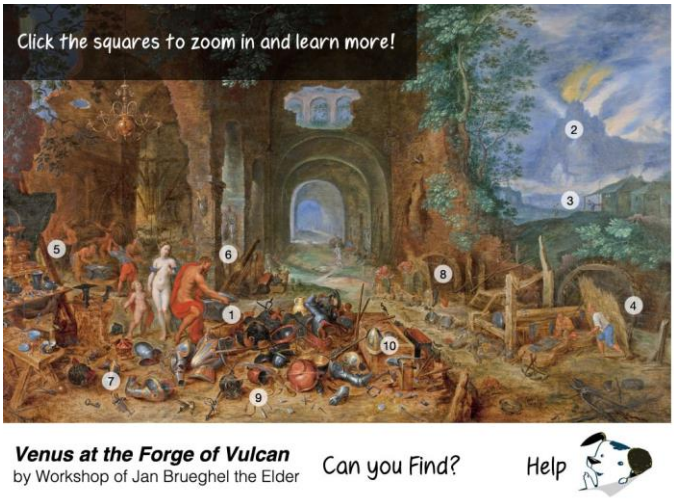
-gives a brief description of the piece and connects it to modern life; “you have probably even seen this type of helmet…”

Overview:

The font used is very kid friendly but may deter older users. Helmutt looks different in each slide making him as a character more interesting. The slides openly and easily offer help if desired. The help page describes how to interact as well what will happen when the user selects things. Broken links for the map and timeline so there is no information on those slides. Major strength is that this interactive is very kid friendly.

Venus at the Forge of Vulcan

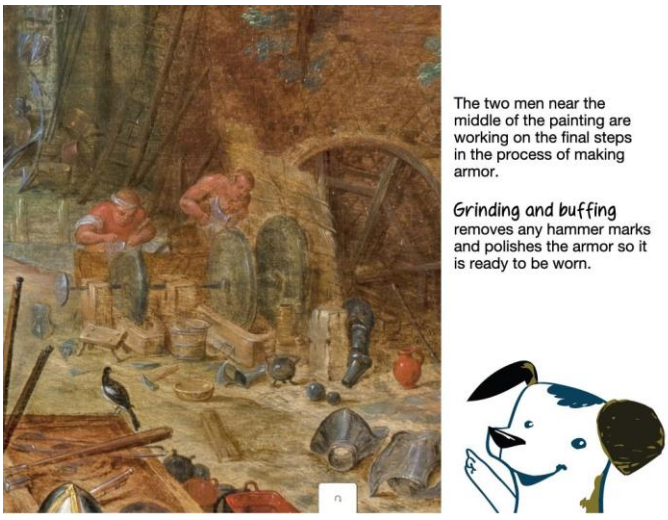
The interactive consists of one page which serves as a guide for interacting with the artwork. When sections of the interactive are selected, the picture is zoomed in on and more information is presented in textual form. The nature of this interactive is to explain an artist's work while giving a background on the time period. The user is able to select what part of the picture they wish to interact with and learn more about. This makes the presentation interactive.



-One slide that allows the user to easily learn all the information presented

-Introduces Helmutt for the kid users

-Easy help option



-zooms into the main picture to explain each section

-tells about the section of the piece as well as the processes being done in them to explain the workings of the time period

Overview:

The interactive is very simple for users. Fully explains the piece as a whole while offering challenges with the “Can you Find?” option. The help option is also nice because it quickly explains how the interactive works. When selecting the title of the piece it explains who the artist is as well as what the piece represents.

Read-Me

Knights! Exhibit

Arch of Arms

iPad Interactive ReadMe

Interactive runs on iPad Kiosk Pro App

* Will run on PC SAFARI browser

Main page for front facing iPad: Index.html

Main page for rear facing iPad: Index_Back.html

TO ADD CONTENT:

* Object Silhouetes

-> Open Arch.psd

-> Go to the layer that corresponds to the arch face to which the item is to be added (left side being the closest to the Pulitzer exhibit and front being the face toward the front of the exhibit)

-> Insert the png from the PNGs folder in resources and adjust the image location to where it is on the actual arch

-> Save the arch face image as a png and replace the file in the resources folder

* XML File

-> Insert new line into .XML file

-> Place picture of object in object_images folder with name as Museum Object ID number

-> Fill in all information needed ie. ID (based on position on spreadsheet), Picture (same as Museum Object ID), Date, Title, etc.

-> The X and Y fields must be filled in for the hotspot dot to be created (X is position from left and Y is position from top)

-> Copy Display_Attributes Area from other entries and paste in new entry

TO DELETE CONTENT:

* Object Silhouetes

-> Open Arch.psd

-> Go to the layer that corresponds to the arch face to which the item is to be added (left side being the closest to the Pulitzer exhibit and front being the face toward the front of the exhibit)

-> Delete the specified items and move the images to the orientation desired

-> Save the arch face image and replace the image in resources folder

* XML File

    -> Delete Row of item

    -> Change ID of other items to be in numerical order again

TO EDIT CONTENT:

* Object Silhouetes

    -> Open Arch.psd

-> Go to the layer that corresponds to the arch face to which the item is to be added (left side being the closest to the Pulitzer exhibit and front being the face toward the front of the exhibit)

    -> Move the images to the orientation desired

    -> Save the arch face image and replace the image in Side HTML

* XML File

    -> Edit information in cell

Root folder contains:

* contents folder

    -> object_images folder

    -> contents.xml

* resources folder

    -> animation

    -> colorbox

-> Flip.Book

-> hammer

-> jQueryAssets

-> PNG

-> UI

-> Arch.psd

-> Help_Screen.jpg

-> Back.png

-> Front.png

-> Left.png

-> Right.png

* ArchInteractiveStyles.css
* colorbox.css
* content.html
* datahandler.js
* Front.html
* Back.html
* Left.html

* help.html
* Index.html
* Index_Back.html
* Right.html

Contents folder contains the files necessary to modify and add objects to the interactive

The pop-up window that appears when an item is selected draws the information from the .XML file necessary for display

object_images contains a picture of each piece named with its cooresponding object ID number found in .XML file

All assets located in resources folder are REQUIRED for the interactive to function.

animation contains all of the images for the image sequences that make up the rotation animations

colorbox is a javascript allowing for a lightbox window to popup displaying content of item

Flip.Book is a javascript plugin that takes the images from animation and runs them in sequence to show rotation

hammer allows for touch abilities on the tablet ie. swipe scrolling

jQuery is a javascript which pulls the information from the content spreadsheet to display on popup

touch-punch allows the slider control to function

PNG contains all the silhouetes for the objects on the arch

Side HTML contains the the HTML files for the back, left, and right faces of the arch

UI contains the images for the interactive background, arrows for turning, and the help button

Arch.psd is the photoshop image of the arch used as the backdrop for the items

Help_Screen.jpg is the the reference image for the pop-up help menu

Within Index.html, Index_Back.html, content.html, and datahandler.js, there are sections of commented out code originally intended to provide Previous/Next and swipe to rotate functionality to the app.

These features were attempted but were unable to be completed by this project.

Contact List

- Tim Furman: Worcester Art Museum Web Design Coordinator

  508-799-4406 ext 3076

  timfurman@worcesterart.org

Conclusion:

The group was selected through interview and application. The students selected were chosen for their skills with regards to research, teamwork, computers, creativity, as well as enthusiasm for the project topic. The desire to participate on a team that was designated to work with historically significant museum pieces stood out and proved to be most valuable for the project to move forward. With all of the aforementioned criteria in mind, project advisor Professor Jeffrey Forgeng had the final say in who would be on the team for this project.

As part of the project the team successfully crafted questions and conducted surveys that were to be used by the WAM. Due to scheduling conflicts within the group and working within the WAM, issues with running surveys at certain times became problematic. Sundays were the days when the group could mainly conduct the surveys. It was found that Sundays were not very busy days for foot traffic at the museum, and other programs (piano concert in the lobby for example) were also diverting visitors from the Knights exhibit. It is suggested for future groups that might be conducting surveys to do so on Saturdays, because that day held the best results the one time the group conducted surveys on a Saturday.

Additionally the group compiled and refined raw data that was collected by the museum in the end of the Knights exhibit. This data (both qualitative and qualitative) was untouched by the WAM, so the process of refinement was developed by the group as the project went on. A system was developed in which having multiple passes of the data and annotating the sheets with highlighter and pen was crucial. Different colors were assigned to common words or phrases used in multiple answers (e.g. Batman was highlighted in purple). Both the information gathered by this IQP group and the information gathered by iPads in the exhibit and compiled as part of the project was used by the museum director.

The group as part of the project also successfully created a tablet interactive that allowed users to learn about the pieces on the arch while keeping the exhibit clean and simple. At first the crafter of the interactive did not go according to plan. With their limited knowledge of coding, the tech development team had some difficulty getting the interactive to work as desired. It is suggested that if future groups plan on creating or editing an application with no student with programming background on the team, have a member start learning coding early in the project (A term). With the help of the internet and the advice of others with more experience, the team was able to complete the interactive as desired. A large issue was getting the arch on the interactive to rotate through the animation of rendered images. After a few weeks of failed attempts, a plug-in was found online that aided in the efforts to get the interactive to work as desired. The group used Google to search key phrases (e.g. FlipBook plugin) for examples of already written code which was then reverse engineered to fit our needs. These resources were not exactly what the development team needed but provided a stepping stone so that progress could be made. Another issue that was encountered was getting the interactive to work completely on the computer through the use of various browsers. Some aspects of the app such as the turning animations, information pop-ups, et cetera worked in some browsers while not in others. Testing the interactive required the use of many internet browsers. To help avoid the aforementioned problems that were encountered it is suggested that the group meet with the Museum app manager (Tim Furman) more often and troubleshoot the app often and as a group. Although there were issues with the development stage, when the interactive was installed on the iPad everything worked as desired.

As a whole, there were no obstacles that could not be overcome during the course of this project. A few suggestions in hindsight to improve this specific IQP as a whole include: have the survey team and development group work more closely together to make the project seem less like

two separate IQPs and possibly have the app development team do a week or so less background historical research on the project to allow for time to learn application design and coding.

This was the first Knights! at the Museum project at the Worcester Art Museum, so paths for new future projects are wide open for investigation. To build upon this specific project relating to the Arch interactive, future groups can update the application to include new content such as games, videos, object history, et cetera to improve visitor experience and entertainment. Additionally, future groups could enhance the functionality of the application by implementing a pinch to zoom feature or implementing possible filters for objects (by country of origin, type of object, et cetera).

About Us

Knights! At the Museum IQP Team
(from left: Derek Johnson, Jonathan Blythe, Thomas Cieslewski, Erich Weltsek

Team Biographies

Jonathan is an Aerospace Engineering major who loves everything that flies. His interest in music comes out when he plays the guitar or violin. When not studying or playing an instrument, Jonathan is playing on the WPI lacrosse team. Lacrosse is a very important part of his life and has been since he was in middle school. In addition, Jonathan's enjoyment of technology propelled his desire to begin building a cube satellite and founding a club at WPI. Building a cube satellite would allow for a dream come true and having something he made in space. Thanks to his older brother, Jonathan also had a big interest in history and historical items. This interest made Jonathan want to participate on the Knights! Exhibit project.

Thomas is an Aerospace Engineering major. When not studying for his classes, Thomas could be found doing one of various activities. He is a member of WPI Men's Varsity Swim Team which takes up most of his time. He also is a member of Lambda Chi Alpha men's fraternity. With all these time commitments Thomas still manages to make time for fun. He enjoys biking, playing video games, and hanging out with his friends in his spare time. Thomas wants to go into spacecraft design after he graduates from WPI.

Derek is an Interactive Media and Game Development major interested in 3D modeling and animation. His love of technology and history were the leading factors in his involvement with the Knights! Exhibit project. When not completing school work, Derek is playing games, building games, or being with his fraternity brothers of Tau Kappa Epsilon. He wishes to become a game developer in Boston after his education.

Erich is an Environmental and Sustainability Studies and Humanities and Arts (Environmental Studies concentration) double major. He has always been interested in the planet and history. These two majors allow him to study both, with the scientific context that only WPI could provide. On his free time, Erich enjoys going to Renaissance Fairs, playing hockey, and playing tabletop wargames. Over the course of the project, he was also introduced to Hurstwic and is now participating in Viking combat training. Erich found about Professor Jeffery Forgeng on a History Channel program, and coincidently saw that he was affiliated with WPI. Erich then looked to see what classes/projects Prof. Forgeng taught and he instantly applied for the Knights! At the Museum project!

Annotated Bibliography (Erich):

Ashdown, C. (1967). *European Arms & Armor*. New York: Brussell & Brussell.

An entry level book that outlines the broad range of European arms and armor. Topics covered in the book include brief history of arms and armor in Europe from prehistory to the time of gunpowder. The book is highly illustrated with engravings and plates. The book is outdated, but still has some good information that has not changed from the time this book was written.

Baker, A. (2003). *The Knight*. New York: Wiley.

An entry level book that provides a background on the knight. Topics covered in the book include: chivalry and its development, general topics in warfare of the time (siege warfare, the crusades, mercenaries), and brief background on arms and armor of the knight. The book is not illustrated.

Blair, C. (1962). *European & American Arms, c. 1100-1850*. New York: Crown.

An entry level book on European & American Arms as the title implies. Topics included in the book are: swords, daggers, staff-weaponry, projectile weapons including the sling, bow, crossbow and firearms. The book is illustrated.

Coe, M. (1993). ***Swords and Hilt weapons*****. New York: Barnes & Noble.**

An entry level book that includes the topics of swords and hilt weapons from prehistory all the way up to pre-conquest America. The book covers these weapons all around the world, with chapters being devoted to geographic areas in addition to time periods. The book is illustrated.

Contamine, P. (1984). ***War in the Middle Ages*****. New York, NY, USA: B. Blackwell.**

An advanced, academic book on the general topic of warfare in the Medieval period. Topics covered in the book include: history of warfare and logistics, different weapons and how they were used including hand held weaponry and siege weaponry, and the social, political, religous and economic aspects of war. The book contains illustrations in the form of photographs and maps.

Edge, D., & Paddock, J. (1995). ***Arms & Armor of the Medieval Knight: An Illustrated History of Weaponry in the Middle Ages*****. New York: Crescent Books.**

An entry level book that provides introductory information on arms and armor of the knight. Topics in the book are broken down by century, ranging from the 11th century to the 16th century. An additional topic covered in the book are knightly tournaments. The book is highly illustrated. The book is large and formatted like a coffee table book, with large, brightly colored illustrations.

Gallwey, R. (2007). ***The Crossbow: Its Military and Sporting History, Construction and Use*****. New York: Skyhorse Pub.**

A more difficult entry level book that covers the crossbow in Europe. This book does contain some historical background, but is very technical, much like *The Secrets of the English War Bow*. Topic written about in the book include: the crossbow for both military and sporting, the technical aspect of the crossbow (dimensions, mechanics, etc.), the bolts used by a crossbow, a comparison of the crossbow to the longbow and shortbow, and a brief discussion of firearms. The book is heavily illustrated.

Oakeshott, R. (1997). ***A Knight and His Weapons*** **(2nd ed.). Chester Springs, Pa.: Dufour Editions**.

An entry level book that focuses strictly on the weaponry of the knight. Topics (chapters) include: the spear, lance, axe, mace, hammer, sword, dagger and early firearms. The book is illustrated with drawings of certain arms and armor of the knight.

Oakeshott, R. (1996). ***The Archaeology of Weapons: Arms and Armor From Prehistory to the Age of Chivalry*****. Mineola, NY: Dover Publications.**

An advanced book on arms and armor throughout history. Topics include arms and armor from across Europe from the prehistoric period to the 15th century. The book is heavily illustrated with drawings and photographs of arms and armor that is referenced in the text.

Soar, H. (2006). *Secrets of the English War Bow*. Yardley, Pa: Westholme.

A more advanced entry level book on the war bow. This is a companion to *The Crooked Stick* and covers the war bow in more detail then *The Crooked Stick*. Topic include the historical aspect of the war bow, but mainly focuses on the construction and design aspects of the war bow including arrows (shafts, heads, etc), strings, and the bow itself. The book is illustrated.

Soar, H. (2004). *The Crooked Stick: A History of the Longbow*. Yardley, Pa: Westholme.

An entry level book on the English longbow and English war bow. Topics include the longbow's history, from prehistory, to its rise as a weapon of war, its decline as a war weapon, and its rise as sporting and social tool. The book has illustrations in the form of photographs and drawings.

Thompson, J. (1931). *History of the Middle Ages, 300-1500*. New York: W.W. Norton.

An entry level book that provides a general background to the Middle Ages. Written as a college text book, this book is well defined and easy to understand. Topics include Medieval history from the fall of Rome. Good as a reference for background to the time, but does not go into excessive detail in any one topic, but brushes on many topics. Note that this is a very old source. This book is not illustrated.

Waldman, J. (2005). ***Hafted Weapons in Medieval and Renaissance Europe the Evolution of European Staff Weapons Between 1200 and 1650*****. Boston: Brill.**

An academic book that provides an in depth information on hafted weaponry in the Medieval Period. Topics include a variety of different hafted weapons, many have a chapter devoted to them. A general background on the evolution of hafted weapons is also provided. This is one of, if not the most comprehensive resource on hafted weapons available. The book is illustrated.

Williams, A. (2003). ***The Knight and the Blast Furnace: A History of the Metallurgy of Armor in the Middle Ages & the Early Modern Period*****. Leiden: Brill.**

An advanced, academic book that provides a comprehensive background on metallurgy and arms and armor making. The book is written using a lot of scientific jargon because the author is an engineer. Topics included in the book are: metallurgy, armor making, weapon making (ranged weaponry notably firearms), and the testing of armor for its protective capabilities. The book is heavily illustrated with mostly photographs of armor from various collections and graphs.

Annotated Bibliography (Derek):

Ashdown, C. (1967). *European Arms and Armor*. New York: Brussell & Brussell.

(HAM 739.73 As 3).

This book is very useful and a very good source for armor progression. There are very large sections on each era of armor from prehistoric man to the introduction of gunpowder. There are pictures of pieces of armor that are related back to the writing for clear visuals.

Blair, C. (1959). *European Armor, circa 1066 to circa 1700*. Batsford: Macmillan.

(HAM 739.73 B 57e; PDF).

This source is a large, very detailed read covering a complete timeline of armor progression. It is illustrated with many examples of different suits and armor types. Some organization was a little confusing with the general breakdown of era and then individual armor pieces. This is a very informative source.

Contamine, P. (1984). *War in the Middle Ages*. New York: B. Blackwell.

(HAM 355.0094 C 76).

Edge, D. & Paddock, J. (1993). *Arms & Armor of the Medieval Knight: An Illustrated History of Weaponry in the Middle Ages*. Greenville: Crescent. (HAM 739.7 Ed 3).

Ffoulkes, C. (1912). ***The Armorer and his Craft from the XIth to the XVIth Century*****. London: Methuen & Co. Ltd. (HAM 739.7 F 43).**

This book covers a lot of how the armorer functioned in the Middle Ages. It is illustrated with images of armor, tools, and different scenes of armor making as well as armorer marks. The book goes over the armorers, their tools, and how different materials were used and worked. The source is very informative.

Hyland, A. (1998). ***The Warhorse 1250-1600*****. Stroud, Glocs: Sutton. (HAM 357.2 H 99).**

This book is more about how a horse meant for war was cared for, traded, or bred and not so much any tactics or armor of the warhorse. It is an intro into the topic of war horses and should not be used exclusively for the armor for horses.

Laking, Sir G. (1920-22.). ***A Record of European Armor and Arms through Seven Centuries…with an introduction by the Baron de Cosson*****. London: G. Bell and Sons.**

(HAM 739.73 L 14a).

This book is an illustrated source that covers both armor and weaponry broadly from 1200s armor to Maximillian Era. It is a good quick read if one needs to brush up on a section of history with a few illustrated examples of pieces.

Pfaffenbichler, M. (1992). ***Armorers (Medieval Craftsmen Series).*** **Toronto: Univ of Toronto Press. (HAM 739.75 P 52a).**

This source is a terrific introductory piece into how armorers worked, lived, and everything pertaining to armor in the Middle Ages. There was a good overview of the process to make both mail and plate armor. It has colored pictures to help explain key points.

Pyhrr, S., LaRocca, D., & Breiding, D. (2005). ***The Armored Horse in Europe*****. New Haven: Yale University Press. (HAM 357.2 P99a).**

This book goes very in depth with how horse armor worked. It followed history and the progression of the armor. It had illustrations to explain some pieces. The first part of the book is a detailed overview of horse armor while the later part writes about different pieces of armor specifically.

Riggs, W. (1915). ***Handbook of Arms and Armor*****. New York: Metropolitan Museum of Art.**

Stone, G. (1999). ***A Glossary of the Construction, Decoration and Use of Arms and Armor.***

Portland: Southworth Press. (HAM 739.7 St 7g 1961).

This book was set up like an encyclopedia of arms and armor of all cultures and regions. Included decoration. The book had extensive detail on many entries, which provided a lot of detail. The source is useful if further information on a specific item was necessary unhelpful if not know what item to look for. The book is illustrated.

Tarassuk, L. & Blair, C. (1982). ***The Complete Encyclopedia of Arms & Weapons: The Most Comprehensive Reference Work Ever Published on Arms and Armor*****. New York: Simon and Schuster. (HAM 739.703 B 57c).**

This source is an encyclopedia of arms and armor from prehistoric man to the present. The large date range leads to small, broad entries. Not useful if unaware of what to look for. Useful for further information on a piece.

Annotated Bibliography (Thomas):

Coe, Michael D.. *Swords and hilt weapons*. New York: Weidenfeld & Nicolson, 1989. Print.

This book discusses swords used in different regions of the world.

Fischer, W., & Zirngibl, M. A. (1978). African weapons: knives, daggers, swords, axes, throwing knives. Passau: Prinz-Verlag.

This book describes the making and use of African weapons.

Robinson, H. R. (1967). Oriental armor [by] H. Russell Robinson.. New York: Walker.

This book discusses Persian, Turkish, and Indian Armor

Schmidt, A. M., & Westerdijk, P. (2006). The cutting edge: West Central African 19th century throwing knives in the National Museum of Ethnology, Leiden. Leiden: National Museum of Ethnology ;.

This shows how throwing knives were made and used in Africa.

Spring, C. (1993). African arms and armor. London: Published for the Trustees of the British Museum by British Museum Press.

This book has information relating to the weaponry used by Africans in both combat and ceremonies.

Stone, George Cameron. *A glossary of the construction, decoration and use of arms and armor in all countries and in all times, together with some closely related subjects*. New York: Jack Brussel, Pub., 1961. Print.

This book describes every type of weapon and armor, how they were made and used.

Thornton, J. K. (1999). Warfare in Atlantic Africa, 1500-1800. London: UCL Press.

This book discusses how slavery influenced war in Africa and surrounding territories.

Annotated Bibliography (Jonathan):

Books:

Indian Arms and Armor

Egerton, W. (2001). ***A Description of Indian and Oriental Armor.*** **New Delhi Asian Educational Services. (HAM 739.74 E 2)**

This book mainly discusses the art styles of Indian arms and armor. History is also given to help give some context to the style of art.

Elgood, R. (1979). ***Islamic Arms and Armor.*** **London: Scolar.**

Elgood, R. (2004). ***Hindu Arms and Ritual: Arms and Armor from India 1400-1865.*** **Chicago: Eburon Academic Publishers. (HAM 739.746 El 3h)**

The book provides examples of Indian arms, armor, and artwork. This book is best used

with references to the history behind the arms and armor displayed. There is not much in the way of information on India during the time but rather what the pieces is in general. Background into the time period is needed along with this text.

Hales, R. (2013). ***Islamic and Oriental Arms and Armor: A Lifetime's Passion.*** **Robert Hales C.I. Ltd.**

Pant, G. N. (1978). ***Indian Arms and Armor.*** **Army Educational Stores.**

(HAM 739.746 P 19)

Paul, E. J. (1995). ***By My Sword and Shield: Traditional Weapons of the Indian Warrior.*** **Delhi: Roli Books Pvt Ltd**

Paul, E. J. (2005). ***Arms and Armor: Traditional Weapons of India.*** **Delhi: Roli Books Pvt Ltd.**

The book provides pictures of weapons and armor used in India as well as a brief history behind the pieces. This is good to compliment other works on the history of Indian arms and armor rather than being used as a singular source.

Rawson, P. S. (1969). ***The Indian Sword.*** **Arco Pub. Co. (HAM 739.77 R 19)**

This book gives a history behind styles of Indian arms. Pictures accompany some of the pieces described. Additional knowledge of the history of India itself would be helpful when using this book.

Richardson, T. (2007). ***Introduction to Indian Arms and Armor.*** **London: Trustees of the Royal Armories.**

This book goes into detail about the various types Indian arms and armor. In the descriptions, time period and sometimes region are provided. Pictures are available for some items but not all. This reference makes a good starting point but more information on India and the use of arms and armor is needed.

Robinson, H. R. (1995). ***Oriental Armor.*** **Toronto: General Publishing Company.**

(HAM 739.745 R 56o)

The book offers a brief history regarding arms and armor of India, China, and Japan as well as the small countries around those main three. Examples of types of armor such as plate, mail, et cetera are all explained for each sub-group. The book is helpful in getting a quick background of arms and armor for Asian cultures.

Stone, G. C. (1999). ***A Glossary of Construction, Decoration and Use of Arms and Armor.***

Portland: Southworth Press. (399.1 S877g)

Gives a list of types of weapons and armor with brief descriptions of the pieces. Pictures are added for some but not all. Best if used with more information on each subject because no history is provided.

Tirri, A. C. (2004). ***Islamic Weapons: Maghrib to Moghul.*** **Lake Elsinore: Indigo Publishing.**

Chinese/East Asian Arms and Armor

Robinson, H. R. (1995). *Oriental Armor.* Toronto: General Publishing Company.

(HAM 739.745 R 56o)

The book offers a brief history regarding arms and armor of India, China, and Japan as well as the small countries around those main three. Examples of types of armor such as plate, mail, et cetera are all explained for each sub-group. The book is helpful in getting a quick background of arms and armor for Asian cultures.

Stone, G. C. (1999). *A Glossary of Construction, Decoration and Use of Arms and Armor.*

Portland: Southworth Press. (399.1 S877g)

Gives a list of types of weapons and armor with brief descriptions of the pieces. Pictures are added for some but not all. Best if used with more information on each subject because no history is provided.

Werner, E. T. (1972). *Chinese Weapons.* Santa Clarita: Ohara Publications.

Japanese Armor

Bottomley, I. (2002). *An Introduction to Japanese Armor.* Royal Armories. (Pam Q3-08)

The pamphlet gives a brief history of armor and is organized by time period. Many images accompany the text. To start research, this resource is helpful. After reading the pamphlet, one has more information to do more in depth research.

Ogawa, M. (2010). ***Art of the Samurai: Japanese Arms and Armor, 1156-1868.*** **New York: Metropolitan Museum of Art.**

This book provides many examples of Japanese arms and armor from another collection of pieces which are good comparison to those from the Higgins Collection. History of Japan as well as processes in making arms and armor are provided at the beginning of the book to provide a background for the pieces showcased.

Ogawa, M. (2012). ***Art of Armor: Samurai Armor from Ann and Gabriel Barbier-Mueller Museum.*** **New Haven: Yale University Press.**

This book provides a history behind Japan as well as the arms and armor used throughout its history. With the history, the book provides images of examples of armor, katanas, tsuba, paintings, et cetera that are excellent comparisons to pieces from the Higgins Collection. History and purpose are also provided for each piece.

Robinson, H. R. (1969). ***Japanese Arms & Armor.*** **New York: Crown Publishers. (NK6684 .J33 1969)**

Robinson, H. R. (1995). *Oriental Armor.* Toronto: General Publishing Company.

(HAM 739.745 R 56o)

The book offers a brief history regarding arms and armor of India, China, and Japan as well as the small countries around those main three. Examples of types of armor such as plate, mail, et cetera are all explained for each sub-group. The book is helpful in getting a quick background of arms and armor for Asian cultures.

Stone, G. C. (1999). *A Glossary of Construction, Decoration and Use of Arms and Armor.*

Portland: Southworth Press. (399.1 S877g)

Gives a list of types of weapons and armor with brief descriptions of the pieces. Pictures are added for some but not all. Best if used with more information on each subject because no history is provided.

Japanese Weaponry

Bottomley, I. (2008). *An Introduction to Japanese Swords.* London: Trustees of the Royal

Armories.

Irvine, G. (2000). *Japanese Sword: Soul Of The Samurai.* New York: Weatherhill .

Ogawa, M. (2010). ***Art of the Samurai: Japanese Arms and Armor, 1156-1868.*** **New York: Metropolitan Museum of Art.**

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Stone, G. C. (1999). ***A Glossary of Construction, Decoration and Use of Arms and Armor.***

Portland: Southworth Press. (399.1 S877g)

Gives a list of types of weapons and armor with brief descriptions of the pieces. Pictures are added for some but not all. Best if used with more information on each subject because no history is provided.

Yumoto, J. M. (2008). ***The Samurai Sword: A Handbook.*** **North Clarendon: Tuttle Publishing. (NK6784 .Y8 1958)**

Supplies information on a brief history of Japan and the progression of the Japanese sword. This is an excellent resource for someone just starting out with research on Japanese weapons. The book goes into detail about the process in which swords are created, the parts of the sword, and smiths of various time periods and provinces.