Research Note

Longbow and Hackbutt: Weapons Technology and Technology Transfer in Early Modern England

Gervase Phillips

Figures

The retention of the longbow by England's soldiers of the sixteenth century was a matter of no little contention among contemporaries, and it has attracted comment ever since. Historians such as Charles Oman have generally regarded the bow as "distinctly obsolescent," and the continued reliance on archery is taken as evidence of an enfeebled capacity for warfare. ¹ Military historians have been particularly prone to making such judgments, relying heavily on the concept of "war-winning weapons" as a causal factor in battlefield success. ² Less attention has been paid to the complex interplay of factors beyond technical performance that have governed the choices surrounding the adoption of particular weapons. A people's chosen tools of war can be a manifestation of economic, political, cultural, and social circumstances, circumstances that defy the simple logic of a new technology displacing an old one. The relationship between the longbow and gunpowder small arms provides an instructive case study in factors relating to technological choice. This is true for military historians in particular, but the case has implications for all those interested in the remarkable persistence with which past societies have clung to "distinctly obsolescent" tools even after more "sophisticated" technologies had become available. The complexity of the factors relating to the slow replacement of the bow by gunpowder small arms puts at issue any overarching theory of [End Page 576] single factor dominance. The transition was chaotic in nature, and incidental changes in surrounding social and political circumstances could have led to a quite different pattern in technology transfer.

Most studies of the equipment of early modern English armies have focused on the bitter debates of the closing decades of the sixteenth century when the proponents of the bow, chief among them Sir John Smyth, argued passionately for the weapon's retention against those veterans of the wars in the Low Countries, notably Humfrey Barwick and Sir Roger Williams, who wished either to see the bow abandoned entirely or its use restricted. ³ These debates centered largely on the technical performance of the bow itself. The issue at stake was the correct proportion of English missile troops who should carry longbows as opposed to guns, for not even Smyth advocated that English armies be equipped only with bows. ⁴ This point has, perhaps, not been fully appreciated. Debates about retaining archers as a proportion of missile troops naturally indicate that an alternative technology, the hand held firearm, had already been adopted, but had yet to supplant fully the traditional arm. Yet the circumstances in which the English first chose to adopt firearms, and the process by which these gradually displaced the bow, have received far less attention than the rearward action fought by archery's defenders at the end of the century. Given the longbow's centrality to English tactical practice
and, perhaps even more important, its immense cultural and political significance, the episode provides a fascinating study in technology transfer. This simple tool had, after all, become inextricably linked to English national identity. As Thomas Churchyard, soldier, historian, and (bad) poet, wrote in 1575, "The bowe is feard as farre as flies our fame / And bowes, I weene, wan Englishmen the name." 5 What can have induced the English to forsake such a potent symbol of their own nationhood?

The most obvious answer to this question is based solely on the technological merits of the two weapons: the bow was simply outperformed on the battlefield by handheld firearms, particularly as the arquebus (or "hackbutt," to the English) and the larger musket were refined over the course of the sixteenth century. Yet the assumption that the early modern period really did see steady improvements in the range, accuracy, armor penetration, and rate of fire of infantry small arms has now been challenged. The test-firing of a selection of early modern firearms at the Landeszeughaus (provincial armory) in Graz Austria in 1988-89 failed to reveal any significant improvements in the performance of muskets manufactured [End Page 577] from the sixteenth to the eighteenth century. 6 The inherent ballistic qualities of such weapons meant that these weapons were only effective when used en masse and discharged at close range. Bert Hall has stressed that sixteenth-century small arms were best deployed on the battlefield in defensive formations, protected by field fortifications and supported by large bodies of pikemen. 2 In short, their tactical employment mirrored almost exactly the formations already favored by the English in set-piece battles of the fourteenth and fifteenth centuries: the "Herse" (wedge or rectangular formation) of longbowmen protected by forests of stakes driven into the ground and supported by heavily armored infantry armed with polearms. 8 The technology of small arms, therefore, had not rendered English tactics obsolescent.

It could still be argued that although the combination of missile and staff weapons was still viable, the traditional formation of men armed with bows and billhooks was less effective than the equivalent unit of men armed with arquebuses and pikes. A direct comparison of the battlefield performance of missile weapons is fraught with difficulties. If the veterans of sixteenth-century wars themselves could not agree, then the historian now must acknowledge the speculative nature of any conclusions. Yet much evidence can be gleaned from the testing of surviving examples of weapons, from the polemics of Smyth, Barwick, and Rogers, and from incidental comments in contemporary accounts of military service. 9

The recovery of large numbers of longbows from Henry VIII's Mary Rose, which sank in the Solent off Portsmouth in 1545, has allowed for extensive testing on authentic weapons and reproductions, modern bows that strive to replicate the technical specifications of originals as closely as possible. 10 These tests have suggested that a bow of 70 pounds draw, firing a heavy bodkin-type arrow, had a potential effective range of between 150 [End Page 578] and 200 meters. This is an impressive distance, but against an armored target such fire would be far from lethal. Test arrows failed to penetrate 3 millimeters of plate armor (the thickness of a good breast plate or helmet) at just 10 meters. Arrows could penetrate 2 millimeters of armor at the same distance, but not with enough force to cause a serious wound. Significant penetration was achieved only of armor 1 millimeter thick. This would have been sufficient to cause injury even to an armored man, since the armor worn on arms or legs was thinner than that worn on the torso. Overall, the suggestion from the tests was that mass volleys of arrows would cause "many disabling wounds and few fatalities." 11 Contemporary evidence would seem to back up this conclusion. At Flodden in 1513 an English army was confronted by an invading Scottish force led by heavily armored pikemen. English archery disrupted the order of their assault but failed to halt their advance. As the English chronicler Edward Hall noted, "they abode the most dangerous shot of arrowes, which sore them noyed, and yet it hit them in some bare place it dyd them no hurt." 12 In the end the battle was decided at "handstrokes," a Northumbrian survivor reporting that "few of thaim [End Page 579] [the Scots] were slaine with arrowes, how be it the billes did beat and hew thaim downe with some
paine and danger to Englishmen." 13

In comparison, the test firing of two late-sixteenth-century Doppelhakens (heavy muskets) from the Graz arsenal indicated a significantly greater armor piercing potential. At 100 meters the weapons penetrated, respectively, 2 millimeters and 4 millimeters of steel, although they would have been unlikely to cause serious wounds at such range since much of the balls' momentum would have been dissipated by the armor even as they passed through it. At shorter ranges, however, and certainly at 10 meters, such muskets would have inflicted horrific wounds. 14 The superior performance of small arms in terms of armor penetration would seem to provide a compelling logic for their adoption in place of the bow. Yet one must be wary. The oldest Doppelhaken fired in the Graz tests was manufactured in 1571. Its heavier ball would have given it, at the least, a marginally improved armor penetration over the earlier, and smaller caliber, arquebus. The advantage offered by the arquebus over the bow earlier in the century may, therefore, be less significant than the above figures would at first suggest.

The extent to which small arms did improve in performance over the course of the century remains a contentious question, but contemporaries certainly believed that technological refinement was delivering better weapons. For example, in 1534 Henry VIII was informed from the continent that "arquebuses are now made here which give double the stroke of the hand gun. . . ." 15 If the sixteenth-century arquebus did offer a marginal improvement over earlier "hand guns" and the musket a marginal improvement over the arquebus, then one can tentatively identify a process by which the bow was gradually supplanted by an improving technology. Again there is some anecdotal evidence to support such an interpretation. In the early continental campaigns of Henry VIII, there is no suggestion of his missile infantry being in any sense "outgunned" by French infantry. Indeed, in 1513 rapid-firing English archers had driven sorties of German Landsknecht mercenaries, whose standard armaments were small arms and pikes, back into besieged Therouanne. 16 But by midcentury small arms were presenting English archers with greater problems. In 1544, during the siege of Montreuil, a Welsh captain with twenty years service in the Calais garrison despaired of his men, "I never saw Welshmen or Englishmen so bad hearted or so unventuresome as I saw at this time. Not a single one of [End Page 580] them would dare to go near where the handguns were shooting at us." 17 Later the same year the Gascon veteran Blaise de Monluc, who commanded a company of French and Italian arquebusiers, commented that during the fighting around Boulogne "they [the English] all carried arms of little reach and therefore were necessitated to come up close to us to loose their arrows." 18 Humfrey Barwick, who was serving in Boulogne at the same time, recalled that "I did never see or hear, of any thing by them [archers] don with their long bowes, to any great effect. But many have I seene lye dead in divers skirmishes and encounters. . . ." 19 Fourteen years later an English officer during the siege of Calais noted the difficulties encountered by his skirmishers in action because French small arms "assuredly shot very great bullets and carry far." 20 None of this demonstrates that the bow was, as yet, utterly outclassed. Smyth dwells at some length on the discomfort that English bowmen caused to German and Spanish mercenaries during the peasant revolts of 1549. 21 However, the confused, running battles fought between agrarian rebels and the Earl of Warwick's foreign hirelings were small-scale affairs. These minor skirmishes in East Anglia and the West Country were less indicative of the mainstream of European warfare than were the grim business of siege and countersiege in which the English found themselves enmeshed around Boulogne and Calais in the 1540s and 1550s. In that theater, at least, the anecdotal evidence suggests that the range and hitting power of enemy small arms was becoming a cause for concern in a way that it hadn't been earlier in the century. 22

Even this, however, would not be enough in itself to cause the English to abandon the bow. The marginal superiority offered by small arms, particularly in terms of armor penetration, would have been paid for in reduced rate of fire. The rapid rate of fire
possible with a bow far outstripped anything possible with an arquebus. Humfrey Barwick (a witness generally hostile to archery) allows the bow a rate of fire of six arrows every forty seconds, compared to the arquebusiers one shot in the same period. Fire at this rate could neither be sustained nor accurate, but it served a vital tactical purpose. As English militia captains were instructed in 1562, the purpose of rapid fire using light "flight" arrows was "to gall and annoy the enemys farder of them [further off than] the usall custom of the sheafe arrowes." Once an enemy had been sufficiently galled he would break formation, either retreating out of harm's way or engaging in an impetuous and undisciplined advance. The most dramatic evidence of the utility of such a tactic comes from the Battle of the Spurs in 1513, when arrowfire directed at French men-at-arms turned an orderly maneuver into panicky flight.

Such long-range harassing fire was attempted with contemporary small arms; Smyth quotes a Spanish military adage of the day, "discharge afar off, to draw on and deceive doterels." Yet nowhere did such fire form such an intrinsic part of a tactical system as in England, where it had been a feature of practically every major engagement fought by English armies since the mid-fourteenth century. Furthermore, the bow's rapid rate of fire made it in one respect an ideal complement to the arquebus, rather than a competitor. The Venetians, who like the English could still draw on a body of skilled archers, used bowmen to cover arquebusiers as they reloaded. Venetian galleys continued to carry archers until well into the seventeenth century, a longevity of service that matches the bow's record in England. The Captain's Handbook, written by Henry Barrett in 1562, also suggests mixed formations of archers and arquebusiers to achieve a continuous barrage of fire, and an Italian mercenary, Giovacchino de Comiano, describes how units of English pikes and bills were flanked by mixed units of arquebusiers and archers as early as 1544. In the first instance, therefore, the English adopted small arms not with a view to replacing the bow but rather combining the two weapons to give their formations of missile infantry the advantages of rapid discharge, harassing fire at long range, and stopping power at short range.

This argument goes some way to explaining why Henry VIII employed expensive foreign arquebusiers while simultaneously discouraging his own subjects from using the weapon. He clearly wanted both troop types in his army. Those who have held to a belief in the inherent superiority of the gun over the bow have argued that arquebuses "were considered too dangerous for the great multitude of the easily disaffected poor." In a way this was true. Yet it was not so much the disaffection of the poor that signaled danger as the inherent inaccuracy of the arquebus. The test firings at Graz revealed the significant extent to which smoothbore weapons scattered their shot. Only one of the Graz muskets demonstrated a significantly greater-than-chance probability of hitting its target. The population of Henry VIII's England had learned the same lesson the hard way. Where the poor were practicing with guns, people were getting killed. A statute issued in Westminster in 1540 limiting the use of handguns chastised arquebusiers for discharging their weapons "in cities, boroughs and towns, and other unmeet places, without having any regard or respect where their pellets do fall ... whereby sundry his grace's officers and subjects, being in the highway, in the open street, or in their own houses, chambers or gardens, have been put in great jeopardy of their lives." Earlier proclamations did indicate that both the handgun and the crossbow were being used by "people given to felonies," but the favor enjoyed by these weapons among footpads and "broken men" does not necessarily imply their inherent superiority as military weapons.

The main purpose of the Henrican statutes restricting the use of handguns and crossbows, while simultaneously encouraging archery, was twofold. First, they were designed to protect life and property, both from deliberate felony and from the irresponsible use of an inherently inaccurate and potentially lethal missile weapon among an unsuspecting civil population. Second, they were expressions of a widespread fear that "the archery of this realm is utterly set
apart and extremely decayed." Effective use of the bow depended on regular practice, beginning in childhood and maintained into manhood. English archery was a cultural phenomenon dependant on the centrality of the butts to village life. The crown feared that rival attractions of hand guns and illegal games, such as quoits, bowls, and dice, were sapping the once vaunted martial prowess of England’s yeomen. Gauging the course and extent of archery's decline is of some importance in assessing the relationship of the weapon to firearms. This decline was a matter of pressing concern for contemporaries. The unwillingness of country folk to practice with their arms was contrasted with the Swiss, whose exercises were "the greyst cause of their grete fame in dedys of armys." John Hales was one who expressed grave doubts about the ability of the English to defend themselves in war. Hales, however, like many others, blamed not the attractions of immoral games but the effects of enclosure and its impact on English rural life, as honest yeoman were forced from the soil to make way for sheep. The status of the bow had thus acquired a political dimension. Already a potent symbol of English nationhood, the bow became a symbol of English liberties. In 1514 the citizens of London, finding themselves grieved with inclosures of the common fields around Islington, Hoxton and Shoreditch . . . whereby they could be suffered to exercise their bowes . . . assembled themselves on a morning . . . and so bestirred themselves that within a short space, all the hedges about the town were cast down." Many of the tracts warning of the decay of the people's skill as archers are, thus, tainted by more than a hint of an ideological agenda. This continued to be the case throughout the remainder of the century. The fate of the bow became linked to the fate of the poor, whether threatened by enclosure or some other manifestation of privileged greed. Thus the blue-blooded Smyth's pro-archery polemic of 1590 was marked by a paternalistic concern for England's yeoman and a ferocious assault on captains who sent their men to certain death in order to pocket their wages as "deadpay." The association of the decay in archery with the plight of the poor in Tudor England indicates that the bow had become much more than a simple tool. The attachment of many Englishmen to the weapon was not so much sentimental as political. This makes assessing the extent to which the battlefield performance of the bow was actually adversely affected by the deteriorating capacity of the bowmen themselves problematic. The extent of archery's "decay" may have been exaggerated to make a political point. Nor were Henry VIII's statutes restricting game-playing in an effort to encourage archery necessarily indicative of a genuine crisis, for they were not without precedent. As early as 1363 a royal ordinance made a similar complaint about the effect on archery when training time was wasted playing football.

Nevertheless, it is clear that the peculiar social and demographic tensions of early Tudor England had some impact on the availability of skilled archers. The 1540s saw a noticeable decline in the number of able-bodied men available for the shire levy, either as archers or bill men, a decline that has been associated with the epidemic of "sweating sickness" (probably influenza) that swept the country. Furthermore, the failure of individuals to practice with their bows may have been indicative of a more serious problem than merely an interest in football, guns, or dicing. Those contemporaries who postulated an association between social conflict and military preparedness were not far wide of the mark. Military service still depended on an individual's, or community's, acknowledgment of a quasi-feudal duty to serve in the retinues of their landlords, but those bonds were now breaking down. In 1542 tenants of a Derbyshire landlord, John Port, maintained that they had no obligation to follow him to the war in Scotland. Tenants, particularly those of some substance, were now possessed of the confidence to challenge archaic demands that they follow their lords to war. It followed that they felt no particular obligation to practice with their bows. Considering both the demographic and social factors, Jeremy Goring has calculated that the proportion of able-bodied Englishmen who could be designated "archers" in the shire muster returns fell from one in three to one in four between 1522 and 1557. Over the same time period, as has been noted here, English armies in the field were making increased use of mixed formations of bow and arquebus.
The decline in the number of archers was not the sole dynamic behind this phenomenon. Such mixed formations were, tactically speaking, a useful combination. The value of the arquebus was particularly appreciated in positional or siege warfare, where small arms could be rested on parapets and fired from cover. As Roger Williams observed, bows were harder to use in entrenchments, or from behind parapets, as they required room to be drawn fully and for the archer to be standing if he was to use his weapon most effectively. 43 With increasing involvement in prolonged siege warfare between 1544 and 1550, the arquebus became increasingly commonplace among English soldiers. Around Boulogne both the French and the English constructed extensive earthwork defenses incorporating the most important features of the *trace italienne* style of artillery fortification. Low-lying angled bastions mounting gun batteries, supported by other cannon located in "flankers" and connected by curtain walls pierced by gun casements, depended for their defence on firepower, particularly enfilade fire delivered onto the flanks of attacking troops. 44 Bows could be, and were, used from these forts, but the arquebus was far more suited to use from deep trenches, narrow parapets, confined casements, and small gun loops. When the English began constructing similar fortifications in Scotland during the occupation of 1547-50, military commanders placed the greatest emphasis on the provision of troops armed with arquebuses for the garrisons. With a French expeditionary force on the way, the Duke of Somerset commanded John Brende, the officer commanding in Berwick-on-Tweed, to train up as many "hackbutters" as possible for the defence of the new forts. 45 The ensuing fighting was characterized by positional warfare around the forts, and was dominated by the arquebus and the cannon rather than the bow. As the French and English fought for Haddington, Lord Methven reported to Mary of Guise, Scotland's dowager queen, that "daly and nychtlie is at all ouris carmoshe [commotion] of hacbutis."

It was also during this campaign that the English first began to make use of mounted troops carrying firearms. One of the most important components of the English army that invaded Scotland in August 1547 was a two-hundred-strong company of "hackbutters on horseback" commanded by a Spanish *condottiere*, Pedro de Gamboa. 47 The precise nature of their equipment is debatable. Although contemporaries such as William Patten [End Page 587] described their weapons as "hackbutts," some historians believe that they were pistol-armed mercenary cavalry of the type known as *reiter*. 48 The hackbutt/arquebus was a long-barrelled weapon, which required two hands to operate. The pistol, which could be used one-handed, seems a more natural weapon for a horseman. Yet in fact Patten may have been correct in describing de Gamboa's men as being armed with arquebuses. In the inventories taken on the death of Henry VIII earlier in 1547, the English referred to pistols as "shorte gonnes for horsemen," as distinct from "hackbutts," which were recorded in a separate category. 49 In the field English soldiers used the word "dag" to describe pistols, the first recorded use of the weapon on a British battlefield occurring in 1548, when a French *chevauleger* (cavalryman in half-armor) shot and seriously wounded an English lancer outside Haddington. 50 Had de Gamboa's men carried pistols, Patten would probably have referred to their weapons as dags, not hackbutts. That the "mounted hackbutter" carried an arquebus would also seem to be confirmed by Roger William's comment on Spanish mounted arquebusiers, that "manie have pistols besides their pieces." 51 This would indicate that such troopers often carried two weapons, a long-barrelled "peece" and a handier pistol. The designation "mounted hackbutter" would seem, therefore, to be essentially correct. De Gamboa's men fought both mounted and dismounted, and the use of arquebusiers in this fashion was of great significance. They offered the benefits of a strategic mobility that English forces of the fourteenth and fifteenth centuries had derived from companies of mounted bowmen. They were particularly useful during the English campaign in Scotland, since light cavalry was vital for escorting convoys to the beleaguered garrisons and patrolling stretches of occupied territory. Indeed, the English came to place so much value on de Gamboa that he was knighted, and his troops received pay of eight ducats a month, twice the normal rate for cavalry. 52
The nature of this style of warfare put a premium on the value of arquebusiers, mounted or otherwise, as opposed to archers. Not only was the English regent Somerset a keen employer of German, Spanish, and Italian arquebusiers, but he was now offering an increased wage of eight pence a day to English soldiers who could use the weapon, two pence more than an archer received. The immediate effect of this generosity was a further decline in the number of archers mustering for service. On 16 February 1547 Lord Cobham wrote to Somerset complaining that "this increase in wages to [arquebusiers] will not only be a great hinderance and a decay to the archery [End Page 588] of the nation, since all men covet the highest pay, but will be a means . . . that the able and tall men who receive for other weapons only 6d. a day shall be greatly discouraged when they see such weak personages entertained for the harquebus." 53 This situation is an interesting inversion of that found in the rest of Europe. The initial adoption of gunpowder small arms has generally been seen as an economic choice for most European armies. The handgun was both cheaper to use and cheaper to produce than the crossbow, and it was this consideration, rather than its intrinsic superiority as a weapon, that led to the replacement of the fearsome all-steel arbalet that had been developed during the fifteenth century. 54 For the English, adoption of the arquebus involved incurring a greater cost than that associated with the bow. Not only were higher wages paid to arquebusiers, but the gun itself was considerably more expensive than a bow. In 1511 Lewis and Alex de Fava supplied 420 handguns to the crown at eight shillings each. In 1530 Henry's master smith, Cornelius Johnson, supplied one hundred handguns, destined for the Dublin Palesmen, at five shillings each. 55 In England the price of firearms rose as the century progressed. The Elizabethan army was paying between twelve and thirty shillings for calibers (a development of the arquebus, with a slightly lengthened barrel and a uniform caliber), and from eighteen shillings to two pounds each for muskets. 56 In comparison, bows were cheap. Henrican statutes of 1542 had set prices, with bows available in three classes from two shillings to 3s. 6d. for high-quality weapons, usually made of imported yew. In 1566 bows of English yew remained available at two shillings to Queen Elizabeth's soldiers, but the price of a first-quality imported yew bow had risen to 6s. 8d. 57 Comparisons between the prices of small arms and bows indicate two things. First, the English decision to adopt guns in the sixteenth century cannot have been made on economic grounds, since firearms cost more than bows. The gunpowder weapons must have conferred some advantage on their users in battle, particularly in the positional warfare in which the English were involved in the 1540s, that did not accrue to bowmen. If this was not the case, there would have been no incentive for the English crown to bear the extra cost associated with buying guns and paying higher wages to arquebusiers. Second, however, the relative cheapness of the bow made a major contribution to its longevity of service alongside the arquebus. This was particularly true for the shire levy (militia), as the counties had to bear the cost of re-equipping with firearms and of providing powder to allow the militia men to train. 58 [End Page 589]

Yet, once again, there is another complicating factor that needs to be taken into consideration. The rising cost of high-quality bows arose from problems in the supply of imported yew bow staves. It became increasingly difficult for ordinary yeomen to secure good-quality weapons as merchants recognized the potential for profit in England's dependence on imported yew. The problem first emerged in 1547. In May of that year Bishop Tunstall wrote to Protector Somerset from the north of England, where troops were mustering for the coming campaign in Scotland. He complained that "We doo fynde in our countrey great lack of bowes and arrowes, and specially of bowes, whereof there is almost none in the countrey of ewe. The cause is . . . that a merchaunte of Danske hath of late tyme engrossed up and gotten in to his hands alone, the byinge of all bow staves in Eastland, which were wont to be brought hyther by diverse merchauntes and then they were plentye and good cheap, and nowe one man haveinge thaim alone, enhaunceth the prices as he lyseth [so that] poore men cannot attain the price of them." 59 [End Page 590]

The high price of top-quality bows in Elizabeth's reign, the equivalent of two week's pay for an ordinary soldier, indicates that the supply of "plentye and good cheap" yew bow staves was
never recovered. The poor performance of English archers in the field, which drew so much criticism from Humphrey Barwick and Roger Williams in the 1590s, may reflect not just a decline in the quality of the bowmen themselves but a decline in the quality of materials from which many of their bows had been made. The combination of poor quality bows in the hands of men who practiced less frequently at the butts might explain why Roger Williams, writing in 1590, was so certain that "among 5000 bowmen you shall not finde 1000 good archers." 60

The pivotal period in the relationship between small arms and bows in English armies appears to be the years 1547-50, when Protector Somerset fought his campaign in Scotland and Tunstall warned him that his army "shall lacke furnyture of archers." 61 In contrast, the number of small arms was rising dramatically. The Tower arsenal alone contained 6,700 "demi-hakes or hand-gonces" and 275 "shorte gonnes for horsemen." 62 As has been noted, small arms and cannon dominated the fighting around the English garrisons themselves, but even in the field the bow was physically sidelined in infantry formations, a weapon for the skirmish line and for supporting "wings" of troops rather than the main "battle," which was composed of soldiers armed with pike, bill and arquebus. In February 1548 an English landing party operating in Tayside was organized and equipped as follows:

Skirmishers--20 harquebusiers and 20 bowes

For the Battle--4 ranks of harquebusiers, 7 ranks of pikes, 4 ranks of bills

For the wings of the battle--40 archers, 20 sword and targets for wyfflers. 63

The bows were concentrated among the skirmishers who preceded the advance, and on the wings of the battle. The battle itself was a column of men fifteen ranks deep, each of which must have been thirteen or fourteen men across. The column was narrow, presumably, to allow it to move relatively unimpeded along track ways and through streets and would probably redeploy in action. Nevertheless, the position of the archers on the peripheries of the formation is noteworthy. This was the location favored by some of those involved in the Elizabethan debates over the bow's future. In Barnaby Rich's 1574 Right Exelesent and Pleaasunt Dialogue betweene Mercury and an English Souldier, the God of War's advice to the Englishmen [End Page 591] was that the bow retained its usefulness except in a direct encounter with enemy firearms. 64 Thus, although the English continued to field bowmen after 1550 their primary function was to support the firearms troops.

The longevity of the bow's service in English armies seems far less surprising when the complexity of issues surrounding its use are considered. In technical terms the superior armor penetration of small arms and the suitability of the arquebus for use in positional warfare had much bearing on the English decision to adopt handheld guns. From 1550 onward English armies in the field would always be well supplied with small arms. Yet over the course of the sixteenth century the bow was never so outclassed as a weapon that a compelling logic could not be found for its retention. Even after the experience of the siege warfare of 1542 to 1550, which had been dominated by gunpowder weapons, the bow remained a rational choice of weapon technology, depending on the circumstances in which English soldiers found themselves. Armor penetration was less of an issue against Scottish light horse on a cattle lifting foray, who might wear mail or reinforced "jacks" but not cumbersome plate, than it was against heavily armored French soldiers assaulting an earthwork. In the low-intensity conflict that was the norm on the Anglo-Scots borders, the bow's light weight, rapidity of fire, and accuracy made it the weapon of choice for most Marchmen for the whole of the century. When Queen Elizabeth dispatched Thomas Radcliffe, Earl of Sussex, to restore order in the lawless border country in early 1569 he demanded archers, not "ill-furnished harquebusiers." 65 In the hands of the skirmisher the rapid-firing bow remained a useful weapon as an addition to small arms so long as there remained men skilled in its use. The inclusion of small numbers of archers in the contingents sent to the Netherlands in 1585, and even in the proposed expedition
to La Rochelle in 1627, was not entirely without reason. 66

The difficulty in mustering sufficient numbers of those skilled archers is a reminder that the relative technical merits of small arms and bows were far from the only criteria that governed the choice of technology. Relatively wealthy yeomen and tenant farmers chose not to exercise with their weapons, an activity that implied an obligation to an archaic form of military service for which they had little regard. For the poor however, the bow became a political weapon in popular protest against enclosure. Those irate Londoners who threw down hedges and filled in ditches and then practiced with their bows on the reclaimed common land in 1514 were surely more concerned with their own security than with the security of the realm. To choose not to practice with one's bow may have been a political act. To be prevented from practicing with one's bow was a sure sign of disempowerment and a loss of ancient privileges. The fervor with which some Englishmen clung to the bow grew from the same seeds as the popular revolts of 1549. In England the bow, not the gun, was the weapon of the "disaffected poor."

The decline in the number of archers available to English commanders, combined with the difficulties in the supply of good-quality yew, undoubtedly made a more widespread use of small arms a pragmatic option, but it is apparent that there is a complex congruence of factors operating over the course of the sixteenth century that dictated the choice of technology. Identifying a paradigm that might explain technological transfer in this period is, thus, fraught with problems. The exact impact of any single factor, technical, cultural, political, or economic, is immensely difficult to calculate. Even the slightest alteration in circumstances might have made a massive difference in the survival or otherwise of the bow as a front line weapon. A more sympathetic attitude on the part of the crown to the plight of commoners as a result of enclosure could have ensured the survival of a skilled corps of bowmen into the seventeenth century. On the other hand, the paucity of high-quality yew might have doomed the bow regardless of how seriously Englishmen took their obligations to practice with the weapon. Similarly, had Somerset's political and religious commitments to British union and anti-Catholicism not led him into a three-year conflict in Scotland dominated by gunpowder fortifications, the widespread adoption of small arms by English troops might have come much later. The system of technological transfer in this case is, in short, a chaotic one. The initial situation of English missile troops, relying on the rapid-firing longbow rather than the crossbow, was different from that of most other western European states. The path they took toward the adoption of the gun was governed by that medley of social, cultural, economic, and technological factors, most of which were peculiar to England. Even within England itself slight differences in circumstances from region to region could affect the choice of technology. The border country was not the only area that had a particular incentive to retain the bow. Charles Oman notes that Oxfordshire and Buckinghamshire mustered significantly higher numbers of bowmen in the invasion scare of 1588 than the surrounding counties. He comments that these two counties were heavily wooded and surmises, probably correctly, that it was the bow's silence in this instance that ensured its continued popularity. Poaching was a matter of life and death in sixteenth century England, and was best done quietly. 67 This is just one more reminder that the choice of technology in this instance was governed by a host of individual considerations and unique circumstances. The complexity of this process should warn against the temptation of formulating overarching paradigms for technological change that do not take into account careful considerations of variations in time, space and cultural context, in which new technologies simply render old ones obsolescent.

Dr. Phillips is lecturer in modern history at the Manchester Metropolitan University. He thanks the Technology and Culture referees for their invaluable critiques of earlier versions of this research note.

Notes


4. See, for example, his comments on the utility of arquebuses for ambushes in broken terrain and when integrated into pike units, in *Certain Discourses Military by Sir John Smyth*, ed. J. R. Hale (Ithaca, N.Y., 1964), 62.


14. Krenn, Kalaus, and Hall, (n. 6 above), 103-5.


16. Edward Hall, 63, 66.


20. Lord Wentworth to Queen Mary, 2 January 1558, reproduced in Tudor Tracts 1532-1588, ed. A. F. Pollard (Westminster, 1903) 308.

21. Smyth (n. 9 above), 94-96.

22. It should be noted, however, that the English weren't the only ones using bows of one form or another around Boulogne. When the town was first besieged its garrison included "arbalestriers." See "Diary of the Siege and Capture of Boulogne, 1544," Journal of the Society for Army Historical Research 1 (1922): 196.

23. Esper (n. 3 above), 387.


25. The best account of this engagement can be found in Charles Cruikshank, Henry VIII and the Invasion of France (Stroud, 1990).

26. Smyth, 63. Smyth gives the original Spanish as "dispares de lexos, para atraher y engañar bobos."


29. Millar (n. 1 above), 22.

30. Krenn, Kalaus, Hall (n. 6 above), 106.


32. Ibid., 1:121. A "broken man" was an individual without master or landlord who lived on the margins of society by whatever means presented themselves. The term was particularly associated with the Anglo-Scots Marches, and was largely synoynomous with "outlaw."

33. Ibid., 1:108.


35. See Elizabeth Lamond, ed., A Discourse of the Commonweal of This Realm of England (Cambridge, 1893).


37. Smyth (n. 9 above), 20-22.


42. Ibid., 193.

43. Evans (n. 9 above), 39.


46. Anne Cameron, ed., *The Scottish Correspondence of Mary of Lorraine* (Edinburgh, 1927), 249.

47. William Patten, "The Expedition into Scotland, 1547," in Pollard (n. 20 above), 78.


50. Bain, 257.

51. Evans (n. 9 above), 19

52. Bain (n. 45 above), 249

53. Dillon (n. 15 above), 230.


55. Dillon, 230.


58. The cost of powder in particular was a consistent complaint from the counties. See Lindsay Boynton, *The Elizabethan Militia* (London, 1967), 33-34, 116, 119.


60. Evans (n. 9 above), 39.

62. Dillon (n. 15 above), 228.

63. Bain, Calendar of State Papers (n. 45 above), 1:172. A 'wyffler' is a sort of proto-noncommissioned officer.

64. Barnaby Rich, A Right Excelent and Pleasaunt Dialogue betwene Mercury and an English Souldier (London, 1574); quoted in Hale, Certain Discourses Military (n. 9 above), xlvi.


67. Oman, 381.