A CURSED, ABOMINABLE DEVICE?

The True, Shared History of Knights and Firearms

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History is not always about what happened. It is often about what someone wants you to think happened. Or, it expresses the way we wish it had been. Or it is a construct built in hindsight, to validate, justify or give provenance and precedent to events and situations of the present moment. Those with a genuine and honest interest in real history, in the real lives of real people who lived in the real past, must therefore work carefully to constantly re-evaluate our historical understanding or collective social memory, according to good evidence.

The subject of early firearms and their long coexistence with full-plate armour is a fascinating illustration of the challenges encountered by anyone interested in human history as it actually happened. We start with a widespread and commonly accepted notion, that the fully-armoured knight, the representative of low-tech, traditional warrior culture as practiced for thousands of years, was the fundamental adversary, almost the elemental opposite, of the emergent hi-tech gunpowder weaponry of the modern world. The respective users of the two opposed technologies were bitter adversaries defined by class and status- the aristocratic knight with his horse and armour vs. the common man with his gun. The story goes that the advent of the latter caused the immediate decline and rapid obsolescence of the former.

This structure appears to have all the ingredients of a well-ordered, emotionally satisfying story. That is why it is easy to accept, and it is also why we should treat it with suspicion. Real history is usually not clear, or logical, or sensical. It is not guided by inherent morality or by the requirements of a good story arch. It does not have a beginning, or a middle, or an end. Nevertheless, it can be quite difficult to distinguish myth from reality. History's storytellers were often masters of their art, and when they present us with a view of the past which makes sense, which makes us feel better about ourselves, which makes us feel as if there is order and meaning to the universe, their narrative becomes difficult to reject.

As an armour specialist I routinely deal with the misconceptions surrounding the knight in armour, and by extension, with myths of the Middle Ages in general. I am also very interested in the enduring power of the image of the armoured warrior in art, and the relationships between the knight as a symbol, as a visual icon, and as a real person who lived a real life inside that armour.

The actual history of the relationship between armour and gunpowder weapons is just one specific way of exploring deeper principles- how fiction can easily become intertwined with or mistaken for reality, how views of morality and justice can be read into technological development, and how, so often, when asked to choose between the truth and a good story, we print the story. It is also just a fascinating piece of the history of weapons and armour.

We must begin with modern Quixotic views of the knight himself. It was Cervantes, in his novel Don Quixote (published in two volumes in 1605 and 1615) who first developed the idea that the image of the armoured warrior could be used to represent a historically elevated class of people who could not change with the times, could not see the world as it really was, who were out-of-touch, obsolete, and unable to evolve. Cervantes had also been a soldier and a prisoner of war- he had experienced the realities of war first-hand; his satire of chivalry, therefore, bites deep. In creating the character of Don Quixote, Cervantes gave the world permission to ridicule the knight, to turn him into a caricature, and ever since, the image of the armoured knight has been a constant inhabitant of the world of satirical cartoons.

After the knight was adopted as a way to represent negative or comical views of aristocracy, the history of late medieval and Renaissance warfare, retroactively, took on a socio-political agenda which has fundamentally distorted our ability to look objectively at its history, again, as real events experienced by real human beings. We can see this phenomenon in action by tracing misconceptions relating to armour and firearms back to the late Middle Ages, and to the Battle of Agincourt in particular, as but one obvious example.

Agincourt is perhaps the most famous medieval battle, certainly in the English-speaking world, enshrined by Shakespeare in his play Henry V, and dramatically visualised in modern films of that play.[1.] Its enduring popularity comes down, again, to the fact that it makes for a good story. The plucky English common soldiers, up against overwhelming odds, emerge victorious against their arrogant, prideful, over-mighty knightly enemies through their mastery of the longbow, a superweapon, a vessel of empowerment for the ordinary man. The battle is characterised as class war, the commoner overthrowing the aristocrat through moral superiority as much as technical advantage. This is not what happened, but rather, again, what we wish had happened. It is a telling of the story which is morally and emotionally satisfying.

No doubt in an effort to elicit a gut-reaction, modern television documentaries and the authors of popular online content routinely describe the English longbow as 'the medieval machine-gun.' It was of course nothing of the kind, but it does illustrate how our understanding (or lack of it) of older, more primitive ranged weapons is connected to firearms. This may be the root of the myth- or at least it is one of the reasons why we see firearms and armour as fundamentally opposed. The archer was (incorrectly) portrayed as the class-warrior overthrowing the prideful but ineffective armoured knight, and this relationship was passed on to the archer's successors, the handgunner and artilleryman- new characters who, like their bowmen predecessors, were characterised as common people empowered by a technology rejected by their social superiors.

Of course aristocratic distain for early firearms is not entirely without an historical basis. Ideological opposition to them was given a thrilling voice in the early sixteenth-century epic romance Orlando Furioso, by the Italian poet Ludovico Ariosto (first

published 1516). The titular protagonist is a Renaissance incarnation of the Carolingian hero Roland, who encounters many colourful characters and villainous opponents possessed of various distinctive attributes and/or unusual technological advantages. Rodomont, King of Sarthia for example, enjoys the special protection of a breastplate made out of the tanned, scaly hide of a dragon.[2] Another, Cimosco, the evil and duplicitous King of Frisia, wields what in the mythical eighth-century world of the story is considered a strange, devilish weapon, described as:

Unknown to our fore-fathers or indeed any of our own generation… an iron tube, two yards long, into which is thrust powder and a ball. At the back, the closed end of the tube there is a little hole, almost invisible, to which he puts a flame, just the way a physician sets his finger on an open vein which needs to be staunched. Out shoots the ball with such a roar that it could be thunder and lightning, and its effect is no different from that of a thunderbolt: whatever it touches it fires, cracks and shatters.[3]

Cimosco foully murders several brave knights with his handgun, 'smashing the breastplate and penetrating the heart' of one and shooting another in the back; in that second killing the poet is careful to inform us that 'the ball came out through his chest.'[4] Later Cimosco flees from a fair fight with Orlando in order to set up an ambush, lying in wait with his gun. He manages to kill Orlando's horse, before the rapidly advancing hero, with 'an ugly look on his face such that Mars himself would have quaked', splits the villain's head down to the neck with his sword. Orlando then sails out into the North Sea, bearing 'that engine of war, which behaves not unlike a thunderbolt.' The poet continues:

He did not appropriate it out of any desire to use it in his defence; for he always regarded it as cowardly to undertake any enterprise from a position of advantage. But he meant to jettison it somewhere in such a way that it could do no further harm; and he took the powder and balls too, and everything else connected with it. And so, when he saw that they had left the shallows and reached deep water further out… he took hold of it and said: 'To ensure that no knight will ever again be intimidated by you, and that no villain will ever again boast himself equal to a good man because of you, sink here. O cursed, abominable device, constructed by the fiend Beelzebub in the forge of Hades when he planned to bring the world to ruin by you, back to hell from whence you came I consign you.' So saying, he threw it into the deep.[5]

However that is not the end of Cimosco's Satanic instrument. Cleverly, Orlando's sinking of the handgun works as a literary device bridging the mythical world of the story with Ariosto's own time, while offering an explanation for why firearms then did not appear again until the late Middle Ages:

…<Orlando> had taken King Cimosco's thunder-machine and thrown it into the depths of the sea, so as to obliterate every last trace of it. Little did that profit us, though: the Evil One, enemy of human kind, who invented the fire-arm, copying the action of the thunderbolt which splits the clouds and falls to earth -the Evil One, serving us almost as fatally as when he deceived Eve with the apple, saw to it that a sorcerer should recover the weapon in our grandfathers' time, or a little earlier. The infernal contraption lay hidden for many a year under more than a hundred fathoms of water, until it was brought to the surface by magic and passed into the possession of the Germans; these tried one experiment after another, and the devil sharpened their wits until, to our detriment, they eventually rediscovered how to use it.

Italy, France, every nation of the world came to learn the cruel science. Some hollow out the muzzle of the gun as they cast it in the furnace; others cast it solid and then pierce the muzzle; some make the muzzle small, others large, so that it weighs less or more; it goes by the name of bombard, or arquebus, small-bore cannon or large-bore; mortar, it is called, or falcon or culverin, according to its inventor's fancy. It splits steel, smashes stone to pieces; wherever it goes nothing can resist it. Unhappy soldier, turn in your weapons to be melted down, even to your very sword: carry a musket on your shoulder or an arquebus-else you will go without wages! Wicked, ugly invention, how did you find a place in human hearts? You have destroyed military glory, and dishonoured the profession of arms; valour and martial skill are now discredited, so that often the miscreant will appear a better man than the valiant. Because of you no longer may boldness and courage go into the field to match their strength. Many a baron, many a knight now lies in earth, and so shall many more on your account, before this war is ended which has brought tears to all the world but most of all to Italy. I have said it, and I speak no lie: the man who invented such abominable contraptions was crueller by far than all the most evil of evil geniuses the world has known. To his eternal punishment I believe that God must shut his cursed soul away in the blindest depths of hell, with Judas the accursed.[6]

That is not quite what happened in reality, suffice to say. The practical war-fighting truth was rather different. In fact knights and men-at-arms in full armour generally embraced firearms, having no Ariostotilian objections to them. Throughout the early history of gunpowder weapons in Europe, the chivalric class were the champions of these new weapons, responsible for equipping their armies with them and employing technical specialists to oversee their use. Many were avid enthusiasts; King Henry V of England for example, one of a number of late medieval rulers well aware of the huge potential of artillery, liked to command bombardments in person, notably before the Battle of Agincourt in 1415, at the Siege of Harfleur.[7] The needs of the armoured elite also extended to their own personal role as active combat participants. Their desire to employ personal firearms in battle in fact appears to have been an important driving force in the early development of such weapons.

Figure 1. Detail from De nobilitatibus, sapientiis, et prudentiis regum by Walter de Milemete, English, 1326-7. The Governing Body of Christ Church, Oxford, MS 92, fol. 70v.

The earliest European depiction of a gunpowder weapon is of course the famous flask-shaped bolt-thrower in the treatise of Walter de Milimete, the chaplain of the young King Edward III of England (Figure 1).[8] This is obviously an artillery piece and clearly not practical for use on horseback. Although they were

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Figure 2. Detail from De Ingeneis by Mariano Taccola, Siena, c. 1427-41. Bayerisches Nationalbibliothek, Munich, Cod. Lat. Monacensis 197 II, fol. 50r.

small enough to be carried and fired in hand, the earliest European personal firearms were still big and heavy, and best suited to siege-work and ship-borne applications. Handheld firearms of the late fourteenth and early fifteenth centuries were usually composed of a short iron or brass barrel mounted on a rudimentary stock or even just a wooden staff. They often had wall-hooks to alleviate the considerable kick otherwise experienced by the user upon firing- they are typically around 75-calibre weapons. Quite impractical, one might think, for any cavalry application. However the desire to deploy these weapons on horseback was already in evidence by the early fifteenth century.

Concepts for armoured cavalry equipped with firearms appear in treatises on military technology as early as the 1420s, the most important for present purposes being De Ingeneis by the Sienese engineer Mariano Taccola (Figure 2).[9] Taccola's approach to the problem is interesting because it demonstrates an awareness of the potential value of gun-toting cavalry, while also showing that the technology was simply not yet sufficiently advanced to make the idea work. Taccola attempted to appropriate the existing infantry weapon for deployment on horseback, without fundamentally changing or redesigning it, with unconvincing results. The handgun of the early fifteenth century had not even a rudimentary lock, so the burning match-cord had to be applied to the touch-hole by hand, while the weapon itself was held in the other hand. Even Taccola's ideas about how to perform this two-handed task while also managing a horse while wearing full plate armour leaves much to be desired. The technology was yet to catch up with its desired uses.

By the beginning of the fifteenth century gunpowder weapons were rapidly becoming an essential aspect of siegecraft and naval warfare, the uses to which they were best suited.[10] Field battles however posed a different set of issues. The loading of these weapons was a slow process, so the rate of fire was low, and they were also highly inaccurate. In a slow-tempo fighting environment however, like a siege or naval battle, these were limitations which could be tolerated, and they were worth putting up with given the enormous power of even the crudest early examples- a gunpowder projectile was an order of magnitude more powerful, if not more,

than any other ranged weapon available in the late Middle Ages.[11] The huge potential of firearms was not difficult to see, and efforts to resolve key drawbacks escalated as the fifteenth century drew to a close.

Figure 3. Detail from a version of the Cyropaedia of Xenophon, Bruges, c. 1470-83. ©British Library Board, London, Royal MS 16 G IX, fol. 76v.

One way to deal with the slow rate of fire, before it was possible to simply field very large numbers of handgunners or musketeers, was to seed the firearms specialists in amongst blocks of infantry, especially pikemen, where they could be protected from attack while they reloaded. There is pictorial evidence for this practice from c. 1470 (Figure 3),[12] and by the early sixteenth century this tactic was yielding impressive results, most famously at the Battle of Pavia in 1525, when the heavy cavalry of the French King Francis I were decisively beaten by firearm-equipped infantry in the service of the Emperor Charles V.

There were however a number of technical challenges to be overcome in order for firearms to become a viable part of a knight's arsenal. Knights fought both on foot and on horseback, but when on foot their advantage lay in close-range, hand-to-hand combat with the pollaxe, sword and dagger. They tended not to be the users of ranged weapons, although it was not unheard of. So there was no immediate motivation for them to adopt firearms when fighting on foot.

Nevertheless, well-trained specialist handgunners were also well-paid and well-equipped, and their equipment often included extensive, good quality armour. From the middle of the fifteenth century, depictions of handgunners wearing complete plate armour become increasingly common (Figure 4). These men were normally specialist infantry however, not knights.

Ultimately knights were mounted warriors- equestrian combat was their raison d'etre. If they were to adopt the new weapons technology in a meaningful way, the equipment had to be developed according to their needs. The construction of firearms which were practical for use on horseback was a major technical hurdle not overcome until the sixteenth century. The first mechanical ignition system, the match-lock, had appeared in the middle of the fifteenth century, but while this was a major step forward for infantry use, it still required the management of a constantly burning length of match-cord. It was not impossible to operate a match-lock gun from the saddle, but it was considerably less than ideal.

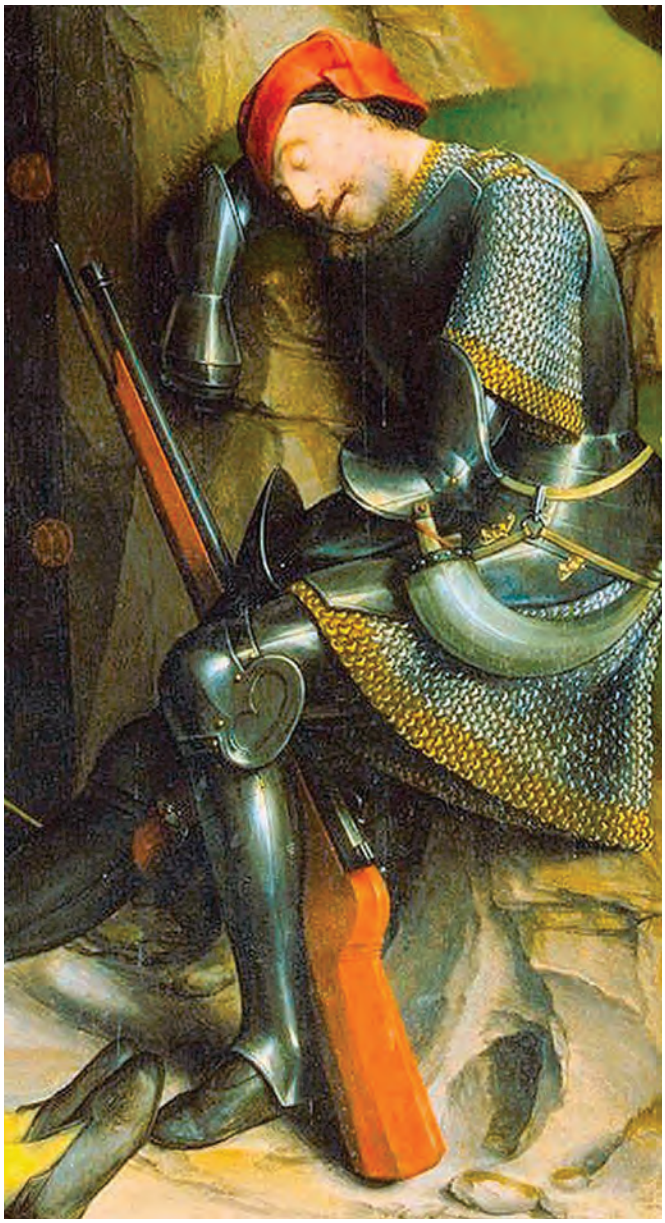

Figure 4. Jan Joest, The Resurrection (detail) c. 1508. Nicolai Kirche, Kalkar, Germany.

Practical gunpowder weapons for cavalry still had to wait for a further advance in the technology of giving fire to the weapon. They also still needed to be lighter and smaller.

Miniaturisation is always one of the great challenges in the advancement of technology, and its achievement is also usually a sign of significant progress. One remarkable illustration from a late fifteenth-century German treatise on explosives,[13] again demonstrates the presence of a clear understanding of what was required, if not quite the way to achieve it (Figure 5). It depicts a combat between two armoured horsemen in which one, armed with a long-sword, is in the process of being shot by an opponent wielding an intriguing combination weapon- a flanged mace which is also a firearm. The artist clearly intended to suggest that the mace was of an all-metal construction, with the haft being hollow and made

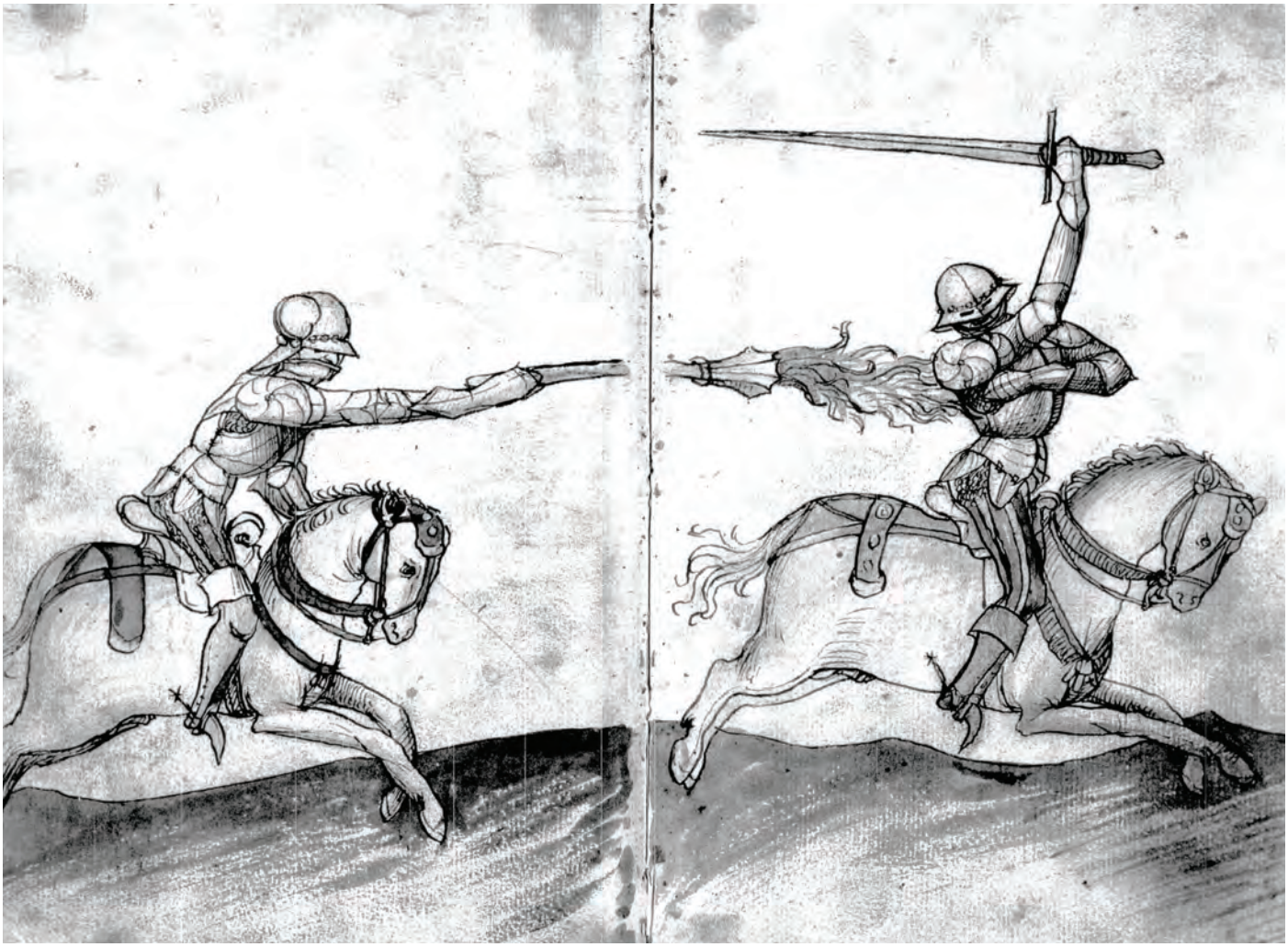

Figure 5. Combat between Armoured Horsemen, German, c. 1475. Bayerische Staatsbibliothek, Munich, Cgm 734, fol. 83v-84r.

to function as a gun barrel. It is not clear how the weapon is fired however. Perhaps the artist was hoping that someone else would solve that particular problem.

That someone else may have been none other than Leonardo da Vinci, who, as Claude Blair has argued, first conceived the wheellock firing mechanism, apparently in the last decade of the fifteenth century.[14.]

From c. 1520, wheellock pistols were available in Europe, ushering in the age of firearms-equipped cavalry (Figure 6).[15.] The removal of the need for a constantly-burning length of match-cord was of course the crucial breakthrough. Now several small but powerful firearms could be loaded and primed, ready to fire, but then stowed for later use as required. This major advance stimulated a proliferation of firearms amongst armoured horsemen. The introduction of cavalry firearms also converged with wider trends in the evolution of armoured cavalry- from the fifteenth century the virtues of light and medium cavalry forces were increasingly recognised, not as a replacement of heavy cavalry but as a compliment to it, allowing equestrian fighting forces to be better suited to the specific situation.

Heavy cavalry remained the knights in full armour mounted on larger, stronger armoured horses, armed with the lance as their primary, first-strike weapon, with the sword and dagger as additional side-arms. They were best suited to massed, frontal attack, charging into the front line of an opposing army and smashing gaps in it if not breaking and routing it entirely. Light cavalry meanwhile

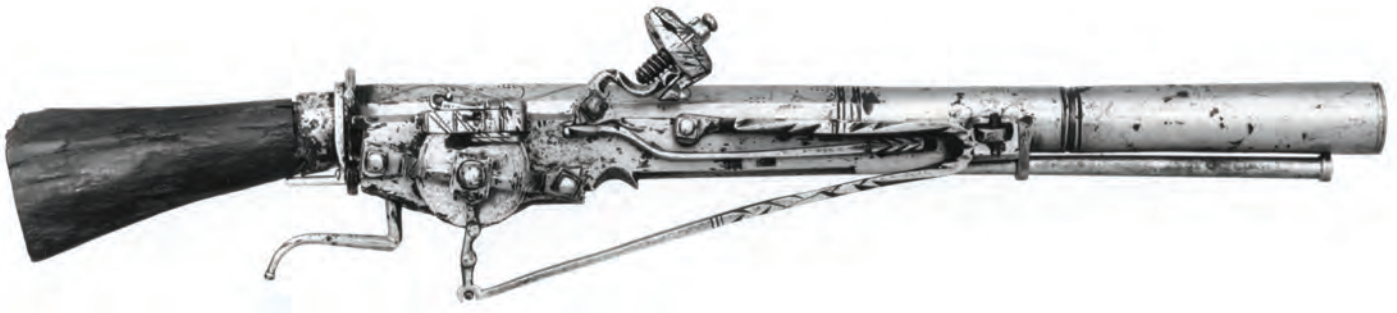

Figure 6. Wheellock Pistol, North Italian, possibly Pontebba, c. 1520. © The Royal Armouries, Leeds, inv. no. XII.1765.

wore only partial armour- a lighter, more open helmet, basic body armour, light defences for the arms and shoulders, and usually no leg armour. Instead of the heavy cavalry lance the light horseman carried a shorter spear, and also a sword. This lighter equipment allowed the men using it to ride smaller, faster horses with much greater range, making them ideal for scouting, skirmishing, rapid response and surprise attack. From the late fifteenth century, we also find medium cavalrymen or 'demi-lancers', who wore more armour than light cavalry but less than heavy cavalry.

Practical small firearms made it possible to specialise these different cavalry forces even more specifically- by the second quarter of the sixteenth century horsemen were being armed with as many firearms as they could carry- a wheellock carbine and at least one pair of pistols, if not more (Figure 7).

Figure 7. Schützenpferd in Trabharnisch, c. 1540. From Kunstbüchlein by Jost Amman, Frankfurt, 1579.

The Emperor Charles V's great victory over the Lutheran Schmalkaldic League at the Battle of Mühlberg in 1547 was a triumph of light cavalry. Crucially, the Emperor fought personally in the battle in this way, and not in full armour. The moment when Charles emerged from the treeline to see that his light cavalry had successfully executed a pincer-movement against his enemies and won him the battle was immortalised in one of the most famous portraits in the history of art: Titian's equestrian portrait of the Emperor at Mühlberg (Figure 8).[16.] This picture is a monument to a historic victory, but it is also a faithful record of how the Emperor was armed on the day.[17.] Interestingly, it has a history of misinterpretation by art historians unfamiliar with arms and armour. The picture has often been characterised as an attempt to model the Emperor's image after the famous equestrian monument to Marcus Aurelius in Rome, or to depict him as St. George, or as the idealised *miles christianus*.[18.]

Those references are incidental, if in fact they are there at all. It is quite easy, without a basic understanding of the equipment, which forms the core iconography of this picture, to see the presence of plate armour of any kind in art as a reference to the ideals of chivalry. However, in this case, when we familiarise ourselves with the real historical circumstances of the battle and take the eyewitness accounts of the Emperor's personal role in the field into account, it is plainly evident that the artist's primary objective was to create an accurate visual record of what really occurred. This is in fact a highly contemporary statement of the Emperor's skill as a military commander and his awareness of the latest tactics and fighting methods. Most obviously, he is not armed in the traditional heavy cavalry equipment of the medieval knight. There is no leg armour, and only partial plate defences for the arms. The helmet is light and open-faced, rather than fully enclosed, and he carries a light cavalry spear, not the knightly war lance; in this context this weapon is present not because it is associated with Saint George and the Emperors of Rome, as has been erroneously suggested,[19.] but rather because it was one of the standard light cavalry weapons of the mid-sixteenth century, carried by all troops fighting in this manner.[20.] Light horsemen were also armed with swords as standard; the gilded spherical pommel of the Emperor's sword can be seen nestled between his breastplate and his rein hand, a detail sometimes overlooked in purely symbolic interpretations of this picture.[21.] Crucially, the Emperor is also equipped with a wheellock pistol slung on his saddle, although it is perhaps too early in date to presume another one on the other side. Notably his armour has been designed to facilitate the handling of his pistol- all of his fingers are protected by steel plates except his trigger finger, which is clad in mail.

It is important to note that the majority of this armour survives. It was made for the Emperor by the great Augsburg master Desiderius Helmschmid in 1544, originally for a different campaign, against the French, and remains today in the Real Armería in Madrid.[22.] Titian almost certainly was permitted access to the parts of the armour worn at the battle when he was painting the picture, so that he could record it correctly.

Charles V was the single most important promoter of the hi-tech concept now termed the garniture- an armour provided with a sets of interchangeable parts or 'exchange pieces.' Through the use of exchange pieces the armour could be converted and re-configured for as many different forms of combat as was required by the client, if he could afford it. This was a vital new capacity for armour, since a Renaissance knight now had to be prepared to fight not just as a heavy cavalryman, but in a variety of other ways, each of which required different armour. The Mühlberg armour is perhaps the greatest war garniture ever created. It was originally composed of around 150 pieces, 125 of which survive.[23.] It is recorded in Charles V's illustrated inventory of his armoury, compiled between 1544 and 1558,[24.] a manuscript which also contains illustrations of a large number of wheellock pistols and longarms, along with their holsters and accoutrements, demonstrating the Emperor's keen interest in such weapons. As the Emperor's favourite armour, the one he was wearing when he achieved his greatest victory in the field, and the one most closely associated with his personal identity, the Mühlberg garniture also appears in many different portraits of Charles V in diverse media, shown in different arrangements and configurations.[25.]

Fully armoured men were doing much more of the shooting than we tend to imagine today, but they were also of course getting shot at. A great challenge to the armourer, and an important issue in the design of garnitures in the second half of the sixteenth century, was the question of how to provide some kind of proofing against firearms while at the same time maintaining an acceptable level of mobility and comfort in

Figure 8. Titian, Emperor Charles V at the Battle of Mühlberg, 1548. ©Photographic Archive Museo Nacional del Prado, Madrid, inv. no. 410.

the armour. Any attempt to address this need was governed by two essential laws of armour design.

First, whether in Ancient Greece or present-day America, the properties of protection and mobility are inversely proportional. As a given design favours one, it must sacrifice something of the other. Second, however well-trained and conditioned, the human body can not operate effectively in an armour weighing more than around 35 kg (77 lbs.). We can perhaps appreciate the hard choices facing the makers and wearers of armour when a breastplate must be 4-6mm (0.16- 0.25 inches) thick in order to withstand musket shot. The bulletproof parts of an armour

Figure 9. Garniture for the field, of Sir Thomas Sackville, Lord Buckhurst, made at the royal workshop, Greenwich, under Jacob Halder, c. 1587. ©The Wallace Collection, London, inv. no. A62.

become heavy very rapidly, demanding precise weight efficiencies to be built into other areas. This is where the interchangeable garniture concept excelled- the armour could be made heavier, substantially shot-proof in fact, if the combat situation required it, while at the same time it could be reset to a lighter mode if firearms did not pose an immediate threat, or if speed, range and mobility were more important factors in the immediate combat environment. So a well-designed garniture like the Emperor's Mühlberg armour had diverse configurations for both infantry and cavalry roles, in light, medium and heavy modes, with the total loads ranging between 15 and 35 kg (33-77 lbs).

From the 1550s, the best German, Italian and English garnitures incorporated extremely effective shot-proofing capabilities. The most important element for the heaviest configuration of the garniture from the middle of the sixteenth century was the plackart or reinforcing breastplate.[26.] This was a solid, single piece of steel 3-5mm thick, which was designed to be worn over the main breastplate. This is one of many demonstrations of historical armourers' detailed understanding of another fundamental design principle of armour: layering. Two layers or more layers of a given material provide better protection than one layer having the same total thickness. This system was also extremely practical, since the heavy reinforce could be removed when not absolutely necessary.

These impressive pieces were proof against direct musket fire at optimal range, not just pistol shot and ricochet. This remarkable capability was recently proven by the Art Institute Greenwich Project led by Jonathan Tavares, Curator of Arms and Armour at the Art Institute of Chicago, who ran an experiment for a recent episode of the documentary television series *Nova*.[27.] The Project first demonstrated that standard munitions armours of the mid-sixteenth century, those provided to common troops, offered little protection against gunfire. Shooting at precisely accurate reproduction armour, with an authentic firearm (70 calibre/18mm) loaded in the correct way, the research team recorded the spectacular failure of armour which was proof against hand weapons and archery, but not against gunpowder weapons. This impressive anti-armour capability is celebrated in the anonymous 1588 publication *The True Portraiture of the Valiant English Soldiers*,[28.] in which a swaggering musketeer comments on his usefulness against armoured opponents:

> *No sooner shall the enemie pipe but I will marke him so,*
> *That he shall gladly on the ground creep, that was apt to go.*
> *With thundring shot ile booge29. him then, albeit he stand aloofe,*
> *That nothing shall his corslet help, though it be made of proofe.*

Tavares and his team then built another target breastplate, based on surviving elements of a field garniture made at the royal armour workshop at Greenwich c. 1590, now in the collection of the Art Institute.[30.] The original complete extent and construction of this armour is indicated by another, slightly earlier Greenwich armour made in the same style and decorated in the same way, now in the Wallace Collection (Figure 9).[31.]

This armour was designed purely for war like the Mühlberg garniture of Charles V, although it cleverly managed to fulfil all battlefield roles using a total of only 17 pieces, rather than 150. This vastly more modest armour nevertheless includes critical measures to address the threat of firearms- two removable pieces 'of proof'- a heavy buffe or faceguard, and a reinforcing breastplate. But would the heavy cavalry configuration of this armour have stood up to musket shot?

Figure 10. Steven van der Meulen (attributed), Thomas Butler, 10th Earl of Ormonde, c. 1560-70. Photo © National Gallery of Ireland, Dublin. Inv. no. NGI.4687.

Using high speed cameras the team recorded the total disintegration of the musket ball on impact. The reinforcing breastplate was dented, but the breastplate underneath, and therefore the man inside, remained completely undamaged. Thus armour and firearms continued to evolve together, and indeed served their owners together. This alliance of the harness and the gun increasingly was represented in portraiture, showing us how firearms became integrated into the Renaissance knight's sense of identity as well as his standard arsenal. A portrait of c. 1560-70 attributed to Steven van der Meulen of Thomas Butler, 10th Earl of Ormonde (1532-1614) is just one of numerous extant examples in which the sitter, wearing a fine etched and gilt Italian armour, brandishes a similarly ornate wheellock pistol (Figure 10).[32.]

Instead of being both ideologically and physically opposed to firearms, knights embraced the new weapons technology, just as they had always done. In reality they were a class of people who had been constantly upgrading themselves, year by year, decade by decade, since the early Middle Ages. Specific classes of fighting men always evolve to make better use of new weapons and tactics. If they do not, they will die.

In fact armoured cavalry were in many ways ideal for the deployment of firearms. Their armour gave them a better chance of successfully approaching within firing range of the enemy, while their horses allowed them to move in, fire and retire at speed. Existing cavalry tactics, developed for the use of the lance, spear, javelin and sword, adapted to firearms quite well. Some way into the seventeenth century, the heavy cavalry lance remained one of the two standard first-strike weapons of the armoured horseman, employed as an alternative to or even alongside the wheellock carbine. Cuirassiers usually carried at least one pair of pistols, as they had done since at least the second half of the sixteenth century. They could then be armed with lance or carbine as deployment required. Therefore training with both weapons remained essential cavalry practice, as shown in a 1599 series of prints entitled *The Riding School* or *The Exercise of Cavalry*, by the Dutch artist Jacob de Gheyn II (1565-1629)(Figure 11).

The massed cavalry charge with firearms was a fearful thing to face on the battlefield. A rare glimpse of the visceral intensity of such an attack is found in a detail of Rubens' equestrian portrait (c. 1634-5) of Cardinal-Infante Don Fernando of Austria (1609-41),[33.] brother of King Philip IV of Spain and joint commander with his cousin Ferdinand of Hungary of the Habsburg army opposing the Protestant Germans, Swedes and Scots at the first Battle of Nördlingen in 1634 (Figure 12). The sitter himself wears the nearly full plate armour of a cuirassier and is armed with pistols and sword. Beneath the horse's belly, Rubens has depicted the charge of the Cardinal's cuirassiers, mounted on fine Spanish horses, blasting away en masse as they charge across the rolling Bavarian landscape. Above him in the sky, the allegory of Fury and the Eagle of Jupiter emphasise the devastating speed and energy of the attack, with Fury hurling bolts of lighting down on the Cardinal's enemies.

Another advantage armoured cuirassiers had over musketeers on foot was their ability to deliver several shots before reloading. In an age when most firearms were one-shot weapons, this ability to carry more individual weapons, all loaded, primed and ready to fire, was a huge advantage. A very low rate of fire was one of the main limitations on firearms technology for quite a long time, and interestingly it seems to have been one of the main reasons armoured cavalry were able to endure as long as they did. Almost until the eighteenth century it was difficult to maintain massed shooting that was intense enough, and sufficiently prolonged, to stop an armoured cavalry charge. The generally low rate of fire meanwhile also gave

Figure 11. Jacob de Gheyn II, The Riding School or The Exercise of Cavalry, 1599.

an advantage to men on horses who were able to carry three to five separate firearms. However, it was clear that one-shot weapons still also placed a crucial limitation on cavalry effectiveness, especially when a wheellock firearm could not always be counted on to deliver its single shot- misfires were common, especially when the weapons had remained loaded for some time without being fired.

Increasing the rate of fire was one of the great technical challenges in the history of firearms, and it is important to acknowledge that the needs specifically of high-ranking elite soldiers, fighting in full armour, the direct heirs to the knights of the Middle Ages, were a driving force behind key advances in firearms technology. First they had needed smaller weapons with mechanical ignition systems- one major leap forward. Next they needed multi-shot weapons. This second challenge would not be met in a decisive way in the time remaining to full armour on the battlefields of Europe, but again, the need for such a capability was well understood. Certainly many fascinating attempts to develop multi-shot weapons were made in the sixteenth and seventeenth centuries.

One of the simplest solutions involved the mounting of multiple firearms on a single stock, as exemplified by two different double-shot configurations in the Wallace Collection. The first, dated 1554,[34.] has a separate trigger for each of the two locks, requiring the pistol to be rotated 180 degrees in the hand to fire the second shot (Figure 13).

The second slightly later design, represented by a pair of finely etched and gilt pistols made in Nuremberg c. 1570,[35.] activates both locks with a single trigger (Figure 14).

By the 1550s experiments were being made with superimposed loads, as shown by a three-shot wheellock pistol now in the Royal Armouries in Leeds (Figure 15).[36.] Another interesting cavalry experiment is recorded in a double-shot short carbine of the early seventeenth century (Figure 16).[37.]

Finally, not even the briefest survey of such weapons can omit the fascinating wheellock revolver, also in the Royal Armouries, one of the very first instances of this concept (Figure 17). Notably, Colonel Samuel Colt studied this particular weapon when he visited London in 1851.[38.]

Figure 12. Peter Paul Rubens, Cardinal-Infante Don Fernando de
Austria at the Battle of Nördlingen, c. 1634-5.
©Photographic Archive

Figure 13. Double-shot wheellock pistol, German, possibly by Hans Schomann of Goslar, Brunswick, dated 1554. ©The Wallace Collection, London. inv. no. A1135.

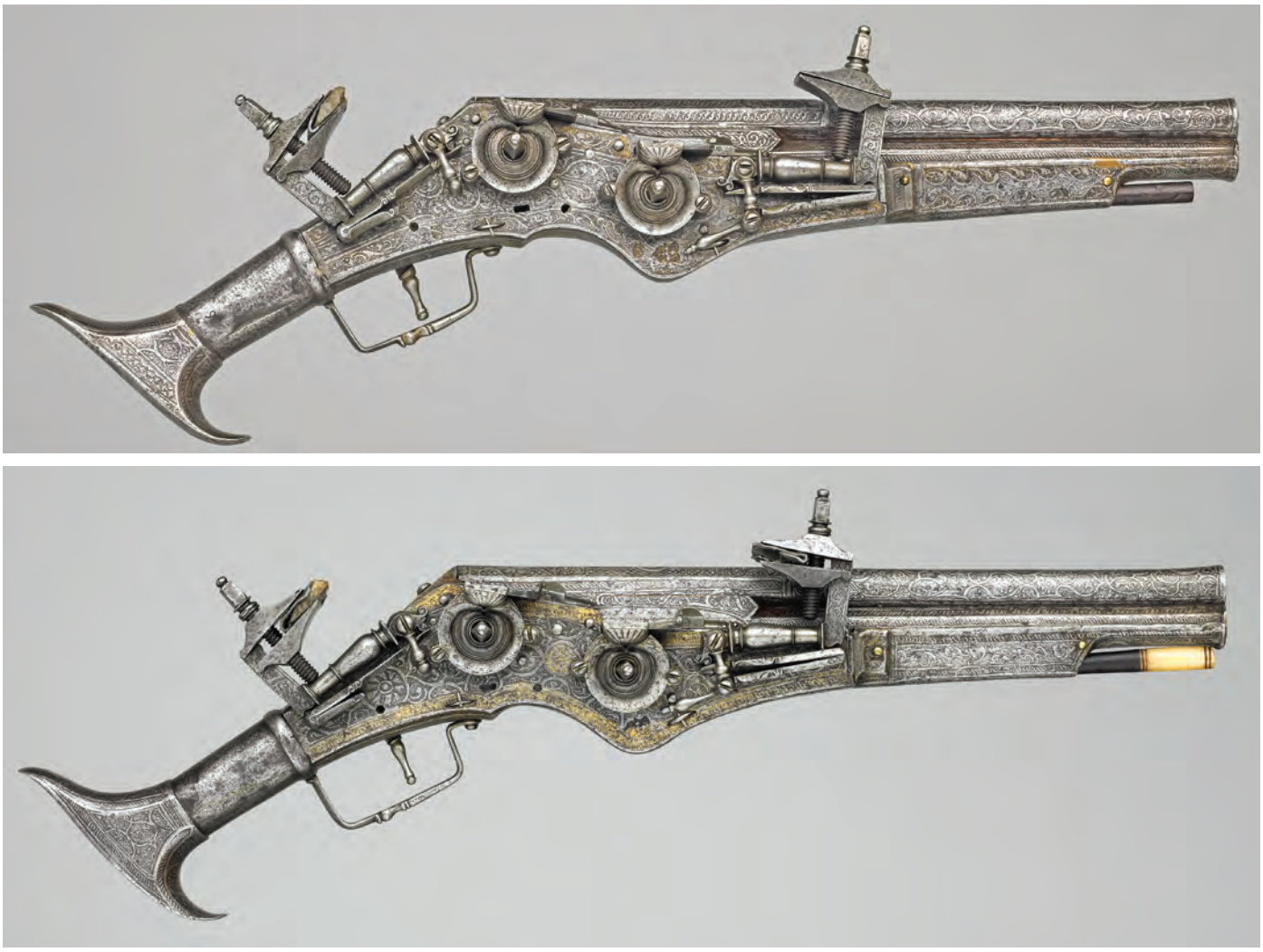

Figure 14. Double-shot wheellock pistols, German, attributed to Peter Daner (barrels) and Gregor Birckholzer (locks) of Nuremberg, c. 1570. ©The Wallace Collection, London, inv. no. A1168-9.

Figure 15. Three-shot wheellock pistol (superimposed load), German, c. 1555. ©The Royal Armouries, Leeds, inv. no. XII.727.

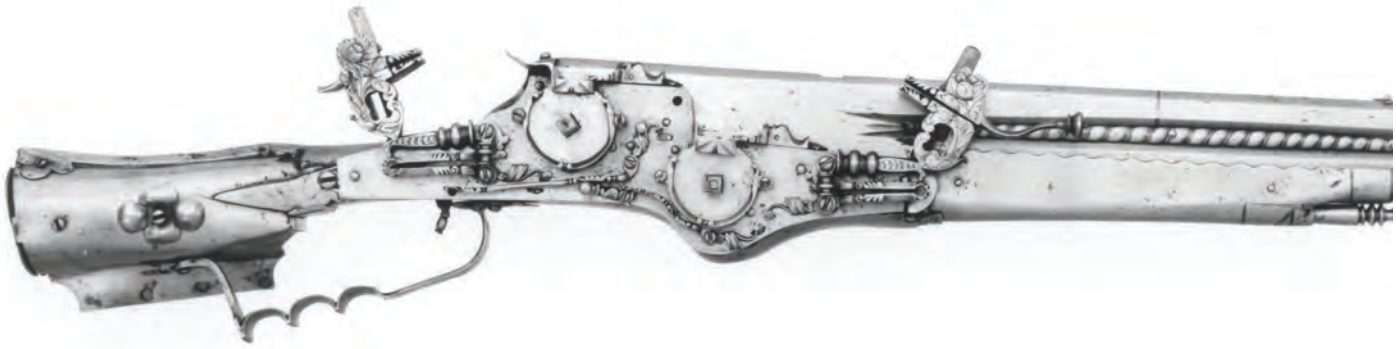

Figure 16. Double-shot wheellock pistol-carbine, German , c. 1620. ©The Royal Armouries, Leeds, inv. no. XII.718.

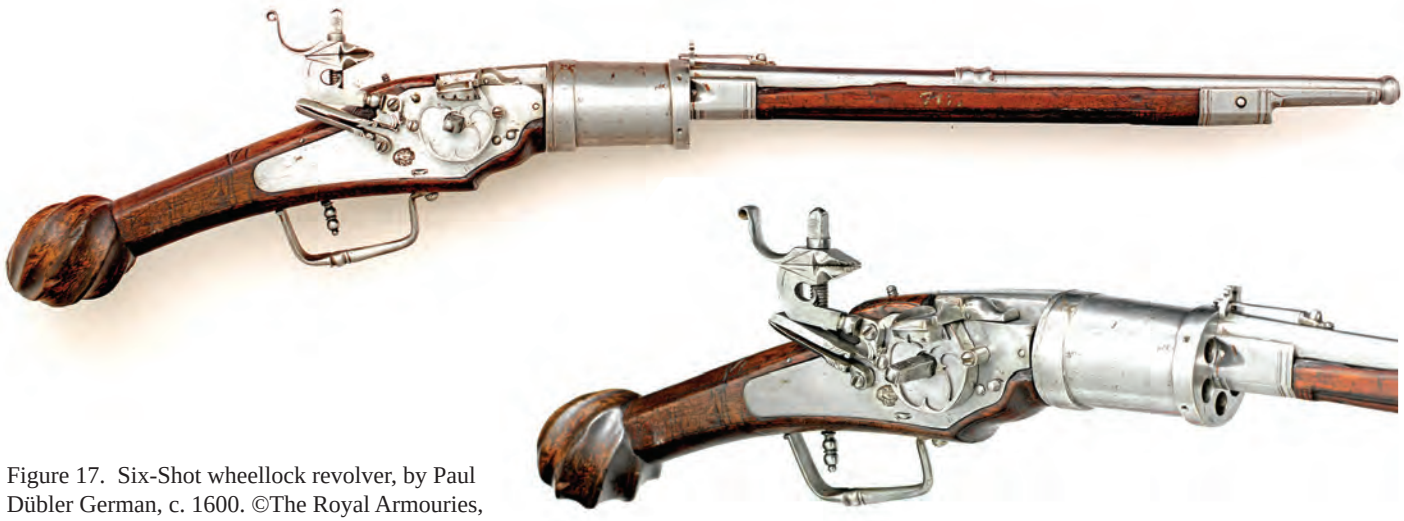

Figure 17. Six-Shot wheellock revolver, by Paul Dübler German, c. 1600. ©The Royal Armouries, Leeds, inv. no. XII.1078.

Such technological advances were however only available to the rich and their retainers, and were essentially impossible to produce on a mass scale. Indeed, multi-shot weapons for general infantry would not become viable yet for many more generations. Instead, limitations on the rate of infantry fire were addressed through the mass deployment of musketeers and the development of rigorous volley-firing drill. Ultimately such barrages could not be endured successfully with any amount of armour, and speed, range and endurance became the most essential factors in cavalry warfare. Full armour therefore had to be abandoned, in an attempt to lighten the load and develop other ways of fighting on horseback.

Crucially however, the improvement and proliferation of firearms and field artillery were by no means the only factors contributing to the disappearance of full armour. Armoured cavalry also required horses of a particular, very expensive type, and these were increasingly in short supply. During the 30-Years War highquality horses became scarcer and scarcer.39. Armoured cavalry still had its champions, most notably the flamboyant cavalry general Gottfried Heinrich, Count von Pappenheim, and in England the Parliamentarian Sir Arthur Haselrig, commander of a cuirassier unit known as the London Lobsters. Nevertheless, the virtues of fully armoured horsemen mattered not at all if they could not be provided with suitable mounts. When it became difficult and expensive to horse such troops, other pre-existing issues compounded the problem- the expense of their equipment for example. The equipment of a cuirassier cost nearly four times as much as that for a harquebusier or light cavalryman in England in 1629.40. Harquebusiers were also increasingly better suited to the rapidly evolving battlefield environment of the seventeenth century. They were better for the job, and cheaper.

Meanwhile the very concept of the knight was changing- no longer the local warrior with his own private fighting force, knights from the sixteenth century, especially in France, had increasingly been taking on courtly and political roles in societies where the rule of monarchs was absolute. Armies therefore could no longer be based on the virtuoso fighting prowess of the elite, because it was increasingly less socially and politically acceptable for the nobility to hold such personal power.

The causes for the decline of armoured cavalry were thus diverse and complex, and here can only be hinted at. The ever increasing accuracy, reliability and proliferation of gunpowder weapons was a factor, the most obvious perhaps, but it was certainly not the only one. Firearms and fully-armoured knights had after all co-existed on the battlefields of Europe for three hundred years. The obsolescence of the latter was not exactly an overnight occurrence.

Moreover, in reality armoured warriors never disappeared entirely. As late as the nineteenth century many European powers still maintained forces of cuirassiers in their armies, and these descendants of the medieval knight still had the ability to play a decisive role on horseback, wearing armour, fighting with lance and sword. During the First World War, all major participants experimented with bullet-proof plate armour, although they now faced a fundamental technological barrier- the power of ranged weapons had greatly outstripped the protective properties of available materials which could be used as armour.

Figure 18. From an exhibit of “future soldier” by the United States Army. Photo by By Daren Reehl - http://www.army.mil/-images/2007/01/07/1718/.

That might seem like the end of the story, but it is not. At present, military organisations with access to advanced technology, such as the United States Army, are moving back into the realm of the knight, vesting superhuman abilities in small numbers of highly-trained individual warriors.[41] Advances in protective materials such as visco-elastics, carbon-fibre, hi-tech ceramics and metal alloys are providing new options for armour proofed against high-powered weapons. The historical weight ceiling of 35 kg is about to be shattered by the introduction of mechanised armatures built into powered, ‘Iron Man’ armours (Figure 18). In the next generation we may very well see the rebirth, a Renaissance it could be said, of the armoured knight- the wielder, as he always has been, of the latest, most advanced military technology.

Endnotes

1. See the cinematic adaptations directed by and starring Laurence Olivier (1944) and Kenneth Branagh (1989).
2. Ariosto, canto 14.118 (p. 151).
3. Ariosto, canto 9.28-9 (p. 84).
4. Ariosto, canto 9.30 (pp. 84-5).
5. Ariosto, canto 9.89-91 (pp. 91-2).
6. Ariosto, canto 11.21-8 (pp. 108-9).
7. See for example Bradbury 1992, pp. 163-4. The forging of guns at the Tower of London and on nearby Tower Hill intensified significantly between 1414 and 1420, during Henry's war in Normandy; Spencer 2016, esp. p. 99.
8. De nobilitatibus, sapientiis, et prudentiis regum by Walter de Milemete, English, 1326-7; Bodleian Library, Oxford, MS 92, fol. 70v. Another contemporary or perhaps even earlier depiction of the same type of weapon is shown in De Secretis Secretorum; British Library, Additional MS 47680, fol. 44.
9. See Galluzzi 1999, esp. pp. 158-63.
10. See Tout 1911; Pegler 1998, p. 18.
11. Various experiments have indicated average energies of impact for the projectiles of the following weapons: longbow arrow = 80-100 joules (J); crossbow bolt = 100-200J; fifteenth-century handgun = 500-1000J; early sixteenth-century arquebus (serpentine powder) = 1300J; early sixteenth-century arquebus (corned powder) = 1750J; late sixteenth-century musket (serpentine powder) = 2300J; late sixteenth-century musket (corned powder) = 3000J. See Williams 2003, pp. 918-23.
12. Examples include two Flemish manuscripts in the British Library, both created in Bruges: a version of the Cyropaedia of Xenophon, c. 1470-83, and the Histoire tripartite, c. 1473-80; Royal MS 16 G IX, fol. 76v and Royal MS 18 E. v, fol. 54v.
13. Feuerwerks- und Büchsenmeisterbuch, Bavarian, c. 1475. Bayerische Staatsbibliothek, Munich, Cgm 734, fol. 83v-84r.
14. Blair 1995. Wheellock mechanisms appear in both da Vinci's Codex Atlanticus (Biblioteca Ambrosiana, Milan) and in a technical manuscript by the Nuremberg inventor Martin Löffelholz, dated 1505, formerly in the Staatsbibliothek, Berlin and now in the Jagiellonian Library in Krakow (Ms. Berol. Germ. Qu. 132). The question of which came first depends therefore on the precise dating of the da Vinci manuscript. This is a matter of debate, but it could have been compiled as early as c. 1500.
15. An important early wheellock pistol, made in North Italy c. 1520, is now in the Royal Armouries (inv. no. XII.1765).
16. Museo del Prado, Madrid, inv. no. 410.
17. See Soler 2001.
18. These ideas were advanced by the art historian Edwin Panofsky in the mid- twentieth century; Panofsky 1969, pp. 84-7.
19. See for example Panofsky 1969, p. 86; Hackenbroch 1969, p. 331.
20. Panofsky appears to have overlooked the fact that the Emperor is armed as a light cavalryman, and in so doing concluded that the presence of the spear was an 'iconographical problem', when it is nothing of the kind; Panofsky 1969, p. 85.
21. See for example de Armas 2006, where the author, following Panofsky and failing to notice that the Emperor is actually carrying a sword, claims that the omission of a sword was an innovation of the artist (p. 85).
22. See Valencia de Don Juan 1898, pp. 60-4, cat. nos. A164-87; Soler 2001; Soler 2010, pp. 160-69, 222.
23. Personal communication, Álvaro Soler del Campo, Curator of the Real Armería, Madrid, October 2017.
24. Now in the collection of the Real Armería, Madrid; the Mühlberg garniture is illustrated across fols. 82v-85r.
25. See Soler 2010, esp. pp. 154-69.
26. The reinforcing breastplate is illustrated as an integral part of Italian heavy cavalry armour in the design album of Filippo Orsoni, Mantua, dated 1554; Victoria and Albert Museum, London, E.1764-1929; see Hayward 1980. An early surviving example is present on an equestrian garniture made for William Herbert, first Earl of Pembroke in the royal workshop at Greenwich under Erasmus Kirkener, c. 1557, Glasgow Museums inv. no. E.1939.65.a-d; see Capwell 2005; Capwell 2006, pp. 48-55.
27. *Secrets of the Shining Knight*; broadcast October 2017.
28. A rare copy of this little-known work is now in the Pepys Library, Magdalene College, Cambridge.
29. The verb booge is a contemporary naval term, to booge, or bouge, describing the process of breaking the ribs of an enemy ship by ramming it, in order to sink it. Here the author seems to be using the analogy of 'booging' the ribs of an enemy inside his armour. The author is grateful to Graeme Rimer for this information, and for that in the previous note.
30. Inv. no. 1982.2241; see Karcheski 1995, p.65.
31. Inv. no. A62. Made for the Elizabethan courtier Sir Thomas Sackville, Lord Buckhurst, c. 1587; see Mann 1962, pp. 78-83, pls.43-5; Norman 1986, pp. 33-6; Capwell 2011, pp. 144-9.
32. National Gallery of Ireland, Dublin, inv. no. NGI.4687.
33. Museo del Prado, Madrid, inv. no. P-1687.
34. Inv. no. A1135, German , dated 1554, possibly by Hans Schomann of Goslar, Brunswick; see Mann 1962, p. 539; Norman 1986, pp. 228-9.
35. Inv. nos. A1168-9, German, c. 1570, attributed to Peter Daner (barrels) and Gregor Birckholzer (locks) of Nuremberg; see Mann 1962, pp. 553-4 ; Norman 1986, pp. 237-8.
36. Inv. no. XII.727, German, c. 1555; see Rimer 2001, p. 25.
37. Inv. no. XII.718, German, c. 1620; see Rimer 2001, p. 27.
38. Inv. no. XII. 1078, German, c. 1600, by Paul Dübler; see Rimer 2001, p. 28.
39. The best and most well-known reference to the problem of horse supply is found in John Cruso's Military Instructions for the Cavalry (1632), in which the author observed that one reason the lancer was disappearing was the lack of quality horses capable of bearing a heavily armed man; p. 30. General George Monck, Duke of Albemarle, in Observations Upon Military and Political Affairs (written in 1644, published in 1671) noted that 'I have omitted here to speak any thing of the Armour of a good Cuiras-

sier, because there are not many Countries that do afford Horses fit for the Service of Cuirassiers: But where Horses are to be had fit for that Service, there a General ought to have two thousand of them in his Army.' (p. 40)

40. In 1632, as part of the government's attempt to standardise equipment in England and Wales, a list of prices for the production and repair of arms and armour was laid down by the Lords Committees of the Council of War. The cost of a complete cuirassier armour was £4 10s 0d, while the lighter, partial armour of a harquebusier was £1 11s 0d; see Grose 1786, p. 109.

41. See for example Friedman 2009, pp. 178, 202.

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