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Heavy Metal in Medieval Europe

Sean M. Klimmek

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Heavy Metal in Medieval Europe

A Thesis presented

by

SEAN M. KLIMMEK

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

MASTER OF ARTS

February 2022

History
Heavy Metal in Medieval Europe

A Thesis presented

by

SEAN M. KLIMMEK

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ABSTRACT

HEAVY METAL IN MEDIEVAL EUROPE

FEBRUARY 2022

SEAN M. KLIMMEK, B.A., UNIVERSITY OF MASSACHUSETTS AMHERST
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Directed by: Professor Brian Ogilvie

How and why did plate armor come to be widely used in Medieval Europe? I trace the historical development of armor in Europe from antiquity to the middle ages, and then identify the main causes that pushed European warriors to develop and adopt plate armor from the 14th to the 16th centuries. I rely on prior research by scholars and historians of arms and armor, as well as primary source documents that describe arms and armor and their use in tournaments and on the battlefield. I conclude that a combination of social, political, military, and technical factors pushed European warriors to adopt plate armor. I also briefly discuss the demise of plate armor due to increasing use of firearms in the 16th century and the growth of professional armies.
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I. A BRIEF HISTORY OF ARMOR IN WESTERN EUROPE FROM ANTIQUITY TO THE MIDDLE AGES

A. Introduction

Heavy plate armor was the preeminent body armor worn by Kings, nobles, knights, men-at-arms and footmen in medieval Europe during the 13th to 16th century AD, but its development was not inevitable. As I will show, the history of armor in pre-modern Europe is not one of continual advancement, but instead retraction, differing application and slow technological refinement. The invention and adoption of plate armor in medieval Europe is unique in that no other region ever produced full suits of rigid steel armor in the form of an exoskeleton. I will therefore focus on the question of why plate armor came to be viewed as a necessity for medieval European warriors. I will begin with a short history of the evolution of armor in western Europe, and review the limitations of the armor that preceded plate. I will then examine pre-conditions and causal factors (social, political, military and technical) that prompted the development and growth of plate armor in medieval Europe. This discussion will be followed by a short analysis of some of the effects of plate armor and concluding remarks on the introduction of firearms and the end of the era of plate armor.

B. The Evolution of armor in western Europe

Heavy armor in medieval Europe was a product of the slow accumulation of craft knowledge and production technologies, as well as the combination of military, political and social pressures. In the course of my research I found that there was not an unbroken tradition of heavy armor from ancient Greece to the Renaissance in Europe, excepting the eastern Roman empire until its fall. The armor used in antiquity is important to discuss,
albeit briefly, since it is what western European armorers would have been familiar with. Furthermore since western Europe is where plate armor was invented, an in-depth history of armor there will be useful.

Heavy armor has been a part of European warfare since at least the Persian Wars (499-449 BC), and, if Homer’s account of the Trojan wars is accurate, perhaps even earlier.\(^1\) Herodotus, writing in the 5th century BC, notes that both the Greek and Persian coalitions employed heavily armored infantry.\(^2\) The Greek victories at Marathon (490 BC), Salamis (480 BC), and Plataea (479 BC) would cement the phalanx as the premier battlefield heavy infantry formation and armament in ancient Eurasia. The Roman Republic would initially adopt the phalanx formation and armaments, but the reforms of Gaius Marius in 107 BC would revolutionize Roman arms and tactics, resulting in the heavily armed and armored legions.

It is during the late Roman Republic (146 - 31 BC) that two new types of Roman armor appeared, the *lorica hamata* and the *lorica squamata*; the former would revolutionize body armor in Europe. The *lorica hamata* worn by Republican legionaries was a type of mail body armor that was made from alternate rows of solid and butted wire rings. The wire rings were easier to make, but weaker and were used to secure the solid rings. Each ring was joined to four others to form an interlocking pattern of rows. It is estimated that 35,000 to 40,000 rings were needed to make a *lorica hamata*.\(^3\) The Roman historian Varro, born in 116 BC, asserts that it was the Celts who first used this

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form of ring mail but is not clear as to when exactly, simply earlier than the Romans.\textsuperscript{4} However the use of mail armor was not a linear progression; in fact by the end of the Western Roman Empire in 476 AD, neither legionaries nor barbarians seemed to be wearing much body armor at all. According to the late-Roman historian Flavius Vegetius Renatus, “they [soldiers] first asked the emperor to set aside the breastplates and mail and then the helmets. So our soldiers fought the Goths without any protection for chest and head and were often beaten by archers.”\textsuperscript{5}

Renatus was not the only Roman to remark on this, and the lack of body armor is mirrored by the barbarian Franks before and after the fall of Rome. In \textit{De Origine et situ Germanorum}, (commonly shortened to the \textit{Germania}), the Roman historian Tacitus, born 56 AD, writes, “they only decorate their shields with the choicest colors. Few have breastplates, scarcely one or two have helmets made of metal or of leather.”\textsuperscript{6} Tacitus' account is written in 98 AD, but a later account of the Franks by the Byzantine poet and historian Agathias of Myrna in his \textit{Historiae} from 570 AD shows that in roughly five hundred years little had changed. According to Agathias, “They are ignorant of the use of breastplates and greaves and most of them fight with their heads unprotected, though there are a few who wear helmets. Back and chest are bare as far as the waist, the legs being encased in linen or leather trousers.”\textsuperscript{7} This is not to suggest armor was never worn by Franks in battle. Indeed, a surviving 8\textsuperscript{th}-century manuscript detailing the laws of the

\textsuperscript{4} M. C. Bishop, and J. C. Coulston. \textit{Roman Military Equipment : From the Punic Wars to the Fall of Rome}. 2nd ed. (Oxbow, 2006), 63
\textsuperscript{5} Flavius Vegetius Renatus quoted in Kelly DeVries, and Kay Douglas Smith. \textit{Medieval Military Technology}. (University of Toronto Press, 2012), 57
Ripurian Franks suggests that body armor was known to the Franks and perhaps used by some. It sets the price of a *brunia*, or mail coat, at twelve *solidi*, which at that time was the equivalent of two horses or two helms. But barbarians wearing armor appears to have been rare to Roman and Byzantine authors; moreover armor has never been excavated in early Frankish graves.

The lack of body armor by both the western Roman armies and Frankish warriors highlights the importance of another piece of armor, the shield. Shields played an important role in both mounted and infantry combat in the ancient world. Most Roman infantrymen had a *scutum*, which was rectangular and curved to protect the body, covering a soldier from his chin to his knees. The common *scutum* was made of a few layers of lightweight wood, then covered with leather or linen, and had a metal boss in the middle. When used in formation combat they were excellent, but in individual combat a scutum was overly large and cumbersome. After the fall of the Western Roman Empire in the late fifth century, these shields disappeared in western Europe; however the Eastern

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8 Norman, 17.
9 Norman, 15.
Roman Empire would continue to use them for centuries. Roman heavy cavalry, both *catafracti* and *clibanarii*, bore oval shields of similar construction.\(^{11}\) The other popular shield in Western Europe at this time was the barbarian shield carried by the various Frankish, Gothic and Germanic tribes, sometimes called a buckler. This shield was round or elliptical, convex, made from thin layers of wood, covered with leather, and had a metal boss in the middle. Such shields were generally 3 feet in diameter and could be highly ornate, covered with symbolic figures.\(^{12}\)

It is hard to pinpoint when the tradition of unarmored combat in western Europe changed. Legal codes of the Visigoths from the 680’s AD and the Lombards in the 750’s AD both required wealthier warriors to be armored but how closely these laws were followed is hard to determine.\(^{13}\) But literary and artistic sources agree that, by the 8th century, mounted warriors commonly wore mail. Unfortunately, the Christianized Franks rarely buried their dead with arms and armor, possibly due to their cost, so the only evidence for the type of armor worn comes from illuminations on surviving Frankish manuscripts and eyewitness testimony. The army fielded by Charlemagne was the first medieval army in Western Europe that was required to wear armor. The *capitulare missorum*, laws, of 792-793 AD required all holders of a benefice or title in Carolingian territory to own armor, shield and weapons. This law was amended by 805 AD and required that anyone who held 12 *mansi* of land was to have his own arms, armor and mount.\(^{14}\) This does not give the number of Franks so armed and the fact that Charlemagne had to repeat his law in a 13-year period makes it difficult to surmise when

\(^{12}\) DeVries and Smith, 59
\(^{13}\) DeVries and Smith, 61
\(^{14}\) DeVries and Smith, 62
or if Frankish warriors met his standards. What can be determined however is that by the early ninth century Franks with significant land holdings were expected to turn out for battle wearing what amounted to heavy armor at the time.

By all accounts the Franks that met those standards wore mail, had iron helms and bore round shields. Of these three pieces of armor only the Carolingian shields showed little change. Regarding Carolingian helms, DeVries and Smith note, “the Carolingian helmet fitted the head closely, was made in two pieces joined down the center, and had a broad brim.”¹⁵ The mail body armor was called a byrnie and was very costly, worth one horse, four times a sword and six times a spear and shield combined.¹⁶ In form, it was a long sleeved mail shirt that fell below the hips and afforded such good protection that Charlemagne forbade the sale of it outside the realm in 779 AD. There are scattered accounts of leg and arm guards in the Carolingian period but they were expensive, rare and probably only worn by wealthy noblemen.

Figure 2: The Bayeux tapestry

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¹⁵ DeVries and Smith, 62
¹⁶ Alan R. Williams, _The Knight and the Blast Furnace: a History of the Metallurgy of Armour in the Middle Ages & the Early Modern Period._ (Leiden: Brill, 2003), 41
The Bayeux tapestry, crafted to memorialize the Norman conquest of England in 1066 AD, serves as one of the best graphical representations of 11th and 12th century arms and armor.\(^{17}\) It should be noted that the Bayeux tapestry is in fact an embroidery, and despite the difficulty in working with the medium it is remarkably consistent in its depiction of armored figures, with 79 of the 200 armed figures wearing body armor. For our purposes, the Bayeux tapestry showcases the changes in armor from the Carolingian period. For their defensive armaments, the figures in it are shown wearing open helms, mail, probably hauberks, and carrying shields. The hauberk is similar to a tunic, with short sleeves, and usually fell to the knees. It could be made of interwoven steel or iron rings, sometimes called chainmail. At this time a hauberk was generally made by attaching iron rings or small plates to a stout woven fabric in either vertical, or horizontal rows.\(^{18}\) A hauberks made with small plates would be an example of scale mail, but was rarely seen in western Europe. Nonetheless there is little real difference between the Carolingian byrnie and the 11th-century hauberk. Both are constructed similarly using similar materials, the only notable difference is that hauberks have longer sleeves and a split from crotch to hem to facilitate riding. A few Norman figures, including William the Conqueror, who would conquer England in 1066 AD, have a colored rectangle on the breast of their hauberks, which may be a rudimentary breast plate or a ventail, the mail face covering of a coif.


Some figures, notably William the Conqueror, and Harold Godwinson, the last Anglo-Saxon king of England defeated by the aforementioned William, are shown with mail coifs and wearing mail leggings, or *chausses*. The wide brimmed Carolingian helmet is nowhere apparent in the Bayeux tapestry. Instead all armored figures, Norman and English alike, are shown wearing a close fitting conical helm, pointed on top, with a wide flat nasal guard attached to the brim. The English do not seem to be equipped very differently from the Normans, except for the occasional round and oval shields they bear.

The depiction of the rest of the Norman and English shields on the Bayeux tapestry showcase another advance in armor. This new shield was called a kite shield, and differed little in construction from earlier shields, however its shape was massively different. Kite shields were long and narrow with a rounded oval top, narrowing to a point at the bottom. They were particularly adapted for mounted combat, the tapering triangular bottom was much easier to use mounted, providing some protection to the left leg, while the broader oval top protected much of the rider's chest.¹⁹ Surprisingly, kite shields were equally effective for infantry, who could plant the triangular bottom in the ground, and overlap the broader tops to form a temporary battlefield formation known as a ‘shield wall.’

An inspection of the armor of the European knights who embarked on the first crusades in the late eleventh and early twelfth centuries shows little change in armor from the Bayeux tapestry. The *hauberker* was still the common armor worn by knights, although on occasion it could have two or even three layers of mail in its construction. It had become slightly longer, falling almost to the knees, was belted at the waist, and

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frequently had long sleeves. There are even some depictions, such as the kneeling knight in the *Westminster Psalter* (written and illustrated in the early 13th-century), that show mufflers that cover the hands.\(^{20}\) This same knight is also shown wearing *chausses* that completely covered the foot, which had become increasingly common equipment when fighting mounted.

The primary differences in armor for Western European knights was a matter of slight refinements in mail. Despite its popularity the price of mail seems to have remained relatively static into the 12th century.\(^{21}\) A brief explanation of the medieval smiths’ process when creating mail should help to explain its cost, although by this point the particular skills needed to produce armor, and the fact that such a smith produced nothing else, may have given rise to the medieval armorer.\(^{22}\) To start, iron wire had to be beaten out of stock which frequently resulted in a rough, uneven

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\(^{21}\) DeVries and Smith, 68 A mail shirt cost the same as a horse, this comparison in cost to horses is fairly common, but refers to a trained war horse, or destrier, not a plow horse.

\(^{22}\) There is no consensus on when exactly armoring became a profession but, by the time plate armor was introduced, there were already established armurers.
ring of wire. It was not until Rudolph of Nuremberg discovered how to draw wire in the 14th century that the process became easier and the resulting rings more uniform.\textsuperscript{23} \textsuperscript{24}

The full process of creating mail started with iron or steel wire, either hammered out or drawn. It was then twisted around a wooden rod of the diameter of the desired rings. The twisted metal wire was then cut off into rings. The two ends were flattened and holes were punched through the flat portion. Finally the rings were interlaced with each ring passing through four others and a small rivet was inserted.\textsuperscript{25}

Although mail had adequate defensive properties against slashing attacks, it did little to stop the impact of a blow. To improve their defense against such attacks, some medieval combatants took to wearing a padded or quilted under tunic, called alternatively a \textit{pourpoint} or \textit{aketon}.\textsuperscript{26} Others wore a \textit{gambeson} over their armor, which was similar to a surcoat, but had substantial padding. One notable addition to the \textit{hauberkr} that was only seen rarely before the 11th century was the \textit{coif}, which was a hood of mail, that was now attached to the body of the \textit{hauberkr}. One other important addition to note in the late 11th century, although it provided no real defense against attacks, is the surcoat, also seen on the kneeling knight in the \textit{Westminster Psalter}. To say it provided no defense is perhaps incorrect, although it would never be considered armor, but it did identify a knight during and after a battle. This was crucial since a rich and powerful knight when defeated would be spared for ransom. The surcoat became the most popular outer garment worn by medieval knights and its depiction on statuary and other artistic sources accounts for the

\textsuperscript{23} Drawing wire is a metalworking process used to reduce the diameter of a wire by pulling the wire through a series of drawing dies.
\textsuperscript{24} Charles John Ffoulkes. \textit{The Armourer and His Craft : From the Xith to the Xvith Century}. (New York: B. Blom, 1967), 44
\textsuperscript{25} Ffoulkes, 45
\textsuperscript{26} These are all different but no early examples survive to show just how they were different.
difficulty in dating the development of the plate armor breastplate. This long, sleeveless garment was split down the sides and went over the hauberk reaching to about mid-calf. It was originally thought that the surcoat was adopted to display the heraldry of its wearer, but this is now doubted as surcoats bearing such heraldry do not appear until well after its initial adoption. One logical theory is that the surcoat was first employed by crusaders to help keep them cool in the desert climate of the Middle East, as the combination of climate and sun would combine to make metal armor unbearable.

The end of the 12th century saw more modifications made to armor. The long popular kite shield was replaced by the lighter, shorter and wider heater shield. The heater shield was much more triangular, even easier to maneuver on horseback but provided no protection for a mounted warrior's leg, probably reflecting the fact that *chausses* had become widespread. This is by no means a certainty, but the preponderance of late 12th and early 13th century artistic sources, such as the *Westminster Psalter*, show knights with full leg armor. Although not particularly adapted for combat on foot, as it protected much less of the body than the previous kite shield, the heater shield would also become common equipment for infantry in the 12th century.

The heater shield was joined by new types of helmets in the 12th century, some worn under the coif, others over. The *cervelliére* or *bascinet* was a rounded helm that followed the contours of the head, and was worn under the coif. By the 13th century a face plate was added, but the design was unbalanced and a rounded plate was added around the back of the head.27 These new parts combined with the original helm was no longer a *cervelliére* but instead a *heaume* or great helm which was worn over the coif and fully enclosed the head. Cylindrical in form, it had slits cut for vision and breathing, but

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27 DeVries and Smith, 71
the major challenge was keeping it on a knight’s head. A quilted arming cap began to be worn over the coif and under the great helm to keep it in place. Despite the weight, unwieldiness, and lack of vision the great helm became the favorite helm for the mounted knight due to its superb defensive properties. One further advantage of the great helm was its replacement of the mail ventail, the armor for the lower face and throat, which was hot and difficult to breathe through. Common infantry could not afford to purchase a great helm and also would have struggled with the weight, and lack of vision, both of which required long training that only knights received. Instead, common soldiers began to wear a new helm called a kettle hat. The kettle hat was in the shape of a bowl with a wide brim, worn with or without a mail coif, and attached by a chin strap. In form it was very similar to the earlier Carolingian helmet of the 9th century.

The last innovation in armor during the 12th century was for the horse. Mounts began to be covered in a large flowing cloth called a caparison. This provided little protection to horses and was augmented by a mail trapper that covered a horse from head to tail and fell down to its knees. The weight of the caparison and mail trapper combined with the increasingly
heavier armor worn by European knights and men at arms, no doubt accounts for the trend in European horse breeding that focused on strength and sturdiness.²⁸

Changes in armor continued in the 13th century as the disadvantages of mail were becoming more apparent and new modifications were undertaken. The 19th century French historian Paul Lacombe argues that in the thirteenth and fourteenth centuries, armor was driven by fashion and the changes seen in a knight's equipment were driven by this sense of fashion. Lacombe's focus on fashion fails to take into account an evolving battlefield and the pressure armorers and knights felt to have the best armor to keep them alive. By the middle of the thirteenth century plate armor of various sorts was being employed to protect the extremities. This armor at first focused on the joints, so coudières, elbow guards, genouillières, knee guards and épaulettes, shoulder guards, were the first additions. By the early fourteenth century two new additions joined the growing list of plate armor, gardes bras, or arm guards and grevières, which were for the legs. It is in the early fourteenth century that these separate pieces of plate armor on the limbs began to be joined together with hinges, leaving little mail exposed. This innovation began the process of creating suits of armor, rather than individual pieces, and increased the protection for the joints, especially at the elbows and knees.

However it was not just the extremities that were being armored in plate during the thirteenth century. Chest armor was also changing, although evidence for when exactly these changes were occurring is hard to pinpoint.²⁹ In his treatise, European Armour, Claude Blair notes that Giraldus Cambrensis's account of a Danish attack on

²⁹ This is due to the dearth of archeological finds and the surcoat's influence on art and sculpture.
Dublin in 1171 observes that the Danes were wearing *laminis ferreis arte consutis*.\(^{30}\)\(^{31}\) However there is no way to determine if this was some form of proto-plate armor or if it was scale or lamellar armor, both of which were worn by Scandinavian warriors. Blair is unsatisfied by this ambiguity and provides what he thinks is the first textual account of plate armor by Guillaume le Breton. Le Breton provides an account of a duel between Richard, Count of Poitou, and William de Barres, a retainer of the French king Phillip II, sometime in the early thirteenth century. Blair notes, “each combatant is described as wearing a plate of worked iron (*fera fabricata patena recocto*) beneath the hauberk and aketon.”\(^{32}\) Although Blair uses the singular when translating, many historians, DeVries and Smith included, think that the combatants wore multiple plates of iron only covering their extremities. This shows that the emerging system of plate armored extremities was not only paired with a mail *hauberk*, but also new forms of plate chest armor.

It is helpful to compare plate armor with lamellar armor, which was popular in south eastern Europe, especially the Byzantine empire. Although precise dating is impossible, it is speculated that the Assyrians used some fashion of lamellar armor in the seventh century BC.\(^{33}\) Due to its flexibility, ease of construction, and maintenance, and the wide variety of materials that it could be made from, lamellar armor was popular throughout Eurasia. Lamellar armor consists of very small plates known as “lames,” which are punched top and bottom and laced together, typically in horizontal rows. The chief difference between lamellar and scale armor was that lamellar was laced together

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\(^{30}\) Claude Blair, *European Armour, circa 1066 to circa 1700*. (Macmillan, 1959), 37

\(^{31}\) Cambrensis, Giraldus. *The Autobiography of Giraldus Cambrensis*. trans. Harold Edgeworth Butler. London: J. Cape, 1937 This is almost certainly second hand since a close read of his autobiography shows that Giraldus was still in training in Paris in 1171.

\(^{32}\) Blair, 38

into armor and worn with additional padding and armor underneath. Scale armor was attached directly to a garment and allowed less flexibility in layering armor beneath it. The other relevant feature of lamellar armor was the overlapping nature of the lames, because adjoining horizontal rows made the seam between each lame a weak point. To combat this, lamellar was overlapped up or down and left or right.

Most equestrian cultures that employed mounted archers, the Mongols and Turks most notably, preferred lamellar armor and were particular to overlap the lames right to left so their bow strings would not catch on their armor. By the tenth century, the Byzantines had begun making a new type of lamellar armor, a *kilbanion*, that placed the lames side by side, affixed to a thick leather backing, and overlapping upwards. The sturdiness of this type of lamellar armor is attested by Anna Komnene, the daughter of the Byzantine emperor, Alexios I Komnenos, who recounts an anecdote from the battle of Dyrrhachium in 1081 where her father survived being struck on either side by multiple lances. Lamellar armor and the *kilbanion* in particular are important due to their similarity to the first real plate chest armor. It was perhaps the crusader contact with Byzantine armor that caused western European knights to line their surcoats with small steel lames, which were riveted in place. Worn over a mail hauberk, these lames added another layer of defense but lacked the glancing surface that was resistant to piercing attacks which could only be provided by a solid steel plate.

The coat of plates was the next attempt at added chest armor made by medieval European armorers and was very similar to lamellar armor and the armored surcoat. In

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34 Comnena, Anna. *The Alexiad of Anna Comnena*. trans. E. R. A. Sewter. The Penguin Classics. (New York: Penguin Books, 1969), 138 There seems to be quite a difference in translation since I have read other scholars accounts of this particular engagement and they have mentioned that Alexios was struck by anywhere between nine and four lances.

35 Nicolle, 111
the shape of a vest, the coat of plates closed in the front and was composed of two breastplates that met in the middle. The back and abdomen were covered by smaller plates to give more flexibility, if less protection. In *The Knight's Tale*, Chaucer, (1343-1400), refers to this armor as a pair of plates, “Som wol ben armed in a haubergeoun, in a bristplate, and in a light gypoun, and somme woln have a paire plates large.”\(^{36}\) The trick of overlapping armor that made lamellar armor so strong was also employed in the construction of the coat of plates, but instead of right over left or bottom to top, it was left over right.\(^{37}\)

A lighter chest armor that was popular among European archers and infantry was the jack of plates, or jack. A jack was usually made of a heavy fabric, probably canvas, into which were sewn iron or steel plates. Unlike the coat of plates the jack was ugly, cheap, easy to produce and was not fitted to the wearer. A mass grave excavated on the island of Gotland, at the site of the battle of Visby, July 27, 1361, produced 25 suits of armor matching this description.\(^{38}\) A similar type of armor that was popular at the same time, but was used by all ranks, was the brigandine. The brigandine was typically made of canvas or leather and lined with small steel plates. These plates were then riveted to the fabric, sometimes with elaborate decorative patterns, and a second layer of fabric was sewn inside. Brigandines were not limited to canvas or leather, and some surviving pieces from noble collections used velvet. Although the jack and brigandine would be

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\(^{37}\) Nicolle, 111, This is because when jousting a knight's left side was always presented to his opponent and it was imperative that the enemy's lance would have nothing to catch on and glance off the halved breast plates. Nicolle further claims this is why men's jackets are buttoned left over right today.

\(^{38}\) DeVries and Smith, 75
used well into the 17th century, they represent the end of European development in multi-plate chest armor.

The first single plate chest piece was produced in the early fifteenth century and was called the *demi-cuirass*. It was combined with another piece called the *faudes*, that extended down like a kilt to cover the hips and upper thighs. Since these pieces replaced the *hauberker*, what was worn under this chest piece was a fine mail vest called a *haubergeon*. The insides of the plate armor on the extremities were padded and the joints had metal disks and a web of mail attached inside to give extra protection.

By the fifteenth century, a knight often wore a complete set of plate armor. Lacombe provides an excellent list of the plate armor worn by a fully armored fifteenth century knight:

1. The *cuirass*, covering the whole figure, breast and back.
2. The *epaulières*, guards for the shoulders.
3. The *brassarts*, or arm guards.
4. The *coudières*, elbow guards, and coverings for the inside of the elbow joints.
5. The *avanbrás*, guards for the lower arms
6. The *faudes*, or *taces*, with the *tuilles*.
7. The *haubergeon*, or defence for the body worn under the cuirass.
8. The *cuissarts*, thigh pieces.
10. The *grevières*, leg pieces.
11. The *sollerets*, or *souliers* (with the spurs), laminated coverings for the feet; and
12. The *gauntlets*\(^{39}\)

Lacombe does not list a helmet, or shield. At this point the common helmet in France was the *basinet*, which was smaller than its larger cousin the *heaume*, and frequently employed a visor that could be lowered to cover the front and bottom half of the face when in battle. For a shield, knights still employed the small triangular kite shield.

\(^{39}\) Lacombe, 148.
Lacombe’s list not only shows all the different pieces of armor a European knight wore but also highlights the complexity such a suit of armor entailed. Medieval European armor smiths had come a long way from the easily produced chainmail and now produced full suits of plate armor that required a much higher level of skill. A full suit of plate armor goes a long way to explaining the relative immunity to harm the medieval knight enjoyed on the battlefield. The only threat that could reliably pierce such armor was a lance wielded by an enemy knight, or a crossbow bolt at close range, and both would need to strike perfectly perpendicular to a plate or a weak point, such as a joint. This is not to imply that a skillfully wielded sword, ax, or mace could not injure a knight, but most casual blows were easily deflected.
II. FACTORS LEADING TO THE ADOPTION OF PLATE ARMOR

Understanding why plate armor was adopted in Europe first involves understanding the pre-conditions necessary for its introduction and the circumstances that contributed to its widespread use.

A. Metallurgy and Blacksmithing

The key preconditions for plate armor were the advances in metallurgy and blacksmithing that enabled European smiths to produce hardened steel armor. The process of making steel was extremely difficult for medieval European smiths and the advantages of steel were not immediately apparent compared to bronze. Low carbon iron produced in a bloomery hearth, the common way iron was produced in medieval Europe, was not as hard nor as resistant to corrosion as copper alloys. The process of turning iron into steel did increase its hardness but it still was not harder than cold worked bronze.40 A bloom is produced by heating iron ore in a furnace, to roughly 1200 C, which causes the majority of the surrounding material, called slag, to liquify and run off, leaving the iron behind. Such furnaces were called bloomery hearths and produced bloomery iron, or wrought iron. Repeated heating and forging were needed to remove as much of the residual slag as possible but only produced a more purified iron. This is not to suggest that bloomery furnaces did not produce some steel. Medieval smelters did this by making a large bloom, breaking it into chunks, and sorting out the hardest pieces. These hard pieces had absorbed more carbon in the furnace and had become low quality steel. The resulting fragments could then be forged back together into steel stock of uneven quality.41

40 Williams, 5
41 Williams, 7
Case-carburisation was the first reliable process used to produce steel and was accomplished by heating iron in charcoal and leaving it in the charcoal for an extended period of time to absorb carbon. This process was understood and practiced in antiquity but was only useful for small pieces, since it started from the outside in and once a large piece of iron had become steel all the way through, the exterior would have absorbed too much carbon and become too brittle. By the early middle ages a new process called “wootz” became popular in India and the Middle East, eventually reaching Islamic Spain. Making wootz steel was a more advanced form of carburisation that was accomplished by heating small scraps of iron in crucibles packed with charcoal until the iron had absorbed sufficient carbon and melted together into steel. This process was completed by allowing the steel to cool extremely slowly.\(^{42}\) This produced very high carbon cast steel, although in very small quantities, and was the primary material used in blades by weaponsmiths from India to western Europe, most notably in Damascus swords.\(^{43}\)

But merely producing steel (or iron) was not enough - the steel or iron had to be hardened to resist a blow and keep its shape. One process used to harden iron or steel was quenching, plunging the red-hot metal into water, which could result in a metal that was much harder than its air cooled counterpart. Although ancient smiths were familiar with quenching, the materials they worked with varied widely in purity, which caused uneven results and may be the reason quenching was less popular in antiquity.\(^{44}\) The other important process for hardening iron and steel was tempering, which involved reheating and then cooling the metal. Tempering is usually done after quenching and

\(^{42}\) Williams, 14
\(^{44}\) Williams, 8
reduces the hardness of steel, but also removes the internal stresses, which in turn reduces
the brittleness of the steel.\textsuperscript{45} By the fourteenth century, quenching and slack quenching
(where the quenching is slower or interrupted), were well understood in Western Europe,
and together with tempering, were the main methods used to produce hardened plate
armor.

Although the transition from iron to steel and the processes needed to work both
are well understood by historians, there is very little documentation concerning this shift.
In many respects this is due to the fact that armor smithing, swordsmithing and
blacksmithing were all crafts based upon tacit knowledge. Furthermore, most smiths in
late antiquity and the early medieval period were probably illiterate.\textsuperscript{46} Even if a smith
were literate and wanted to leave written instructions, too much of their craft required
hands-on experience that could not be precisely written down. How could one describe
the exact color of iron stock when removing it from a forge to work, or the sound a
hammer made that could tell a smith about the purity of the metal stock he was working
with? Because it was difficult to convey in writing, this tacit knowledge was passed on
in one-on-one instruction. This accounts for the paucity of sources detailing technical
knowledge and explains the longevity of the apprentice system that pervaded
blacksmithing in the pre-modern world.

The problem of sources becomes further complicated by the dynamic between
techné, praxis and épisteme, begun in the ancient world. Greek thinkers and writers held
techné, material and technical work, in low regard, perhaps due to the association of craft

\footnotesize{
\textsuperscript{45} Williams, 18
}
with unfree labor. This is not to suggest that *techne* was completely disregarded: Aristotle acknowledged the mechanical arts, but placed them as subordinate to the liberal arts. *Techne* was similarly separated from *praxis*, political or military action, and this attitude would last well into the medieval period and accounts for the lack of sources about *Techne* until the late medieval period. Medieval armor smithing is probably one of the earliest examples of the reunion of the two. Few, if any, medieval armorsmiths read Aristotle and were undoubtedly unaware of the disregard classical thinkers held for *techne*. But the educated elite in Europe were familiar with Aristotle, and their emulation of the classical thinkers resulted in little interest in investigating and writing treatises on technical matters, such as smithing and metallurgy. It is for these reasons that literary sources are hard to come by, and archeology, especially experimental archeology, have been useful in providing some clues to help historians reconstruct medieval smithing and metallurgy techniques.

**B. Mounted Shock Combat**

While improvements in smithing and metallurgy made plate armor possible, the challenges of mounted shock combat contributed to its widespread use. As discussed below, Charles Martel devoted considerable resources to converting his military into an armored fighting force. But the Franks were far from the first Europeans to fight mounted. One early advocate for cavalry in antiquity, who used them to great effect in his wars of conquest, was Alexander of Macedon (356-323 BC). He was followed by the Romans, who recruited their cavalry from the patricians in the early Republic. These

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patricians became members of the equestrian order and were known as *eques*. During the Roman Empire, personal service by the wealthy only occurred in the officer corps. To recruit enough cavalry the Roman response was to require allied tribes on their borders that had equestrian traditions to serve as auxiliaries. In the eighth century, Charles Martel saw the advantage of mounted warriors and, as described below, required men of certain wealth to assemble with arms, armor and mount when called for service. However, the number of such mounted warriors in the Frankish army was low and their use is unclear.

The mounted warrior of pre-feudal Europe had access to large horned saddles, bits, and reins, but lacked the most important stabilizing piece of tack, stirrups. The importance of this piece of technology has become quite a bone of contention since the publication of Lynn White’s polarizing volume *Medieval Technology and Social Change* in 1962. White, as an advocate of technological determinism, even goes so far as to rest European Feudalism on the stirrup and his discussion of the Frankish adoption of the stirrup and the response of historians is important to understanding mounted combat in medieval Europe.

White contends that the stirrup was introduced to the Franks in the early eighth century. At first glance placing the adoption of the stirrup in the 8th century seems problematic since there is significant lag in contemporary surviving western European art. However, White argues that there is abundant archeological evidence that agrees with the Frankish adoption of stirrups in the early 8th century. Furthermore, White observes that in the 8th century the French verbs *insilire* and *desilire*, that had been used to describe mounting a horse, began to be replaced by *scandere equos* and *descendere*.

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49 White, 25.
leaping had been replaced by stepping. But it is the concurrent shift in arms that he considers the most telling. Both the *angon* (a heavy javelin) and *francisca* (a light throwing ax), hallmarks of the Frankish light infantry, disappear to be replaced with an elongated spatha and a heavy spear with spurs below the head, which White argues evolved into the longsword and the Carolingian wing-spear respectively. Although both of the new weapons could be used by infantry, and probably were at need, they were both specifically engineered for what White called “mounted shock combat.” Longswords were particularly useful for the mounted warrior who wanted to easily slash or stab at other mounted foes or infantry below him. The Carolingian wing-spear’s most prominent feature is the crosspiece below the head of the spear, which was to prevent the spearhead from penetrating a foe too deeply, making it difficult to withdraw the spear. This had never been a concern for infantry but a rider using stirrups could now put the full weight of horse and rider behind his charge, and a spear could penetrate so deeply that it would be irretrievable. White took his thesis further, arguing for a form of technological determinism, in which the development of the stirrup caused widespread use of mounted shock combat. This necessitated the allocation of sizable landholdings (such as benefices) to support the substantial cost of supporting a mounted and armored knight, leading to the growth of vassalage arrangements and feudalism.

White’s thesis concerning European feudalism caused almost immediate pushback and Bernard Bachrach’s article “Charles Martel, Mounted Shock Combat, the Stirrup and Feudalism,” refuted much of White’s evidence pertaining to the stirrup as the foundation of European feudalism. Despite this critique, no one has seriously attacked the necessity
of the stirrup for mounted shock combat.\textsuperscript{52} Furthermore, White’s observations about Frankish weapons were mostly accurate, although his supposition that the Franks used the Carolingian wing-spear couched as a lance is doubtful since later artistic evidence such as the Bayeux tapestry only depicts a few riders using their spears in such a manner. Despite this difference in arms it is important to note that every mounted figure in the Bayeux tapestry is using stirrups. Furthermore all of the important English and Norman figures shown in combat in the Bayeux tapestry were mounted. It is hard to imagine that only the English and Norman elite fought mounted in western Europe and it seems probable that mounted combat among the elite had become the norm.

This shift to mounted combat presented a problem for mounted warriors, who became much more conspicuous and significant targets on the battlefield, attracting attacks from archers, infantry, and other mounted warriors. And the stirrup allowed mounted combatants to deliver much stronger blows to their opponents, particularly using a lance. These changes led to advances in armor so that the extra exposure afforded by their mounts did not become a fatal disadvantage to mounted combatants.

Accounts from the crusades illustrate the tactics used in mounted shock combat and the resulting need for improved armor. Mounted shock combat was the preferred method of combat by the European crusaders during the First Crusade (1096-1099). In the \textit{Alexiad}, Anna Komnene describes the tactics and armor of western European knights, “indomitable in the opening cavalry charge, but afterwards, because of the weight of their armor and their own passionate nature and recklessness, it is actually very easy to beat

\textsuperscript{52} Connolly, Peter, and Carol Van Driel-Murray. "The Roman Cavalry Saddle." Britannia 22 (1991): 33-50. Both authors agree that Roman saddles did allow for a wide range of actions for the mounted warrior; neither suggest anywhere that it was sufficient for mounted shock combat.
them.” The standard tactic for this new form of combat was to have the knights form a line facing their enemy and charge, this line abreast charge allowed mounted knights to fully employ the weight of their mount, armor, and long lances. This tactic crushed medieval infantry with relative ease, and the preferred response appears to have been a counter force of knights. The use of the couched lance in such a charge could easily pierce mail armor, as evidenced by later accounts from the holy land. According to the memoirs of Usāmah ibn Munqidh when fighting the Franks in 1119, “I rushed on the horseman and smote him with my lance, which pierced him through and projected about a cubit in front of him.”

Later Usāmah recounts a conversation with a Frankish knight that commented on his blow, “verily the Franks have all been astounded on account of that blow which pierced two layers of links in the knight’s coat of mail.” The deadliness of the lance, and weakness of armor against it is also prevalent in the Song of Roland. “He breaks the shield, he cleaves the hauberk close, clean through his breast drives lance and pennon both.”

Although the epic poem is ostensibly about the battle of Roncevaux Pass in 778, it was written in the late eleventh century and describes combat, arms, and armor of that time.

The new method of using a couched lance was not the only challenge faced by mail clad warriors. Improved bows and crossbows - and in particular the recurve composite bow - could also pierce mail. Bows were not particularly popular in early medieval European warfare, mostly because hand or “self” bows that were effective when

53 Comnena, 320
55 Usāmah, 69
hunting lacked the power to penetrate most armor, including mail. One particularly
telling account comes from the *Alexiad*: “They were issued with a plentiful supply of
arrows and told not to be at all niggardly in their use; but they were to shoot at the horses
rather than the Kelts, for he knew that cuirasses and coats of mail made them almost, if
not entirely invulnerable.”

57 Comnena, 382

C. Bows and Crossbows

The bow eventually became popular in medieval European warfare for three
reasons. The first was increased contact with the Muslim world during the Crusades that
would reintroduce the majority of European fighting men to the composite recurve bow.
Archeological finds confirm that composite recurve bows were in use well before written
records mention them but their use across the Eurasian continents was not uniform.
Packing enormous power for their small size, composite recurve bows were the favorite
weapon of horse nomads such as the Turks and Mongols. To be sure, not all Muslim
archers encountered by Christian fighting men had such bows, or the right arrows to
pierce their armor. According to Saladin's biographer Behaa ed-Din, “Each foot-soldier
[of the Crusaders] wore armor made of very heavy felt, and so stout a coat of mail that
our arrows did no harm. But they shot at us with their great crossbows and wounded both
horses and riders. I saw foot-soldiers with as many as ten arrows in their backs, who
marched on just as usual without breaking rank.”

58 J. F. Verbruggen, *The Art of Warfare in Western Europe during the Middle Ages: From the
Eighth Century to 1340*. Second edition, Revised and enlarged. (Warfare in History. Woodbridge:
Boydell Press, 1997), 235

This would seem to indicate that
Muslim bows were not very powerful, but this is probably because the average troops
levied by Saladin would not have been equipped with a composite recurve bow. By contrast, most medieval elite Turkish and Arab units and virtually all Mongol warriors had composite recurve bows and used them to deadly effect.

Recent efforts in experimental archeology have proved that eastern fletched arrows, the type used by Arabic and Mongol archers, with a bodkin point in the shape of a sharpened metal spike, were easily capable of penetrating mail. This research highlighted that the failure point in mail shirts was always the rivets holding each link together, since medieval smiths did not use butting or heat welding when making the links for mail. With the technology available to armorsmiths in the 12th century the next logical step to increasing body armor’s defense against projectile weapons was steel plates.

The second reason for increased interest in bows was the Welsh longbow, later adopted by the English, which was also capable of piercing mail, and would be fielded in massed quantities by the English during the hundred years war. Some caution is required, since historians have re-evaluated the impact of the longbow at the battles of Crecy (August 26, 1346) and Agincourt (October 25, 1415) and concluded that the massed arrow fire in these battles did not produce mass casualties, as previously thought, but rather served to demoralize the enemy. Mail was not the primary armor worn by knights and men at arms during these battles, but earlier accounts when mail was still the

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59 This is due to the cost of a composite recurve bow, the training required to be a competent archer, and the nature of medieval levies that were generally composed of conscripted peasants.
61 Mitchell, 26
primary armor worn attest to the longbow's power to penetrate mail. *The Itinerary of Archbishop Baldwin through Wales,* written in 1148 AD by Giraldus Cambrensis states.

Another soldier had his hip, equally sheathed in armour, penetrated by an arrow quite to the saddle, and on turning his horse round, received a similar wound on the opposite hip, which fixed him on both sides of his seat. What more could be expected from a balista? Yet the bows used by this people are not made of horn, ivory, or yew, but of wild elm; unpolished, rude, and uncouth, but stout; not calculated to shoot an arrow to a great distance, but to inflict very severe wounds in close fight.63

The third reason for increased interest in bows was the development and improvement of the crossbow. Ultimately, the crossbow, rather than the longbow and the composite recurve bow became the most feared ranged weapon on the medieval European battlefield. William de Braose called it a “ballista”, but Baha ed-Din uses the more common name that we still use today, the “crossbow”. It is speculated that the medieval European crossbow is based upon the late Roman *gastraphretes* but no examples of the Roman weapon have survived to confirm this.64 Chinese crossbows from the Han dynasty are contemporaneous with the Roman *gastraphretes* but the release mechanism is entirely different, which argues for independent invention.65 Medieval European crossbows do not appear until the ninth century; the earliest example was found on the Pictish Drosten stone.66 Early medieval crossbows had a short, thick bow, to the center of which was attached a stock that was grooved on top to accommodate a short, heavy bolt, with a release mechanism underneath. Initially the string of a crossbow was

65 Nicolle, 122
66 Nicolle, 123 the Pictish Drosten stone was carved in the 9th century at St Vigeans, near Arbroath, Scotland
spanned, or pulled back, by using a stirrup at one end of the bow and a claw that attaches to the crossbowman’s belt. Due to advances in gearing a mechanical device was invented called a cranequin or windlass mechanism that made spanning a crossbow much easier.  

This enabled crossbows to have a much higher draw weight than even the best composite recurve or longbow, penetrating mail with ease and even early plate armor. Although fairly common in western Europe by the Crusades, they were practically unknown in Constantinople. According to Anna Komnene,

The crossbow is a weapon of the barbarians, absolutely unknown to the Greeks . . . In the firing the string exerts tremendous violence and force, so that the missiles wherever they strike do not rebound; in fact they transfix a shield, cut through a heavy breastplate and resume their flight on the far side, so irresistible and violent is the discharge.  

Christian contact with their Muslim adversaries during the Crusades spurred further innovation since crossbows began to use composite materials in their bows. The strongest evidence for this is the new crossbow quivers that became popular in 12th century Europe. These new quivers were box-like with a flaring base that stored bolts point up, and were almost identical to the arrow quivers used by the Seljuk Turks. The possibility of Islamic influence is further reinforced by the name of King John’s chief crossbow maker found in a 1205 record, ‘Peter the Saracen.’  

The increasing power of the crossbow did not go unnoticed by the Catholic Church, as both Pope Urban II, in 1096, and the Second Lateran Council, in 1139, condemned their use against Christians.

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67 DeVries and Smith, 42  
68 Anna Comnena, and E. R. A. Sewter, 406  
69 Nicolle, 123  
70 David Edge, and John Miles Paddock. *Arms & Armor of the Medieval Knight: An Illustrated History of Weaponry in the Middle Ages*. (Crescent Books, 1993), 36  
This had little effect; Catholic condemnation and the church's promulgation of chivalry would not stop European princes from employing the best weapons they could lay hands on.

The bow, the crossbow and the lance impacted different aspects of medieval European combat, but they all defeated mail easily and prompted medieval combatants to push armorers for a solution on the battlefield. Plates of solid steel armor crafted to present a glancing surface to most attacks was the solution that European armorsmiths developed. That plate armor was the response is not surprising, but what then occurred was an arms race between armor, and the lance and crossbow. Good plate was, for all intents and purposes, impervious to bow fire, but improvements to the crossbow, notably the adoption of a steel bow and the cranequin, forced armorers to perfect the process of making hardened steel armor. The lance gained increased lethality by the invention of the arret, or lance rest. This was a metal flange that was added to the right side of a breastplate that more effectively transferred the charging force of mount and warriors to his lance. This not only increased the striking power of a lance, but took the strain off a knight's hand and arm, and made aiming a lance much easier. This small, yet powerful innovation owes its invention as much to the medieval battlefield as it does to the medieval tournament.

D. Feudalism

Another factor that contributed to the development of plate armor was socio-political pressure brought about by European feudalism. Although historians are not completely certain, it is widely agreed that the Franks were the first to wear plate  

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72 Crecy and Agincourt both featured mass longbow fire against plate armored lights with very little effect.
armor; therefore they make an excellent case study for the social and political effects of feudalism. In late antiquity and the early Middle Ages, the Franks were predominantly light armed infantry. They wore no body armor, except the occasional helmet, but did employ small oval or round shields; and wielded swords, daggers, angons (similar to the Roman javelin), and franciscas (light throwing axes). The core of the Frankish fighting force was the *comitatus*, an assembly of the best warriors who served the chief in return for food and shelter. To be sure there were differing levels of privilege, but until the eighth century, Frankish society seems remarkably egalitarian, as illustrated by the fact that the majority of Frankish men trained together and were armed and armored very similarly. It was not unreasonable for a man to expect that his son, if blessed with strength and speed, could become a member of the Chief’s *comitatus*, with the privileges such a position entailed.

However, a social and economic transformation was occurring among the Franks in pre-feudal Gaul that would pave the way for a transformation of Fankish arms and armor. The *comitatus* system of patronage ran parallel to a similar system of dependent land tenure known in Latin sources as *precarium* and later *beneficium*, in which one man worked the land and received the profits from it, even though legal title belonged to another man. With the fall of the western Roman empire, payment for a service with money was being replaced by payments in kind. Cash-poor landowners began to reward those who served them faithfully with grants of land. By the 8th century, only kings, great nobles, or the church had large tracts of land, or benefice, with which they could

73 Provided the descriptions of pre-feudal Franks by Cornelius Tacitus and Agathias are to be believed.  
reward a faithful vassal. It was Charles Martel, (died in 741) the de facto ruler of the Frankish state, who began to require benefice holders to swear an oath as his vassals and serve as mounted warriors. Fielding a man on a horse with sword, shield and armor was an expensive proposition that was well beyond the means of the average Frankish free man. Furthermore, fighting on horseback required continual practice, since a knight was required to handle a shield and reigns in his left hand, while striking blows with a lance, sword or mace in his right, all while directing his horse with his legs and spurs. Achieving mastery of this type of combat required experience and exacting training that could only be achieved by warriors that were rich enough to afford horses and arms, and free from any other duty so they could devote themselves to mounted combat.

Whether it was the particular genius of Charles Martel or one of his advisors, by about 730 both vassalage and benefice were employed to enable Martel to recruit mounted warriors. A benefice would be worked by farmers protected by the holder of the benefice, who would use the taxes he would levy to mount, arm, armor, and train himself for the new form of mounted warfare that Martel required. However, Martel soon realized that he did not have enough land to recruit vassals without completely divesting himself of crown land, which would thoroughly diminish the power of the crown. To solve this dilemma Martel turned his eyes to the vast holdings of the Gallic church, and compelled it to grant benefices to warriors chosen by Martel on the condition that these new land holders owed him military service. The German 19th-century historian, Heinrich Brunner, was the first to posit why the Franks demanded service in the form of mounted warriors, and he concluded that it was probably the advance of Islamic raiders

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75 Beeler, 6
76 Beeler, 11
across the Pyrenees in the early eighth century. Although evidence is spotty, it is probable that these Moorish raiders were mounted, and responding swiftly to their incursions necessitated mounted troops. However, an overview of the Frankish campaigns at that time shows they were more often at odds with their European neighbors than the Moors to their south. Brunner’s thesis is now seen as describing one of many pressures that pushed the Franks towards mounted combat. In any event the Frankish precedent established a link between military service and land-holding vassals, which would become the norm throughout the rest of Europe.

To be clear, this service was not an absolute requirement, as there were ways to avoid it, large monetary payments being the most common. However service became a matter of prestige, since one's peers, aided by a burgeoning minstrel culture, could and did ridicule those who failed to serve when called upon. European feudalism required the rich and powerful to serve on the battlefield, and surviving it became a priority. Training in arms and the new form of mounted combat only increased vassals' deadliness, and a new type of armor was needed to safeguard them on the battlefield. Land-holders also had the wealth available from rents to pay for the substantial cost of a set of plate armor.

It is worth pausing here to consider the relationship between feudalism and advances in armor. As explained above, feudalism can be viewed as providing a means (concentrated wealth from rents) and incentive (surviving personal military service) for developing more effective armor. But one could imagine the causal relationship being reversed. One could argue for a variation of White’s thesis, in which it was the need for increasingly costly military technology, especially armor (and to a lesser extent, mounts), rather than the stirrup, that led to a system of vassalage in which prominent warriors were
given large tracts of land that would give them the financial resources to purchase superior armor and the free time to train in its use. In support of this thesis, one could point to the capitulare missorum (792-93 AD, amended 805 AD), discussed above, which specifically required holders of a benefice - a proto-feudal estate - to own armor shields, weapons, and later, mounts. This law specifically connects feudal land arrangements to ownership of weapons and armor, suggesting that the purpose of a benefice was to finance the substantial cost of acquiring and maintaining them. The difficulty I see with this argument - as with many forms of technological determinism - is that its focus is too narrow. There were many reasons independent of the growing cost of military technology for the development of a system of vassalage. For example, as noted above, the reduction in coinage following the fall of the western Roman Empire led European rulers to pay for military service using grants of land, rather than cash.

E. Tournaments and Jousting

Another important factor in the development of plate armor was the growth of jousting. The medieval tournament, not to be confused with the tourney or joust, probably began as early as the tenth century.77 Hugely popular between the twelfth and fourteenth centuries, such tournaments were also called a mêlée, or mêlée tournament. Such tournaments were fought between teams of mounted knights, who were fully armored and usually armed with a sword or club. The initial rules were rudimentary and participants would fight until a halt was called.78 Taking place in a large open area, more

77 Noel Fallows, *Jousting in Medieval and Renaissance Iberia. Armour and Weapons.* (Woodbridge: Boydell Press, 2010), 3. Fallows references an early set of tournament rules for a tournament at Magdeburg in 938 but acknowledges that there is some debate over their authenticity.
78 Tobias Capwell, *The Real Fighting Stuff: Arms and Armour at Glasgow Museums.* (Glasgow: Glasgow Museums, 2007), 36
than 100 knights could participate in the mêlée but both teams were required to be the same size. However, such events were not just for martial training in group tactics and coordination on horseback, political agendas were frequently pursued and grudges could be settled, sometimes permanently. The historian Noel Fallows’ describes the lack of rules and scoring, as well as the politically motivated use of force, in early tournaments.

In the absence of standardized method for quantification of performance or of clearly delineated opportunities for scoring, a typical large-scale mêlée tournament might consist of passive clusters of men who were there to be seen rather than to participate, counterbalanced by more sinister groups of men who desultorily pursued, ambushed, thwacked and cudgeled their victims.  

By the twelfth century, tournament rules became much more common, if not standardized, in an attempt to prevent excessive bloodshed and establish tournaments as a sport and not a political grudge fest. It soon became customary to have multiple judges for the mêlée; twelve on each side is suggested by Alfonso de Cartagena in his Tratados Militares for a mêlée involving 100 knights. Despite rules, restrictions, and pledges of honor, tournaments could not entirely escape political influences, weapons were not always blunted, and though it was heavily frowned upon, death was a common occurrence at mêlée tournaments. This did not go unnoticed by the Catholic Church, and, appalled at Christians killing each other in sport, Pope Innocent II banned tournaments at the Council of Clermont in 1130, and instructed the clergy to deny Christian burial to

79 Fallows, 3
knights who died in them.\textsuperscript{81} It is uncertain if such extreme measures were ever carried out, but the ban remained in effect until Pope John XXII lifted it in 1316.

Church sanctions did little to reduce the popularity of the tournament, which began to be much more than an exercise in martial prowess. Peers and peasants alike enjoyed watching the sport, if for different reasons, and tournaments began to draw large crowds of spectators. Festivals began to accompany tournaments and the larger and better-sponsored would host multiple events and last for days. Perhaps the most famous tournament was held in France in 1520, and was later called \textit{the Field of the Cloth of Gold}. It was attended by two kings, Henry the 8th of England (reigned 1509 to 1547), and Francis the 1st of France (reigned 1515 to 1547). Writing seventy years later in 1590, the printer Richard Jones’ still claims \textit{the Field of the Cloth of Gold} was the best tournament and in his description mentions the two events that had become more popular than the mêlée.

\textit{BVt farre exceeding al these was that magnificent Iusts & Turniments, at the meeting of the two excellent Princes, King Henrie the eight of England, & K. Frances the French King: who choosing vnto them xiiij. others, did challenge to runne at the Tylt, and fight at the Turney and Barrier with all commers.}\textsuperscript{82}

Jousts and various forms of foot combat (which Jones calls “barrier”) had become the two most popular events at tournaments because they were one-on-one events that clearly showcased individual skill and had a much lower casualty rate. In the various types of foot combat the contestants wore field armor, usually wielded the same weapons

\textsuperscript{81} This was the same Pope who would reinforce the ban on crossbows at the second Lateran Council.
\textsuperscript{82} Richard Jones, William Segar Sir, and Vincentio Saviolo. \textit{The Booke of Honor and Armes.} [Electronic Resource]. (Early English Books Online. Printed by [Thomas Orwin for] Richard Ihones, dwelling at the signe of the Rose and Crowne neere Hoburne Conduit, 1590), 92. I was obliged to use the original English since modern translations omit the key phrase.
and fought in a ring. A later addition was a low barrier between the two knights that they
would fight over.

But it was the joust that would come to be the defining event in tournaments, and
must be considered at length because of its impact on the development of medieval
armor. By the twelfth century jousting had become a distinct sport. Writing in the
mid-twelfth century, the monk William of Malmesbury called it both a single combat
sport and one-on-one spear play. Compared to the tournament, the joust was a much
narrower fighting environment. The combat typically took place on a short, level field,
where a mounted knight encountered one similarly mounted opponent. The primary
target of both knights was the head or shield, although the rest of a jouster's body or
mount could be injured. Jousters could not evade and also deliver a blow, so it was
expected that each would deliver a single blow simultaneously with a spear or lance.

_Frauendienst_ (In service of ladies) by the Austrian knight Ulrich von Lichtenstein
is one of the earliest accounts of jousting in medieval Europe and went a long way to
popularizing the sport. This autobiographical poem follows Ulrich’s month-long jousting
exploits across central Europe in 1226, from Venice to Bohemia, in which he claims to
have broken more than three hundred spears. His poetic account of one joust is
particularly noteworthy for its concise description of the sport.

> When I beheld him start his course
> Without delay I spurred my horse.
> He did the same, and so we two
> Were hurled together this is true,
> As if our horses now could fly.
> Each hand was steady, and each eye;
> The spears both struck with practiced art

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83 Tobias Capwell, _Arms and Armour of the Medieval Joust. Royal Armouries: Arms and Armour Series._ (Royal Armouries Museum, 2018), 9
Right where the shield and helmet part.

The lances made a crashing sound
And splinters flew for yards around;
His shield struck mine, we came so near.
At once each got another spear.
Again we jousted, hard and well,
And so that neither of us fell.
I and this nobleman so bold
Broke skillfully six spears, all told.\textsuperscript{84}

This particular account highlights both combatants' skill, not just Ulrich’s, and showcases the chivalric spirit of the sport. Winning was important but victory was meaningless if one’s opponent was not likewise skilled. Ulrich also twice mentions the breaking of lances, which to spectators and combatants alike meant the best possible blow had been struck. Lastly it mentions the exact target a knight aimed for, the helmet right above the shield. What is unclear is the type of jousting Ulrich undertook, as there were two types of joust that were popular in medieval Europe at that time, the \textit{hastiludia pacifica} or (joust of peace) and \textit{hastiludia de guerre} or (joust of war).\textsuperscript{85}

The origin of the joust of war is unclear but it echoes the battle between champions recorded in antiquity and occurred before a battle between knights of both sides. Such jousting was also extremely common in contested border lands, such as the English/Scottish border. As such the joust of war was a formalized type of single combat, frequently between traditional enemies that could occur during peace or war. It was more highly esteemed by knights because of its danger and the greater nerve it


\textsuperscript{85} The other common terms were the French \textit{à plaisance} (for pleasure) and \textit{à outrance} (to the utmost)
required. Jousters wore field armor, used sharp lances and both combatants acknowledged that injury and death could result from it, even if that was not the primary objective. Capwell recounts a famous *pas d’armes* (deed of arms) held at Saint-Inglevert in 1385 undertaken by Jean de Mengre, lord Reginald de Roye and the lord de Saimpi. The three committed themselves to joust against all challengers for thirty days, and allowed their challengers to choose the joust of peace or the joust of war, all of whom chose the joust of war. That all three survived without serious injury was a testament to their skills and the soundness of their armor. The joust of peace, on the other hand, was for sport, much loved by the crowds who came to watch, and death and injury were avoided. To that end, changes needed to be made to a knight’s armor, some of which made their way to the battlefield.

By the end of the twelfth century the knight taking part in the joust was covered in mail from head to foot, wore a helm with a nasal guard and bore a kite shield. The immediate problem was that the primary target when jousting was the head, and twelfth century helms did not offer nearly enough protection from a lance. This spurred the development of the great helm, and the many variations that came after, which has been detailed previously, and began the trend of fabricating armor just for the joust. Although most helms saw action in battle as well as the joust, when produced specifically for jousting the steel on the left side of the helm was thicker, and there were no breathing holes on the left side. The slit for vision was also much abbreviated, since peripheral vision was not considered necessary for the joust. The sight or *ocularium* was the

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86 Capwell, 29
87 Capwell, 60
88 Most jousting helms that survive today show this detail, a particularly fine example is a 15th century Stechhelm, jousting helmet, from the The John Woodman Higgins Armory Collection, in Worcester Art Museum, Object Number: 2014.1164.1
greatest weak point in any helm, and attempts to increase the safety of the joust of peace saw the invention of the coronel, a crown-like spearhead with three or four prongs. A lance equipped with a coronel could still cause serious injury, as the prongs were not always blunt, but the coronel was unable to pass through the sights in an opponent's helm. The shape also made it less common for a lance to skate up from the original point of impact on a shield and the prongs assisted in aiming a lance at full gallop.

While the coronel made the joust of peace relatively safer, the introduction of the lance-stop helped increase the power a jouster could deliver. Previously the strength of a blow was determined by the strength of the jouster's hand and arm, since beyond a certain point a spear would slip through a jouster's fingers. The lance-stop was a thick sphere or disk of wood behind the grip of the spear which allowed jousters to rest the spear against their chest and shoulder, receiving the shock there instead of in their hand and arm. The increase in force from a couched lance and the desire to avoid injury pushed the continued evolution of helms. Jousting helms grew heavier, had their breathing slits or holes completely removed, and eventually were fastened directly to the breastplate. This change did not happen swiftly because, for most of the 14th century, unhelming was believed to be a safe way of diverting the force of a blow to the head. It was also a crowd pleaser and demonstrated that a strong and precise blow had been struck.\textsuperscript{89}

\footnote{Capwell, 47}
It was not until the end of the fourteenth century that jousting helms began to be extended down the chest and attached both back and front to the breastplate. This was followed by the extension of the lower lip of the sight of a helm, which gave lances almost no opportunity to penetrate the sight. The final form of the jousting helm was the thick (as much as 6mm in front), heavy, ‘frog-mouthed’ helm of the fifteenth century which was never seen on the battlefield. By contrast the visored bascinet was one of the more common helms worn on the battlefield in the fifteenth century.

Plate-armoring the rest of the body was concurrent with the innovation in jousting helms, but particular innovations became necessary for jousting. One deviation was a trend to not wear any armor on the legs, and instead use a jousting saddle. Jousting saddles sat a knight six inches above their mounts back and had seat hoops to hold the hips and pelvis in place. A high front plate protected the rider's groin and abdomen, and sweeping side plates covered the legs. Although such saddles did offer more protection to jousters, especially in the case of a collision, they were also designed to keep blows as far away from the mount as possible.\footnote{Capwell, 41} Jousting saddles were not popular everywhere and the introduction of the tilt, a low fence between the two jousters, solved the issue of
The plate armor produced for jousting began to be made much thicker than that used for war and asymmetrical in this respect. The left side was made thicker or strengthened by adding reinforcing plates while the right side could even be reduced.

Another approach was to use specially crafted pieces of armor, generally called ‘exchange pieces’ with field armor. One suit of armor that was particularly easy to do this with was the Greenwich field harness, which was produced by the Royal Almain Armoury in the 16th century. To convert a Greenwich field harness into tilt armor the regular field helmet was replaced with a heavy tilting helm, or a heavier visor was fitted to the field helmet. Next a grandguard, a chest piece that reinforced the left and part of the right side of the breastplate was added. Finally a pasguard, which reinforced the elbow, and a manifer, which reinforced the left gauntlet. All of these additions provided more protection when jousting but added significant weight and were not always practical on the battlefield.

The biggest reason for thicker and heavier armor, especially in the joust, was the lance rest. Heavier lances, both longer and thicker, began to be used in jousting but such heavy lances were not practical on the battlefield and were rarely if ever used there. Capwell’s experience as a reenactor and experimental archeologist provides a useful first hand description of a heavy lance, using lance stop and lance rest (arret), at the tilt:

“When the arret-locked (fewtered) lance shattered on impact, it did so in spectacular fashion, with a loud crack like a gunshot, throwing shards of wood high into the air.”

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91 Capwell, 78
93 David Edge, and John Miles Paddock, 173 The manifer was originally called a main de fer (hand of iron)
94 Capwell, 52
The impact of a *fewted* lance was three or four times more powerful than a lance simply equipped with a lance stop. Jousters could now be thrown from their saddles, sometimes even horse and rider together could be knocked to the ground.

The production of such heavy armor (one suit for the joust could weigh more than 100 lbs.) gave some medieval writers pause. In *Las Siete Partidas* Alfonso X of Spain (reigned 1252 to 1284) advises knights that their arms and armor must be strong, elegant and light.\(^95\) Obviously strong armor provided better defense, but that it should be elegant seems absurd for something that's primary purpose is keeping the wear safe. Alfonso points out that such elegance will give the wearer a finer appearance and thereby strike fear in their opponents.\(^96\) Equally important, if unsaid, is that such elegance displays the wearers’ wealth, status, and taste. This runs counter to historian Charles Ffoulkes’ research on medieval armorers which observes that one of the cardinal rules of the war harness was that it should be devoid of all such ostentation, as any form of decoration could be detrimental to the soundness of the armor.\(^97\) Alfonso’s final point about lightness bears repeating in full as it highlights the struggle to provide optimum defense and mobility:

> Lightness renders them easier to handle, and enables them to make a better use of them . . . for it would seem very absurd if he who wears armor or carries arms to defend himself from death or imprisonment by another, should be killed or taken prisoner by reason of his being hindered by them.\(^98\)

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\(^96\) Scott, 444

\(^97\) Ffoulkes, 10

\(^98\) Scott, 444
Although Alfonso was writing about field armor, it is probable that he had the influence of jousting armor in mind, since heavier plate armor for jousting influenced what was being used in the field.

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I have outlined above the preconditions and factors that contributed most significantly to the invention and development of plate armor in medieval Europe. None of these circumstances by themselves were enough to prompt the development of plate armor. Numerous cultures around the world faced one or more of these circumstances, but did not likewise develop plate armor. Both medieval China and Japan had socio-political organization similar to European feudalism and advanced metallurgy, but never focused on mounted shock combat or developed a tradition of jousting. These comparisons are admittedly imperfect, as east Asian states were very different from European feudal states, faced different pressures and had radically different social norms and interests. But it is important to note that medieval European plate armor was vastly different from other forms of armor, even the armor of their Roman predecessors. European armor had come to resemble a rigid exoskeleton instead of the flexible lamellar, scale or mail, preferred everywhere else. The intersection of conditions leading to the development of plate armor only occurred in medieval western Europe.

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99 Williams, 56 “European armor starts to differ fundamentally in design from the “loricæ segmentatae” used by the Romans and those forms of armour used in other parts of the world, namely Islam, India, China and Japan.”
III. THE EFFECTS OF PLATE ARMOR

The conditions necessary for the development of plate armor have been discussed at some length but the actual tenor of medieval military organization and tactics deserves some attention, to further examine the impact heavy armor had on medieval combat.

Contrary to popular belief, the knight was not the only heavily armed, armored, and mounted warrior on the medieval battlefield. A lower class of soldier that was similar in most respects except perhaps a lifetime of training and social class was the man-at-arms, or as referred to in French sources, mounted sergeants. Even with this distinction, knights and men-at-arms accounted for less than a quarter of the men on the battlefield in medieval Europe. The remainder was composed of archers, crossbowmen, and infantry, drawn from peasant levies of variable quality that were almost universally looked upon with disdain by the mounted elite. The famous French charge at the battle of Crecy (1346) through, or more probably over, their own retreating Genoese crossbowmen is a case in point. The French knights were frustrated by the ineffective attack that their Genoese mercenaries executed at the outset of the battle. The account of Jean de Venette claims the French knights were unsympathetic that the rain the night before had wet the strings of the crossbows, reducing their effectiveness.  

Another observer, Giovanni Villani, suggests that the superior training and volume of fire produced by the English longbowmen opposing the crossbowmen thoroughly demoralized them. The exception to this rule seems to be English yeoman archers, who were generally treated better by

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101 Russell Mitchell, "The Longbow-Crossbow shootout at Crecy (1346): Has the “Rate of Fire Commonplace” been overrated?". In L. J. Andrew Villalon & Donald J. Kagay *The Hundred Years War (Part II): Different Vistas*. History of Warfare: V. 51. (Leiden: Brill. 2008), 235

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their knights, at least on the field of battle. Despite amounting to perhaps a quarter of the
men present on the field of battle, mounted knights and men-at-arms had an outsized
influence on the outcome.

Knights and men at arms did not only fight mounted, and plate armor affected
combat on foot as well. Although there is some debate about the utility of the
dismounted knight, the reality is that field plate was not so heavy that fighting afoot was
impossible (on average, field plate weighed 60 lbs.). A well trained and fed knight
could fight afoot fairly easily and was not overly encumbered by the armor he wore. The
late medieval fighting manual produced by George Silver, *Paradoxes of Defense* (first
published in 1599) is almost entirely concerned with fighting on foot. Furthermore, the
influence of heavy armor is seen in the slashes and thrusts that it suggests, which ignore
the chest and other parts of the body that were heavily armored and thus unlikely to be
injured by such an attack. There are numerous other accounts of knights fighting on
foot and their heavy armor was certainly a key factor in their success. One such flash of
tactical brilliance is accorded to Edward of Woodstock (1330-1376) the oldest son of
King Edward III and heir to the English throne. His use of dismounted knights to
receive a cavalry charge with their lances at rest at the battle of Crecy would ultimately

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102 Dirk H. Breiding, “Arms and Armor—Common Misconceptions and Frequently Asked
Questions,” The Met, last modified October, 2004,
https://www.metmuseum.org/toah/hd/aams/hd_aams.htm

103 George Silver. *Paradoxes of Defence. Wherein Is Proued the True Grounds of Fight to Be in
the Short Auncient Weapons, and That the Short Sword Hath Advantage of the Long Sword or
Long Rapiere: And the Weakenesse and Imperfection of the Rapier-Fights Displayed. Together with
an Admonition to the Noble, Ancient, Victorious, Valiant, and Most Braue Nation of Englishmen,
to Beware of False Teachers of Defence, and How They Forsake Their Owne Naturall Fights:
With a Briefe Commendation of the Noble Science or Exercising of Armes. By George Siluer
win the day. Unmounted combat for knights on the battlefield was not commonplace, but it did occur.

In addition to changing military tactics, the adoption of plate armor also increased the social stratification European feudalism had established. Acquiring and maintaining multiple sets of plate armor required a large investment that impacted both the economy of medieval Europe and its social structure. The cost of plate armor made it all the more necessary for medieval knights to have large land holdings that could generate the rents necessary to purchase, repair, and often replace a complete set of plate armor. And the increased weight and restrictiveness of plate armor required a better diet and a lifetime of constant training to use it effectively in tournaments or battle.

The economic implications of the medieval European shift to vassalage and beneficium are fairly straightforward. The chief source of income for feudal land-holders was from rent. Recent scholarship suggests that medieval rents were not the type of exploitative rent that was formerly attributed to these feudal overlords. The historian Phillipp Schofield argues that the more well off peasants could even have a meaningful surplus after paying their rent.¹⁰⁴ Rent was by no means the only source of income either, the historian Guy Bois points out that the seigneurial mill was extremely lucrative.¹⁰⁵ However these land holders raised money their feudal vows ensured that much of it went to mounts, arms, armor and training. Armor was not a one time expense since more than one suit of armor was needed if the wearer took part in tournaments as well as war. After

a campaign or tournament season, it was not uncommon for a knight to need a new suit of armor. In even one engagement, armor could be so damaged that it could not be mended and had to be replaced. The medieval armorer was a dedicated profession who sprang up to support the manufacture and maintenance of such heavy armor.

This leads to the other way a knight could enrich himself. The rules of tournaments dictated that a defeated knight had to surrender his horse and armor to the victor. The possibility of fame and fortune made the tournament circuits of medieval Europe irresistible to many knights. In the early twelfth century one knight who made his name and fortune on the tournament field was William Marshal (1146-1219), later to become the first Earl of Pembroke. Marshal was considered the greatest knight of his generation, at least according to the biography written shortly after his death, and his exploits on the battlefield were equally remarkable.\textsuperscript{106} Although there are few surviving records it is probable that the fortune Marshal made on the tournament field was just a shadow of what he made from battlefield ransoms. It is here that the impact of heavy armor can really be seen. A fully armored knight had a high probability of being spared, regardless of his background, since the armor itself proclaimed his wealth. The prospect of financial gain greatly increased the likelihood of a victorious knight to show mercy toward those who surrendered to him. This had the obvious side effect of making the lives of knights more valuable than the lives of anyone else on the battlefield.

In many ways, heavy armor represented the pinnacle of military technology in medieval Europe. Medieval tactics and forms of combat were also shaped by heavy armor. In its most finely crafted form, plate armor also represented the elite in society and showcased their wealth. It is therefore not a stretch to surmise that the survival and

longevity of medieval European feudalism hinged in no small part on plate armor and the men that were trained to fight in it.
IV. GUNPOWDER AND THE END OF ARMOR

Plate armor may have emerged the victor in the arms race between bows and armor in medieval Europe, but the invention of the firearm and their widespread use would spell the end of knights and plate armor alike. The first literary reference to gunpowder in medieval Europe is found in the *Epistola de secretis operibus artiis et naturae* of Roger Bacon written in 1267, but at that time gunpowder was still only a novelty from the east. This would change quickly, and by the early fourteenth century there are records of Florence ordering cannon for the defense of the city.\footnote{107} Cannon may have been initially unreliable and difficult to aim, but their potential was clearly grasped by European generals and advances in the materials used and design combined to make them the preferred siege weapons of the late medieval period. The first reliable account of cannon used in battle is the battle of Aljubarrota in 1385, but the 16 cannons used by Castilian forces had no effect on their entrenched Portuguese adversaries.\footnote{108} Cannons were not always so ineffective; King James II of Scotland was killed while parading in front of his own cannon at the siege of Roxburgh in 1460.\footnote{109} This was far from the only prominent casualty due to cannon fire, although perhaps the most embarrassing.

But the true threat faced by the armored knight was from the firearm. The widespread use of early firearms was inhibited both by the crude early designs and a lack of saltpeter but once both were addressed the arquebus and its larger cousin the musket became the weapon of choice for infantry, while cavalry would use pistols. Loading was slower by far than non-gunpowder weapons and firing early firearms was also

\footnote{108} Bert S. Hall, 47
\footnote{109} David Edge, and John Miles Paddock, 134
problematic, as a slow match or hot wire had to be brought into contact with powder in the touch hole. But the results against armor far surpassed the bow or crossbow, especially when using cast iron shot, which was especially prized for its ability to pierce even the best plate armor.

This change in armament was exacerbated by a shift towards professional armies, begun by Charles VII of France (reigned 1422-1461). He demanded strict discipline, but paid to have a permanent body of trained soldiers at his disposal. These professional armies were mainly composed of common foot soldiers, and once armed with firearms had the ability to easily kill heavily armored knights and gave little thought to chivalry and ransom. But these changes took time, and did not lead to the immediate abandonment of plate armor. Rather the use of professional armies, coupled with more efficient production methods allowed monarchs, powerful city states, and great nobles the ability to armor some portion of their infantry in “munitions” plate. This was a far cry from the finely crafted, hardened steel armor of the nobility, and was usually made of thick iron. Late medieval heavy infantry units, such as the German mercenary Landsknechte, all wore such “munitions” plate but leg armor was usually not included.

The variable quality of armor in the fifteenth and sixteenth century is further corroborated by Alan Williams’ research in The Knight and the Blast Furnace. Throughout his book Williams samples hundreds of surviving plate armors from the medieval period and determines that they ranged from air cooled (meaning completely unhardened) iron to supremely well hardened steel. The range of quality is very wide, however there are very few examples of well hardened steel, especially in the sixteenth century, which seems to suggest that there was more demand for lower quality plate
armor, which was probably not designed to support mounted shock combat. Some explanation for this can be found when examining the Milanese armorsmiths, particularly the Missaglia family. During the fifteenth century the Missaglia were the preeminent armorers in Europe, and delivered the best hardened steel armor to nobles and kings across Europe. But in the sixteenth century, the Missaglia adopted the decorative practice of fire gilding, which was not compatible with their steel hardening processes.\textsuperscript{110}

Between professional armies, the widespread use of firearms, and the increase of mass-produced munitions plate, it is hard to determine if there was continued demand for high quality hardened steel plate armor in the sixteenth century.

\textsuperscript{110} Williams, 203
V. CONCLUSION

Plate armor was a response to multiple factors in medieval Europe, but the most important by far was feudalism. The shift from mail to plate armor was prompted by a body of warriors whose preservation on the battlefield was paramount and who had the wealth necessary to invest in new armor technologies. This large infusion of wealth could only be provided by feudal lords. Advances in tactics, especially mounted shock combat, and weaponry; specifically lances, bows and crossbows made the medieval battlefield a much more deadly place than ever before. This combined with tournaments and the wildly popular sport of jousting served as additional pressure to increase the protective properties of armor. However, plate armor could not have been developed without the accumulation of craft knowledge and production techniques necessary to consistently produce steel plates. Plate armor lasted for centuries until the introduction of firearms, the death of chivalry on the battlefield, and the shift to professional armies rendered it obsolete. It is tempting to adopt White’s technological determinism and make plate armor the essential component in lengthening European feudalism but in the end it was one of many factors. Plate armor was a response to a variety of factors more than a cause, and should be seen as the material embodiment of European feudal martial culture at its height.


Lacombe, P. *Arms and Armour in Antiquity and the Middle Ages. Also a Descriptive Notice of Modern Weapons; Translated from the French of M.P. Lacombe, and with a Preface, Notes, and One Additional Chapter on Arms and Armour in England*. Translated by Charles Boutell. Conshohochken, Penn: Combined Books, 1996.


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