

ARCHAEOLOGIA AELIANA.

I.—EARLY ORDNANCE IN EUROPE.

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THESE notes have been written with a view of subjecting the early records concerning ordnance to some examination, as well as to collate them, and to trace the development of the new artillery through the more rudimentary stages of its career. Trustworthy evidence concerning it is rare until the second half of the fourteenth century is reached. It is not proposed to carry these remarks beyond the end of the sixteenth century, except in a few cases for the purpose of comparison.

The introduction of cannon¹ may be said to have inaugurated a new era in the relative forces at command for attack and defence, and it ultimately caused the entire scheme of fortification in the countries of chivalry to be recast, besides bringing about great changes in tactics in the field. It may, however, be remarked that, during the incipient stages, ordnance by no means took the first place among the military engines of medieval times, and, indeed, the effect produced was one more calculated to alarm than to cause any very serious damage; but cannon were invested with superstitious terrors, which often resulted in the surrender of strong places to an inferior force.

There is great uncertainty as to the date of the earliest application of an explosive powder as the motive force for the discharge of missiles from a hollow tube, which would, however, appear to have taken place about 1320 A.D., or perhaps some years earlier, near which time it is often stated that Bartholdus Schwarz, an Augustinian monk, an alchemist, of Freiburg in Breisgau, made a fortuitous discovery of a detonating mixture, but this legend, of which there are several versions, may be dismissed as absolutely untrustworthy, though the suggestion made by various writers that his

¹ The word is derived from the Latin *canna*, a reed or tube.

experiments resulted in the invention of the mortar² is not so improbable. We are in possession of evidence that ordnance was in use not long after the legendary discovery by Schwarz, and it is clearly recorded by the clerk or keeper of the king's privy wardrobe at the Tower that gunpowder was being made for Edward III. by Thomas de Roldeston in 1344, but we must go much farther back than to 1320 for the date of its invention.

It is unprofitable to discuss the various speculations indulged in by many writers as to a supposed knowledge by the ancient Greeks and Romans, or by the Chinese, of any explosive compound of the nature of gunpowder, but firmer ground is reached when allusion is made to one of the mixtures given in a MS., dated 846 A.D., written by Marcus Graecus, who evidently contemplated its use as a military agent. The MS. runs :—*Incipit Liber Ignium a Marco Graeco prescriptus, cujus virtus et efficacia est ad comburendum hostes, tam in mari quam in terra*, etc.³ This compound contains six parts of saltpetre, one of sulphur, and two of charcoal, which is really what is now known as gunpowder, and, furthermore, it is a much stronger combination than that used for cannon during the fourteenth and fifteenth centuries, and even much later. There are repetitions of this recipe mentioned in the thirteenth century by Albertus Magnus,⁴ by Ferrarius,⁵ and by Roger Bacon. All this is suggestive of the possibility that there may have been far earlier attempts at cannon-making than is generally supposed, and, if so, the first experiments, European at all events, were probably made in Italy. The subject of gunpowder is treated more fully later in these notes.

A weapon for discharging 'Greek fire' is described by the Byzantine princess, Anna Comnena⁶ as 'tubes fixed on the prows of the emperor's galleys,' but the mixture employed was composed, she states, of bitumen, sulphur and naphtha, thus not possessing the explosive properties of gunpowder, or at all events not to any great extent, and one cannot

² The word, as applied to a form of cannon, may have been derived from the pounding vessel of the name.

³ In the National Library at Paris.

⁴ In *De Mirabilibus Mundi* of Albertus Magnus, bishop of Ratisbon.

⁵ The MS. is in the Bodleian Library, and considered to be of the time of Edward I.

⁶ *Alexiad*, book ii.

imagine how this form of Greek fire was projected from the tube so as to be effective in action. The composition, enclosed in a barrel, with a lighted match attached, and hurled by an engine into a town or other fortified place for the purpose of setting the buildings in flames, was probably a similar mixture, perhaps with the addition of resin.⁷ The Byzantine tubes, used on the emperor's galleys, were decorated on the surface with the heads of fabulous animals, and this custom may possibly have given rise to the many legends in romantic literature of encounters between knights errant and fiery dragons belching forth sulphurous flames, etc. A statement is made in an Arabian treatise of the thirteenth century, preserved, I believe, in the Escorial, written by Hassan Abrammah, that Greek fire was used in globes or vessels made of pottery or glass. The mixture thus employed would seem to have been explosive in character, and to have foreshadowed the grenade of later times.

It is uncertain whether the statements made that ordnance, in the sense of the hurling of projectiles, was in use by the Moors and Spaniards in the early years of the fourteenth century have any foundation in fact, nevertheless it is far from being improbable that these peoples were acquainted with an explosive mixture at that time, and used it, too, in the manner described.

John Anderne, an eminent surgeon living in the reign of Edward III., in his treatise, *Practica*, makes a clear distinction between '*Fewes Grégois*' and '*Fewe Volant*,' the latter being what is known as gunpowder, showing that both compounds were employed in warfare, *temp.* Edward III. Froissart makes the same distinction, though less clearly, and a passage in his work concerning the siege of Romorentin, on the Sandre, obviously refers to Greek fire having been used there, and with cannon. Monstrelet, who fills the gap between Froissart and Philip de Comines, makes mention of '*bastons à pouldre*' and '*à feu*.'

It is reported that the city of Ghent was in possession of ordnance, *anno* 1313, a date somewhat anterior to the legendary discovery by Schwarz; and that the magistrates of the town gave to their ambassadors going to England *bussen met kruyt* or *donderbussen*;

⁷ The treatise *Du Feu Grégeois*, by MM. Reinand and Favé, gives much information concerning Greek fire.

but this statement, made in a work published in 1843,⁸ has not been authenticated, and the city archives have been searched since with a view to finding the passage, but without success. It is incredible, however, that a statement so precise as this, made by a writer of repute, could be a pure invention, and really there is no reason for doubting his good faith. The use of ordnance was known in Italy at least as early as 1324-1326, for the archives of Florence of that time furnish a reference to it, occurring in a decree of the Senate, instructing the Gonfaloniere and Council of Twelve to have cannon and balls of iron made for the defence of the state, which evidence would rather point to the new artillery having been in existence somewhat before, and, though proof is lacking, it seems in every way probable that in 1320, if not earlier, most, if not all, of the important states in Europe were in possession of ordnance. The Florence record has been preserved and is often copied : it is printed in *Etudes sur le Passé et l'Avenir de l'Artillerie*.⁹

Colonel L. Robert, Conservateur du Musée d'Artillerie, at Paris, states in his introduction to the *museum catalogue* that the town of Metz made use of two small cannon in 1324 when besieged by the combined forces of the archbishop of Treves, the Comte de Bar and the king of Bohemia, but there is no reference.

Ordnance was undoubtedly employed by the English in the fourth decade of the century.

John Barbour, archdeacon of Aberdeen, in his metrical life of king Robert Bruce, written in 1375, states that 'crakys of war' were employed by Edward III. when invading Scotland in the first year of his reign (1327) :—

' The other crakys were of war
That they before never heard sir,'

and that these 'crakys' meant cannon is obvious from another couplet in the same poem, referring to the Scottish army—

' Bot gynnys for crakys had he nane,
For in Scotland yeit than but wane
The uss of thaim had not bene sene.'

Barbour was probably about seven years old when this invasion took place, so the statement must be taken for what it is worth.

⁸ Reynard, *Trésor national*, t. ii. p. 35, Liège, 1843.

⁹ By the emperor Napoleon III., t. iii. p. 72.

Edward is said to have had ordnance with him at the siege of Berwick in 1333,¹⁰ and the French fleet, in its attack on Southampton five years later, was supplied with the new artillery.¹¹ Another early instance of the presence of cannon on warships is given in an indenture between John Starlyng and Helmyng Leget, dated 1338, which mentions ordnance as forming part of the equipment of the 'Barnard de la Tour,' 'ij cannons de ferr, sanz estuff.'¹² A brass cannon is scheduled in the same document for 'La Marie de la Tour,' showing that, even at this early date, guns were provided with more than one movable chamber or breech block. Walsingham, describing the defeat of the French fleet, which took place off Sluys, in 1340, says there were 'Gunnæ plures, cum magna quant' pulveris,' etc. Up to the time of the introduction of cannon, or rather somewhat later, when ordnance had made some progress in power and efficiency, for very early pieces could not breach a wall, the defence of fortified places had for a long time proved stronger than the means available for attack, which then lay in mining and the employment of mechanical engines and war-sheds, with the bore and battering-ram. These agencies were often ineffectual for the reduction of fortified places, however strongly invested, and it was famine alone that could bring about a capitulation. After having passed through its preliminary stages, say by the year 1375, cannon obtained command simultaneously over the concentric lines of defence, such fortifications having been constructed with a view to the withstanding of quite another and more gradual mode of assault, and a breach in the walls could be effected by the new artillery from some distance, so that the attacking force was not so much exposed as hitherto, to be driven from their lodgments, and to be harassed by the numerous means of offence and annoyance resorted to from the battlements for the checkmating of mining, the destruction of war-sheds, and missile-casting engines, and the catching of the head of the ram in a sort of vice or fork, to prevent that engine from being drawn back again for another stroke. It became necessary therefore to mount cannon on the walls of fortresses in order to check

¹⁰ *Proceedings of the Royal Artillery Institution*, vol. ii. page 340.

¹¹ M. Léon. Lacabane in *Bibliothèque de l'École des Chartes*, vol. i (second series), page 51.

¹² Given by sir Nicholas Harris Nicolas, G.C.M.G., in his *History of the Royal Navy*, London, 1847.

the besiegers' fire, to batter down his entrenchments, and to destroy his stores and magazines, but the buildings, the walls of which were narrow, had not been built strongly and massively enough for sustaining the heavy shock arising from the concussion in firing, and from the effects of the recoil of the rude and elementary guns then available. The effect of this was that these walls were greatly injured by their discharge ; indeed, it sometimes happened that more harm was experienced by the garrison within the fortress than that inflicted on the besieging force without. Firing had to be discontinued, and when the besiegers' cannon could no longer be replied to, especially when covering and supporting the movements of the attacking columns on the day of assault, a surrender became imperative, or a successful *coup-de-main* resulted in the reduction of the fortress. In fact, by the end of the third quarter of the fourteenth century, the assault had the advantage over the defence.

An item in the accounts of the French War Treasurer of 1338, a MS. formerly in the National Library at Paris, cited by Père Daniel and by Ducange,¹³ runs :—' A Henri de Faumechon pour avoir poudres et autres choses necessaires aux canons, qui estoient devant Puy Guillaume.'¹⁴ This document has disappeared, but no doubt is cast on Ducange's statement that he made extracts from it.

In the same year a contemporaneous manuscript, now in the Paris Library, and cited by M. Léon Lacabane, states that among the military stores then in the arsenal at Rouen, was a 'pot de fer' for discharging bolts¹⁵; and sulphur and saltpetre, to make powder for the same, are mentioned.

A year later a parchment, found among the sealed title-deeds of Clairambault,¹⁶ states that the Seigneur de Cardilhac et de Bieule, received from the master of the 'Arbalétriers' of the town of Cambrai 'ten cannon, five of iron and five of metal,'¹⁷ for the defence of the town, and, to make powder for these pieces, eleven livres, four sols and three deniers, were expended in the purchase of saltpetre and sulphur. These weapons were employed when the town was besieged somewhat later.¹⁸

¹³ *Glossarium, Bombarda.*

¹⁴ A castle in Auvergne.

¹⁵ 'Carreaux' or 'garros,' winged arrows or quarrels.

¹⁶ M. Léon Lacabane, *Bibl. de l'Ecole des Chartes*, vol. vi. p. 51.

¹⁷ The brass cannon is 'canon de métal.' ¹⁸ Johnes's *Froissart*, vol. i. page 145.

Again, in 1339 reference is made in the archives of Bruges to *nieuwen enginen die men heetr ibaude*.¹⁹ Cannon are first mentioned by Froissart as having been used in the defence of Quesnoy in 1340, 'those of Quesnoy let them hear their cannon,' when *carreaux* of iron were the missiles employed²⁰; and at the siege of Vannes in 1343 both the besieged and the attacking English had artillery.²¹ Froissart also refers to a cannon at the siege of Oudenarde, 'the noise of its discharge could be heard five leagues away during the day and double this distance at night.' This piece is supposed by Captain Favé, and others, to have been the *Dulle Griete*, a very large bombard, still preserved at Ghent, but the cannon in question dates from a considerably later period, as will be shown in a special reference later. Edward III. had certainly a large siege train before Calais; and it was probably provided by Peter of Bruges; for the communal accounts of the town of Tournay state that in 1346 Pierre de Bruges made cannon of iron for England, which were tested at Tournay. This master is mentioned in one of the accounts of Egmond de la Béche, as being master armorer to king Edward III. in 1335.

A document of 1348 is given by the emperor Napoleon III. in *Etudes sur le Passé et l'Avenir de l'Artillerie*,²² in which wedges covered with leather are mentioned, '11^c *cavillis pro eisdem canonibus munitis de trachis*.' These are the wedges for fixing the charge in the chamber.

In the Pipe Rolls of the Exchequer of 1351 is an account of the receipts and outgoings between the years 1344 and 1351,²³ and among the entries occur: *Gunnis cum sagittis et pelletis; gunnis cum pelletis et pulvere pro eisdem gunnis; x gunnis cum telar; vj pecie plumbi; v barelli pulveris, et c magn' pelot plumbi, pro eisdem gunnis*. These entries, it will be observed, include cannon with powder and shot, leaden balls, some of them large,²⁴ and also darts.²⁵

The meaning of the word *telar* has been variously interpreted. It occurs also in the inventory of the effects of Roger Mortimer,

¹⁹ Comptes comm. de Bruges, 1340.

²⁰ Johnes's *Froissart*, vol. i. p. 190.

²¹ *Ibid.* vol. ii. p. 29.

²² *Tome* iii. p. 80.

²³ Given in the *Archæological Journal*, vol. xix. p. 70.

²⁴ Probably relatively large only.

²⁵ *Carreaux*.

taken in 1322 : *vij talar pro balistis* ; and again in the accounts of the Constable of Dover castle of 1361 : *xxiv arc de corn saunz telers*,²⁶ and in another account : *xxiv arcus pro balistis sine tellur*. Here the word may refer to the stocks of crossbows, or to the stands for mechanical engines of war, for I remember seeing the word used in what might be either sense, in connexion with handguns, but I am sorry I have lost or mislaid the reference. In Suffolk, according to Moor's *Glossary*, the stock of a farm shovel is still called a *tiller*, and in accounts of the fourteenth century nails and pins are mentioned in connexion with the word. The expression *ars telaria* was sometimes used as a general designation for shooting with bows and other mechanical engines of war. Napoleon, in *Etudes*,²⁷ gives the following item from a Bologne inventory of the year 1381 : *Tres teleries novos non fulcitos a bombardis*, which would indicate that these *telaria* were intended to support bombards. Lieut. Brackenbury, R.A., F.S.A., in his notes on *Ancient Cannon*, makes the following remark concerning *telaria*. 'These were clearly and unmistakably the beds or supports in which bombards were partly embedded, and not, as some antiquarians think, the handles of the guns.' Some of these *telarios* are mentioned in the inventory referred to as being worn out and useless and not attached to bombards. Brackenbury quotes from another Bologna inventory (1397), also given in the *Etudes*, when three cannon, two of which were in one *telarium*, and one, like a bombard, without a *telarium*. In the entry *corrigiis, teleries et canonibus*, the first two words are translated in the *Etudes*, *affâts courbés*, while Brackenbury is of opinion that *corrigiis* refer to the iron bands used to fasten the bombard on to its stand ; but the bands were not necessarily of iron, as shown in fig. B ; and the equivalent of *corigio* is to bind with thongs. Bands of iron round large guns would be soon ruptured by the force of the recoil of the piece.

In 1377 Thomas Norwich was directed by king Richard II. to provide 'two great and two less engines called cannon to be sent to the castle at Brest, [Bristol ?].'²⁸

²⁶ The document is given in the *Archaeological Journal*, vol. xi.

²⁷ *Tome i.* p. 358.

²⁸ The MS. is given by Rymer.

Until 1776 there was a very large iron cannon, of great length, stated as being inscribed with the year 1354, lying at the fort at Margate²⁹; but the date given is in all probability wrong, as there is no other mention of any very large cannon anything like so early. An inventory of the stores at 'Baynard' castle in 1388 includes the item *j petit gonne de feer*. These instances given are sufficient for establishing the approximate date of the introduction of the new artillery in Europe, and will have given some idea of the general employment of cannon at sieges and on ships in the fourteenth century.

Artillery was first employed in assaults on castles and towns, and it is many years before we hear of it being used for field purposes; the earliest mention in this sense, excepting the very doubtful one of Créçy, is, I believe, on the occasion of an engagement before the walls of Bruges, between the forces of that city and those of Ghent, in 1382. These were small pieces, probably discharging cannon arrows (*carreaux*); several guns together mounted on a wheeled carriage. They are mentioned by Froissart, and are called *ribaudeaux* (*ribaudequin*), after the mechanical engine of the name, discharging darts. A fuller account of these early guns, on a carriage, follows later. The statements made by Giovanni Villani, a Florentine historian, born in Florence in 1280, who wrote very shortly after the battle of Créçy,³⁰ and by the *Grandes Chroniques de France*,³¹ assertions which have been often repeated, that ordnance was employed in that engagement, from the side of the English, are open to considerable question; but there is no inherent improbability that this was the case. Certain it is, however, that cannon played no very important or decisive part in the warlike operations of that time (1346). An argument much relied on by some writers as demonstrating the improbability, nay impossibility, of artillery having been used by the English at Créçy, is that their army made forced marches, and could not hamper its military train with heavy guns, then, as far as is known, without wheels of any kind, but there is every reason to believe that the guns

²⁹ *Archæologia*, vol. v. p. 156.

³⁰ He died of the plague shortly afterwards.

³¹ There is no knowledge as to who wrote the *Grandes Chroniques*.

of that day, far from being heavy and unwieldy as is often supposed, were really small and easily transportable. It is very likely that the English forces, marching on Crécy, carried guns and other military engines with them for the purpose of assaulting strong places *en route*. We know that the troops, led by sir John Chandos, had cannon, transported on carts with its military train, in 1369 ; on which occasion it was, as Froissart tells us, to besiege Montsac. Demmin gives a drawing in his book of a cannon 'from the field of Crécy' ; but he adduces no evidence that it ever was there, indeed the piece he reproduces would appear to be of a somewhat later date. Such loose statements are to be deprecated. Perhaps the strongest argument against them lies in the fact that Froissart makes no mention of ordnance in connexion with any battles in the field ; and such a new departure would hardly have passed unrecorded by so careful a historian had it really happened, but in estimating the value of his evidence it must be borne in mind that this portion of the *Chronicles* was written from hearsay for he was only nine years old when the battle was fought, while Villani was a man of mature years at the time, and unlikely to have made such a precise statement without foundation. Froissart frequently alludes to the employment of cannon at sieges and on warships, and gives a circumstantial account of the battle of Crécy ; attributing the victory of the English to excellent shooting with the longbow.

Mr. Grose in his *Military Antiquities respecting a History of the English Army*,³² quotes from a contemporary account giving the detailed forces and the pay of the several grades and bands composing the English forces in Normandy and before Calais, and both gunners and artillerymen³³ are mentioned. The latter class would seem to have had charge of the mechanical engines. As late as 1559, bows are scheduled in a *Tower Survey*, under the heading of *Artillery* ; while all cannon mentioned in the inventory go under that of *Ordnance*. It is thought by some that the word artillery is derived from *Ars telaria*, an expression just referred to in connexion with the word 'tellur.' Valturius calls both mechanical engines and ordnance 'ballistae,' and a Brussels bowmaker, of the year 1400, was styled *Jean l'Artilleur*.

³² Vol. i. p. 278.

³³ Ingyners, Artellers and Gonners.—Harl, 782, fol. 63.

Mr. Joseph Hunter, F.S.A., in his notes *On the early use of Gunpowder in England*,³⁴ mentions that in 1369 the store of ordnance at Calais consisted of fifteen guns, 995 pounds of saltpetre, 1,298 pounds of quick sulphur, three great guns of brass and one of iron, 224 balls of lead, and 84 pounds of gunpowder.

Ordnance was by no means universally popular among the military authorities of the day, until long after its introduction; and Froissart does not seem to have attached special importance to its use, any more than to other warlike engines before the big siege bombards came into vogue. Mechanical engines, such as the mangonel, ribaudequin, bricolle, perrières, and the trébuchet (trebuket), machines to which the principles of tension, torsion and counterpoise were applied, were used, side by side, with cannon in the fifteenth century, but by that time the estimation of the relative importance of such machines in warfare, as compared with ordnance, prevailing until the last quarter of the fourteenth century, began to be reversed as cannon became more powerful and efficient in action; and the great advantages of a much lower trajectory than the great mechanical engines possessed began to be appreciated. The trebuket threw as heavy a stone as a big bombard; but neither with the same velocity nor anything like so horizontally. This machine was, thus, far from being so effective as cannon for breaching a wall. Claude Fauchet, writing as late as *anno* 1600, says, 'that cannon were only used by cowardly people, and that valiant knights did not approve of them.'³⁵

The great cost of materials must have retarded the employment of ordnance on a large scale; indeed it was almost prohibitive. Ordinary iron was 5d. to 6d. per pound; gun-metal 20d.; lead 10d.³⁶; and when one considers the great difference in the value of money at that time from the present, one wonders how ordnance could be used at all extensively.

A book published in 1699³⁷ says: 'The king of England, at the battle of Agincourt, placed some pieces of cannon on an eminence,

³⁴ *Archæologia*, vol. xxxii. p. 384.

³⁵ *Origines des Chevaliers, Armoiries, etc.*, Paris, 1600, p. 57.

³⁶ *Proc. of R.A. Institution*, vol. v. p. 11.

³⁷ *The History of M. de Boucicaut*.

which did not kill many men but threw a panic into the French army, who were absolutely strangers to it;’ and in Nicolas’s *Agincourt* it is stated that artillery was engaged in the battle. Whether this be true or not, we do not hear much, if anything, of field guns in England before the Wars of the Roses, and abroad in the campaigns of Charles the Bold, of Burgundy.

Gun factories are stated to have been in operation in France in 1345; the accounts of Cahors of that year mention cannon that were being cast.³⁸ The archives of Bruges state that Peter of Bruges cast a small brass cannon for two pound leaden balls in 1346. Switzerland was casting at Bale in 1372; Venice in 1376; and in 1372, bronze cannon were being cast at Augsburg by Johann von Arau. Malines had a *Meester van den dond’bussen*, in 1365³⁹; and in 1369 Arras had thirty-eight cannon in her arsenal. In 1358, Laon was in possession of twelve cannon, and was ordering forty-three more; and in 1368 Guillaume l’Esquier was *Maistre des canons du roy*,⁴⁰ up to which time the ordnance was under the charge of *le maistre des arballestriers*. In 1375, Bernart de Montserrat was *maistre des canons*, and superintending the construction of a large gun at Caen weighing more than 2,000 pounds.⁴¹ He was also casting very small brass cannon at Caen that year.⁴²

The first expressions employed in medieval literature to denote ordnance, then mostly small breech-loading pieces, are *canon* and *gunnis*; *gonnes* being the English name, and *canon* the French, the medieval Latin equivalent is *cannones*. The word *bombard* came into general use for the large muzzle-loading, stone-throwing pieces, and appears about the close of the third quarter of the fourteenth century, but many chroniclers have the confusing habit of using the designation very much in a general sense. Froissart mentions ‘*canons and bombardes*’ in his account of the siege of Quesnoy in 1340, but he was only three years old at the time, and did not begin his chronicles until sixteen years later. Villani mentions ‘*gunnis and bombardes*,’ about 1347, so we may perhaps assume that the latter term was applied to the larger guns in Italy then, but the word does not occur

³⁸ *Proc. R.A. Institution*, vol. iv. p. 297.

³⁹ *Comptes comm. de Malines*.

⁴¹ *Etudes*, etc.

⁴⁰ Ducange.

⁴² *Ibid.*

in any French contemporary account before 1381. It is clear that towards the end of the fourteenth century, when new varieties of ordnance began to appear, and names had to be found for them, the word *bombard* was specially applied to the description of cannon I have mentioned. In the *Artillery Accounts* of Burgundy, of the first half of the fifteenth century, the terms *grosses bombardes* and *grand canon* are used synonymously.

The craft of gunmaking in the fourteenth century was necessarily experimental, and practised at a time when the mechanical arts were at a very low ebb, and this was especially the case in regard to England, which country, however, does not seem at this time to have made any of her own ordnance.

Towards the close of the century, great improvements were made in France, Italy and Flanders, in the casting of brass guns. The earliest ordnance was of the crudest description, being dilatory and uncertain in action, and dangerous to the gunners. The tube was of equal thickness throughout, and a sort of box, for the charge, was joined on to it, and the whole piece required washing out after each discharge.

The information is scanty among contemporary English records, as to the descriptions and sizes of guns available in England, from, say, 1335 to 1370, but we may conclude that they were mainly small pieces, without trunnions, for the discharge of winged-arrows or quarrels, similar to those already in use for such mechanical engines as *espringales* and *ribaudeaux*,⁴³ and by leaden balls. The 'large' cannon often referred to in chronicles, indentures, royal wardrobe and other accounts, of a like nature, would appear to have been relatively large only, for a 'great' gun, costing but twenty shillings,⁴⁴ could not have been very big, taking into account the cost of materials and making every allowance for the difference in money value at the time; and a variety of other items in these accounts, such as the amounts expended on materials for making gunpowder, with the quantities to be used for certain cannon in war time, and the *personnel* employed in transporting and serving them; all tend to the conclusion that early

⁴³ *Roman and Medieval Military Engines*, by the writer, *Archaeologia Aeliana*, vol. xxiv.

⁴⁴ *King's Wardrobe Account*, 1370, printed in *Archaeologia*, vol. xxxii. p. 386.

cannon were very small pieces, no bigger than the *harquebuse à crock*, of later times. Really large guns, however, became quite common, after 1377, and an account of the town of Lille of 1382, mentions a bombard as costing an amount, in our currency, equal to £20. Some of the English accounts disclose the curious fact that cannon were sometimes owned by private persons, and hired by the king when wanted.⁴⁵

With every change of the governor of a fortress, commissioners were appointed under the Great Seal, to take an inventory of all the warlike stores contained therein, which was attached to the indenture, and it is from documents of this nature that a mass of data has been drawn.

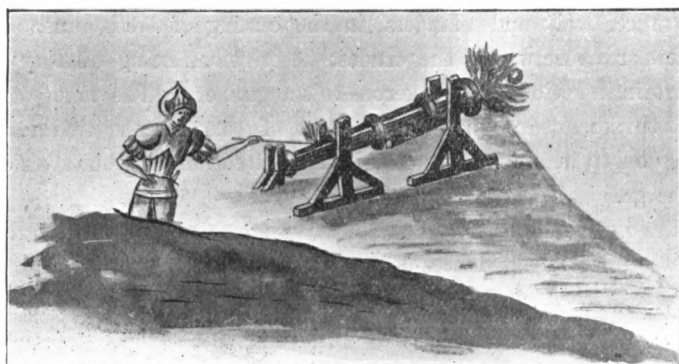


FIG. A.

Fig. A gives a representation of a cannon, used at the siege of Tunis, *anno* 1390.⁴⁶ It lies on wooden supports, with a strong piece at the breech end, for sustaining the recoil, and is being fired *point-blank*,⁴⁷ though the drawing is inaccurate.

Early cannon were mostly of wrought-iron, though by no means exclusively so, for as already stated, bronze guns were cast even earlier than the last quarter of the fourteenth century, and the wardrobe account of 1370, has the following entry :—‘ iij gunner feer, j gunner de laton.’⁴⁸

⁴⁵ *Proceedings, R. A. Institution*, vol. v. p. 24.

⁴⁶ From a Froissart illumination.

⁴⁷ Froissart was not present at the siege, but the figure probably portrays a contemporary gun.

⁴⁸ In French, *laiton*, a mixture of bronze and tin.

The emperor Napoleon the third's book⁴⁹ contains a vast amount of valuable data concerning early ordnance, such as indentures, inventories, and extracts from contemporary accounts, many of the documents being printed *in extenso*. These afford the most trustworthy evidence to be had; but like English MSS. of the period, of a similar character, there is practically no information given as to the sizes of the earlier guns, which can only be guessed at by a process of deduction, of the nature just applied to early English guns. This, however, leaves an impression, amounting to certainty, that all the pieces made up to about the end of the third quarter of the fourteenth century were small. In the *Etudes*, we find a reference given to 1375, when five small cannon are mentioned as costing under £2. The missiles employed in France were similar to those used in England. Cannon-arrows (*carreaux*) were made first of wood, feathered with brass and tipped with iron; later, they were of lead, and called *plommée*.

As to the arrangements for aiming, rough principles were known from the beginning, from the experience gained in the use of mechanical engines, of widely different trajectories.

In the last quarter of the century, guns were forged to project stone balls weighing from 20 to 450 pounds. The jump from very small guns to those of say ten, twenty, and even forty times their weight seems to have been the reverse of gradual, but great difficulty was experienced in the welding together of the strips of metal employed in the construction of the heavy guns.

Really large bombards, made to carry, say, from 200 to 400 pound stone shot, appear in England about the same time as in France and Flanders, in the years 1377-78, at least as far as there is any information, while in Italy, which country almost always took the lead in ordnance, they are mentioned a few years earlier.

Lieutenant Brackenbury, R.A., F.S.A., in an able paper on *Ancient Cannon*,⁵⁰ quoting from Andrea Redusio, in *Chronicon Tarvisinum*,

⁴⁹ *Etudes sur le Passé et l'Avenir de l'Artillerie* published in 1846.

⁵⁰ Printed in the *Proceedings of the Royal Artillery Institution* of 1847, vol. v. p. 32. He promised a continuation of his notes, and to carry them beyond the fourteenth century; but, if written, I believe they were never published, owing to a number of drawings, which had been prepared for them, having been destroyed by fire.

of what had come to that writer's knowledge during his lifetime, says :—' That when the Venetians attacked Quero, in 1376, they had bombards with them, such as had never been seen or heard of before in Italy. The bombard is described as an iron instrument of great strength, with a tube in front, in which is a large stone of the size of the tube, and it has a *cannon* joined on to it at its rear end, twice as long as the tube, but narrower,⁵¹ in which a black powder, made of saltpetre, sulphur and willow-charcoal, is inserted in the opening of the cannon towards its mouth. This opening is then closed with a wooden plug, which is pressed in, and when the round stone has been inserted and adjusted against the mouth of the cannon, fire is applied through a small opening in the cannon, and the stone is projected with great impetus by the force of the lighted powder ; nor can any walls, no matter how strong, withstand it, as was found by experience in the following wars ; and when these bombards belched forth stones the people thought that God was thundering from above.' Previous to the invention of trunnions, such a gun was secured to a wooden bed or stand by means of thongs, hempen rope or wire, while small pieces, for a low charge, were fastened permanently, so to speak, to their stocks or stands, by iron bands. The cannon lay well down in a groove, and the beds or stands were provided with strong wooden uprights behind, strengthened by thick angle iron for sustaining the recoil. A stand of this description is on fig. B,⁵² and on it lies the barrel of a chambered gun of the early bombard type, as described by Redusio. It consists of two lengths, the chamber, and the barrel. The latter portion is first laid in its bed and properly secured, then the part containing the chamber (*cannonen*) is slipped into its place after having been loaded and roped, and the whole is adjusted in position by a wedge, usually of iron. These wedges I take to be the *cocones*, mentioned in accounts, and not the wooden plugs or wads for separating the powder from the projectile, nor the *cavillis*, a

⁵¹ The word *cannonen* is often used by Italian chroniclers to denote the chamber portion of the gun, whether in a cannon of two lengths, or for the breech-block for insertion in a space or chamber ; an inventory of Bologna of the year 1381, mentioned in the *Etudes* (t. i. p. 359), refers to chambers as *canons*.

⁵² A stand and cannon of this kind is given by Mr. Grose in *Military Antiquities, respecting a History of the English Army*, vol. i. p. 398. The chamber-portion is adjusted in its place.

wooden wedge, covered with leather for fastening the breech-block in the chamber.

This system of guns, forged in two parts or lengths, at first probably applied to all guns, presented serious difficulties in the way of sealing and adjustment. It was, however, retained for a long time for guns of large calibre, and the ultimate screwing of the parts together effectually kept the powder gas in its right direction. Smaller ordnance was forged in one piece, with a space or chamber for the reception of the breech-block, which was also secured in position by a wedge. The difficulties of working the gun in two lengths, as shown on fig. B, are very obvious, and their action must have been most dilatory. The 'Dulle Griete' of Ghent, and 'Mons Meg,' afford illustrations of the screwing together plan, as indicated by the holes

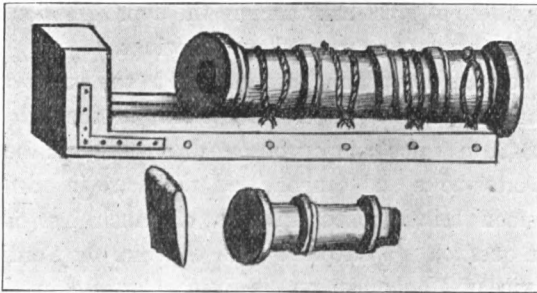


FIG. B.

in the hinder end for the reception of levers, and these guns became, in fact, muzzle-loaders, the divisions and even sub-divisions being so arranged merely for the purposes of transport.

Froissart speaks of very large bombards, one he refers to as having been at the siege of Oudenarde, in 1382-1383, *jelant des carreaux merveilleusement gros*,⁵³ and another he mentions as having been at the siege of Odrnik, in 1377, shooting 200 pound shot. A gun called a 'bombard,' forged at Châlons, in the same year, for Philip of Burgundy, weighed 450 livres.⁵⁴

⁵³ Froissart would appear in this case to have used the word '*carreaux*' as expressing missiles generally, and not literally, as cannon-arrows, and there are many such cases requiring careful examination.

⁵⁴ *Mémoires pour servir à l'histoire de France et de Bourgogne*, Paris, 1729.

The earliest instance of a large bombard occurs in the *Chronicles of Pisa*, in 1362 ;⁵⁵ this cannon exceeded 2,000 pounds in weight.

Monstrelet mentions, under the year 1478, a great bombard, made at Tours, with a ball 'cccc livres de fer', while Florentius of Buda, makes the remarkable statement that a cannon, used at the siege of Belgrade, was twenty-five feet in length, which is of course much longer than the gun at Ghent, but even this great size would seem to have been exceeded in a cannon made at Bruges in 1445, the chamber alone being twelve feet long.⁵⁶ These large bombards were very difficult to manage when fired, and their wooden stands had but a very short life.

Fortunately, there are rare instances of very early pieces inscribed with the year of make, as instanced the bronze cannon, now in the Musée d'Artillerie, at Paris, by George Eendorfer, 1404.⁵⁷ These dated cannons are of great assistance in the approximation of the age of other specimens, as also are medieval drawings.⁵⁸

I have not seen any definite statement as to the extent of the range of early cannon, but the emperor Napoleon, in the *Etudes*, quotes a MS. of 1346, in which comparisons are drawn between the respective ranges of cross-bows and cannon, and these are in favour of the former, cannon being looked upon as of much less importance. The MS. in question is a direction from the Sire de Cardilhac, etc., for the defence of Montauban, and is given *in extenso* in the *Etudes*. The mechanical engine *ribaudequin* would shoot its heavy brass-feathered arrows much more frequently than a cannon could do.

Richard Grafton, many of whose statements require critical examination, writing in *A Chronicle at large and Meere History of the Affayres of England, 1569*, says, in referring to the siege of Le Mans, in 1424 : 'The Englishmen approached as nighe to the walles as they might without their losse and detriment, and shot against their walles great stones out of great Goonnes whiche kinde of enginnes before that tyme, was very little seene or hearde of in France ; the strokes whereof so shaked, crushed and rived the walles that within few dayes the citie was dispoyled of all her toures, and outward defences.'

⁵⁵ Muratori, *Cronica de Pisa*, tome 15, col. 740.

⁵⁶ *Etudes*, etc., t. iii. pp. 128-130.

⁵⁷ Appendix, No. 36.

⁵⁸ There is a fine collection of these at Vienna.

The time employed in loading very early cannon was so protracted that again and again we hear of batteries having been taken by the enemy, after a single discharge. To meet this difficulty in loading, several cannon were often mounted on one stand, and later, many chambers, ready charged, were supplied to each gun. The piece no. 3 of the appendix affords an instance of a double cannon.

Throughout the fifteenth century, and even later, great muzzle-loading pieces like 'Mons Meg,' continued being called bombards. Diminutives of this class, *bombardes portatives*, of the last quarter of the fourteenth century, which are mentioned by Froissart, and the somewhat later bombardelles, referred to by Andrea Redusio,⁵⁹ were in general use. A fine specimen, taken at Granson or Murton in 1476, is now in the museum at Nauveville (Canton Berne); it is clasped with iron bands to a wooden stock, and lies on its *cepi* or *cippus*, a square stand of wood: it resembles a very early handgun in form.

Although there was but little scientific knowledge or mathematical calculation applied to the construction of early ordnance at this time, there was clearly some idea in the first half of the fifteenth century, of the pressure the powder gas exercised on the bore during the discharge, and of getting each portion of the metal to bear its fair share of the strain; for before the middle of the century experience had taught that the strain on the piece when discharged decreases from breech to muzzle, and the parts were strengthened that needed it. A rule was established in the relations between the chamber and the barrel, that one pound of powder was required to project nine pounds of stone, and that the capacity of the chamber must be such as to contain the charge of a volume of three-fifths of its size, leaving one-fifth for the wad, which was constructed from the wood of the medlar or the ash, the remaining fifth being empty. The system of forging very heavy guns in separate compartments alone made the transportation possible.

Villeret, writing in the middle of the fifteenth century, thus describes cannon: 'their figure was that of a hollow cylinder,

⁵⁹ *Chronicon Tarvisinum*, 1376, and the *bolteri* of Swiss Records.

strengthened from space to space by several embossed circles, the breech end terminating in a knob, and the match was placed between the first and second circles.'

After the battle of Hexham, 'sir Ralph Grey fled to Bamburgh, and was there besieged *cum maximis bombardis*, by the earl of Warwick. The king maker brought with him two huge cannon, one of which he called *London*, and the other *Newcastle*.'⁶⁰

Cannon continued very apt to burst, and we find the Scottish king James II. killed, when present at the testing of a bombard, possibly made in Scotland, in 1460.⁶¹ The weakness lay, however, more in imperfect welding, rather than in the quality of the material employed, which was excellent, for a portion of a serpent gun, of the reign of Henry VI., 1422-1461, now in the Rotunda, at Woolwich,⁶² has been tested, the result showing a tensile strength of 55,258 pounds to the square inch, being very little less than that of the best descriptions employed in the manufacture of the first Armstrong guns. This weapon is imperfectly welded together, for solder has been poured into the interstices, left in the process. Some of these guns continued in use for many years.

Other designations were now found for pieces of small calibre, and these had often two movable chambers. The *veuglaire*,⁶³ a cannon first consisting merely of the chamber box, and the barrel, appears in Flanders during the first decade of the fifteenth century, and this cannon (*vogeleer*) is so mentioned in the archives of Malines, about 1409. In 1406 the town of Mons had in its arsenal:— 12 cannons of iron, each with 3 chambers; 7 *veuglaire*s, with 2 chambers; 21 small *bombardes* (?), throwing darts; and 19 other cannon, each with 1 chamber; besides 6 of metal (bronze).⁶⁴ A *veuglaire* is scheduled in an inventory of the Canton de Fribourg, of 1445, as 'wigler,' Pierre Follare, 'fondeur,' and '2 *vulgaire*, à 2 *chambres*, de *bronze*' are referred to in the accounts of the same Canton, of 1454. Thirty-seven *colovrines* appear under

⁶⁰ 10 Camden Soc. Publ., p. 38.

⁶¹ Lindsay of Pitscottie, 1728.

⁶² Appendix, No. 4.

⁶³ Flemish, *vogeleer*, English, *fowler*.

⁶⁴ A. Lecroix, *Episode du règne Jean de Bavière (Jean-sans-pitié)*.

1450, and 3 *tarrasbüchsen*, de *Pierre Follaire, fondeur*, under 1445.⁶⁵ The *tarrasbüchse* is a light piece of small calibre,⁶⁶ essentially a field gun, but used from entrenchments, quickly thrown up on the field of battle. They are mentioned as having been employed against the Hussites, in 1427⁶⁷. A drawing of one of these guns is given in *La Chronique bernoise de Schilling*.

*Coulevres, couleuvrines*⁶⁸ and *serpentes*⁶⁹ appear about the end of the first quarter of the century; the former were guns of a small calibre, and the latter smaller still. Fig. C represents a fifteenth century serpentine, in the Porte de Hal Museum, at Brussels; the carriage is a restoration from an old print.⁷⁰ The method of construction of many was the same as that of the bombard, being

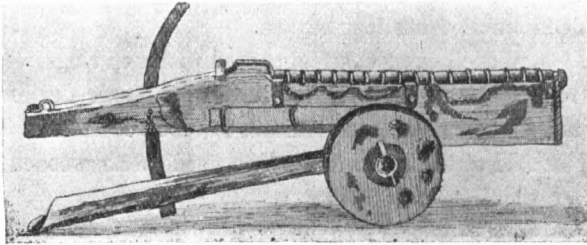


FIG. C.

longitudinal wrought-iron bars, welded together, and strengthened with rings, the walls of the chambers were thicker than those of the barrels, which were of a considerable length in proportion to their diameter, say from twenty to forty calibres or more, but without any fixed rule in this respect. Other guns of these classes were of bronze, but all without trunnions, until these appliances appear, probably early in the third quarter of the fifteenth century. *Strittbüchsen* and *Riegelbüchsen*⁷¹ are mentioned in German

⁶⁵ *Archives de la Société d'Histoire de Canton Fribourg*, 1900, tome vii. p. 107.

⁶⁶ *Tarras*, an entrenchment, rapidly extemporized on the field.

⁶⁷ *Le développement des armes à feu*. Schmidt, 1870.

⁶⁸ Culverine.

⁶⁹ Guns were often named after birds or serpents. Culverin is said to come from *Colubrine*, a kind of snake.

⁷⁰ See Appendix, No. 41.

⁷¹ *Riegel*, a bolt or bar, but whether this alludes to the missiles employed, or to the rack with its bar on the gun carriages, is uncertain.

accounts as field guns with two-wheeled gun carriages. The term *courtaud* appears after the middle of the fifteenth century. The *Chroniques d'Angleterre*, written for Edward IV., contain some representations of the cannon of that reign.

Late in the century, Leonardo da Vinci, born in 1452,⁷² and others, began more scientifically to treat the subject, hitherto guided merely by a knowledge of certain empirical rules.

In the museum at Edinburgh are rude specimens of ordnance from Wemyss castle, Fife, one with two wrought-iron barrels, about thirty inches long, and 2·5 inches in calibre. They are strengthened with rings, and the intervals are bound round with small cord, the whole has been covered with leather, and the piece is further fortified with thin copper at the breech and muzzle. Another smaller gun of similar construction has four barrels.

There is a wooden cannon, strengthened with iron rings, which was brought from Cochin China, and now lies in the Musée des Invalides, at Paris, but there is nothing to indicate its date of make,⁷³ and the same may be said of the cannon at Genoa, made with wooden staves, and covered with leather.

A mortar in the arsenal at Vienna is made of several layers of coiled hempen rope, with an outside covering of leather, said to have been captured from the Turks ; and mortars made of paper, also covered with leather, lie in the arsenal at Malta. All these guns are doubtless provided with an inner tubing of metal of some sort.

It is stated that the Venetians used small leather mortars at the battle with the Genoese and Paduans before Chioggia in 1379 ; when some of the guns are said to have burst on the first discharge : one of these weapons, believed to have been used at the battle, is still preserved in the arsenal at Venice.⁷⁴ Leathern cannon, with an inner tubing of beaten copper, were used at the siege of Hohensalzburg in 1525 : and by Gustavus Adolphus in his earlier campaigns, which are said to have been brought to his army by an English knight,

⁷² This remarkable man, besides being a great painter and sculptor, was deeply versed in dynamics.

⁷³ There is a wooden cannon at Woolwich, which was used by the Canadian rebels in 1837 ; it is bound round with four iron hoops, and is without trunnions. It was loaded with buck shot and small pieces of lead.

⁷⁴ Great bombards are freely mentioned in accounts of the series of engagements that took place, but I see no references to the leather pieces.

sir Robert Scott, who commanded a troop of Free Companions in the king's service. The king of Sweden replaced these guns by iron four-pounders, one of which went with each regiment. They weighed each about six cwts., and were drawn by a pair of horses.⁷⁵ The king made the first really effective use of cannon in the field; the victory at Leipsic, in 1631, was almost entirely due to the mobility of his artillery; Tilly's guns being of no account whatever. Cannon covered with leather were not uncommon in the seventeenth century—examples may be seen at Zurich. The 'Kalter' guns of Gustavus Adolphus were specially constructed with a view to mobility; but they could only bear the strain of a small charge. The ball passed through a thin copper cylinder, screwed into a brass breech, the chamber being strengthened with four bands of iron. The tube is covered with layers of mastic, around which hempen cord is wound, then comes a layer of plaster (lime), and the whole is covered over with leather, boiled and varnished.⁷⁶ There is an example in the Rotunda collection at Woolwich,⁷⁷ and two others are at the Invalides, Paris.

Iron shot is usually considered to have been an invention of the fifteenth century; but this is not so, for iron balls are mentioned in the Florence reference of 1324-1326, already alluded to. It is certain, however, that the great majority of projectiles used in the fifteenth century were of stone. A more particular reference to this subject will be given later in these pages.

There were very early mortars, hollow tubes, like an inverted cone; they were short pieces of large bore, and some were graduated in the tube for the reception of shot of different diameters. Like bombards, very large mortars were made late in the fourteenth and early in the fifteenth centuries; but the size was much reduced later. A very large specimen called *Der grosse Pumhart von Stehr* lies now in the Herres museum, at Vienna. Length, seven feet, ten inches; diameter, three feet, six inches. The English army before Orleans, in 1428, had a train of fifteen breech-loading mortars.⁷⁸

⁷⁵ Owen, *Modern Artillery*, p. 345.

⁷⁶ Chesney's *Observations on Firearms*; published in 1852.

⁷⁷ Appendix, No. 17.

⁷⁸ Jollois, *Histoire du Siège d'Orléans*.

The cannon, at first without trunnions, which do not appear before the beginning of the second half of the fifteenth century, was cylindrical in general form, and made of longitudinal bars of wrought iron, in overlapping sections, welded together on a mandril, or a core. and with hoops shrunk on, somewhat similar in principle to the first Armstrong guns ; which were built up with concentric layers, shrunk over one another, on a hollow cylinder of forged iron, so as to produce compression of the inner tube ; the outer covering being in a state of tension. An experiment was made in 1857, by Mr. Mallet, who constructed a thirty-eight inch mortar, by shrinking a number of wrought-iron rings over one another, strengthening the outside by longitudinal bars. The gun was ruptured after a few rounds, owing to the imperfect welding of the rings. Lefroy, in *Note on Mortar Practice*, estimates the mean weight of the thirty-six inch shells loaded at twenty-six cwts.

The windage allowed in all forms of ancient cannon was excessive ; and the force of the recoil was so ill-managed as sometimes to throw the pieces off the stands on which they were placed. This force would greatly depend on the rate of the combustion of the powder : one rapidly converted into gas would produce a low recoil, while the contrary is the case when the powder burns more gradually. The ballistic force of the explosive used, in the fourteenth and fifteenth centuries, must have been very low ; but there is every reason to believe that a low grade of powder was purposely employed, on account of the great liability of the guns to fracture by reason of the imperfect welding of the longitudinal bars of iron used in the construction of the cannon ; and that a knowledge existed, from the very earliest introduction of ordnance of a much stronger compound.

Cannon were fired with a live coal, or by a firing iron, heated in a pan of charcoal (payrolet). Accessories, such as hammers, shovels, and bellows for blowing the charcoal, constantly recur in accounts of stores.

Volturius, writing in 1472, describes the war engines then in use, including cannon, and guns of that period continued in employment as late as the reign of Henry VIII., as shown among the specimens recovered from the wreck of the ' Mary Rose.'⁷⁹

⁷⁹ Lost off Portsmouth in 1545.

Napoleon III., in the *Etudes*, refers to two bombards taken from, or left by, the English at the siege of Mont St. Michel in 1423, and a drawing of them is given by Captain Favé in his continuation of the work. These guns are thus of a considerably earlier date than 'Mons Meg,' and very valuable as illustrating the bombard of the first quarter of the fifteenth century. General Lefroy, R.A., F.R.S.,⁸⁰ quotes the abbé Desroches as referring to the guns as being made of bars of iron, two inches in thickness, bound round with hoops of the same material and that in the larger piece is still to be seen the stone shot with which it is loaded.⁸¹ It is far from uncommon to find ancient guns ready loaded and charged; and an apron or hinge over the vent, a protection against wet, so often present on ancient guns, shows that it was customary to have cannon ready loaded for discharge when likely to be required, and in this condition they often remained for days and even longer.

One of these bombards is rather larger than the other and the system of construction, that of longitudinal bars welded together, is the same. The larger gun is 19 inches in present calibre and twelve feet in its entire length, the chamber taking up about one-fourth. The granite balls are about 18 inches in diameter.

The smaller gun has a calibre of 15 inches and is 11 feet 9 inches in total length. The granite ball for this gun is $\frac{3}{4}$ of an inch less in diameter than the calibre of the cannon. The weight of the two guns are $5\frac{1}{2}$ and $3\frac{1}{4}$ tons respectively, thus the larger piece is even heavier than 'Mons Meg,' although with a considerably smaller calibre.

Favé quotes freely from the artillery accounts of the dukes of Burgundy; and mentions that in 1436 a bombard called *Bourgogne* was forged in two pieces for rendering transportation more easy: the pieces were conveyed on separate waggons, each drawn by 48 horses: and were screwed together for firing; as in the cases of 'Mons Meg,' and the 'Dulle Griete' of Ghent; this system was further developed in 1443, in the case of two bombards, each consisting of four pieces. Favé mentions, under the same year, a bombard called *Dijon*, the barrel portion of which, alone, weighed 20,000 livres: also another cannon, the chamber portion of which was 12 feet long;

⁸⁰ *Proceedings, Royal Artillery Institution*, vol. iv. p. 10.

⁸¹ One of the shot for this gun is now at Woolwich.

throwing a projectile 22 inches in diameter. In 1451, a bombard was made at Luxemburg, weighing 36,000 livres; and it received the name of that town.

There is a bombard in the arsenal at Dresden dating towards the end of the fifteenth century; calibre, 14 inches. It is named *Die faule Magd* (the dirty maid); and another at the arsenal at Bâle; calibre, 13 inches.

We have a familiar instance of a bombard of the middle of the fifteenth century in the Scottish cannon, 'Mons Meg,' already referred to, and a rent near the breech is instructive in laying bare the system of construction, which has just been described. The bore of the barrel is largest near the chamber, which appears from a rule laid down by Wolfius to have been considered an advantage in these times. The inscription on the gun, placed there at the instance of sir Walter Scott, states that the bombard was forged at Mons, but it is believed by some to have been made in Galloway in Scotland and presented to James II. by the town of Kirkcudbright, when the king went to besiege Thrieve castle (the Douglas stronghold) in 1455; and that it was named after 'Meg,' the wife of the smith who forged it in a few days, for the king's use.⁸² The king is said to have granted the lands of Mollance to the smith in recognition of his skill, and hence the *sobriquet*. 'Mollance Meg,' shortened to 'Mons Meg.' Some support is afforded to this legend by the discovery of a deep bed of cinders at Carlingwark when making a road, showing that there had probably been a great forge there in early times, and the statement that the king was killed in 1460 by the bursting of a cannon, when it was being tested, would tend to show that ordnance was being made in Scotland about this time. Holinshed⁸³ states that about the year 1498 James IV. gave orders to Robert Borthwick to make field pieces and other guns in the castle of Edinburgh, which guns were inscribed, *Machina sum Scoto Borthwick fabricata Roberto*.

Some entries in the *Accounts of the Lord High Treasurer of Scotland* are, however, fatal to this patriotic legend,⁸⁴ for there the gun is referred to as 'Monns,' 'Mons,' and 'Monsis,' and the addition of the affix 'Meg' does not appear in any record before the seventeenth

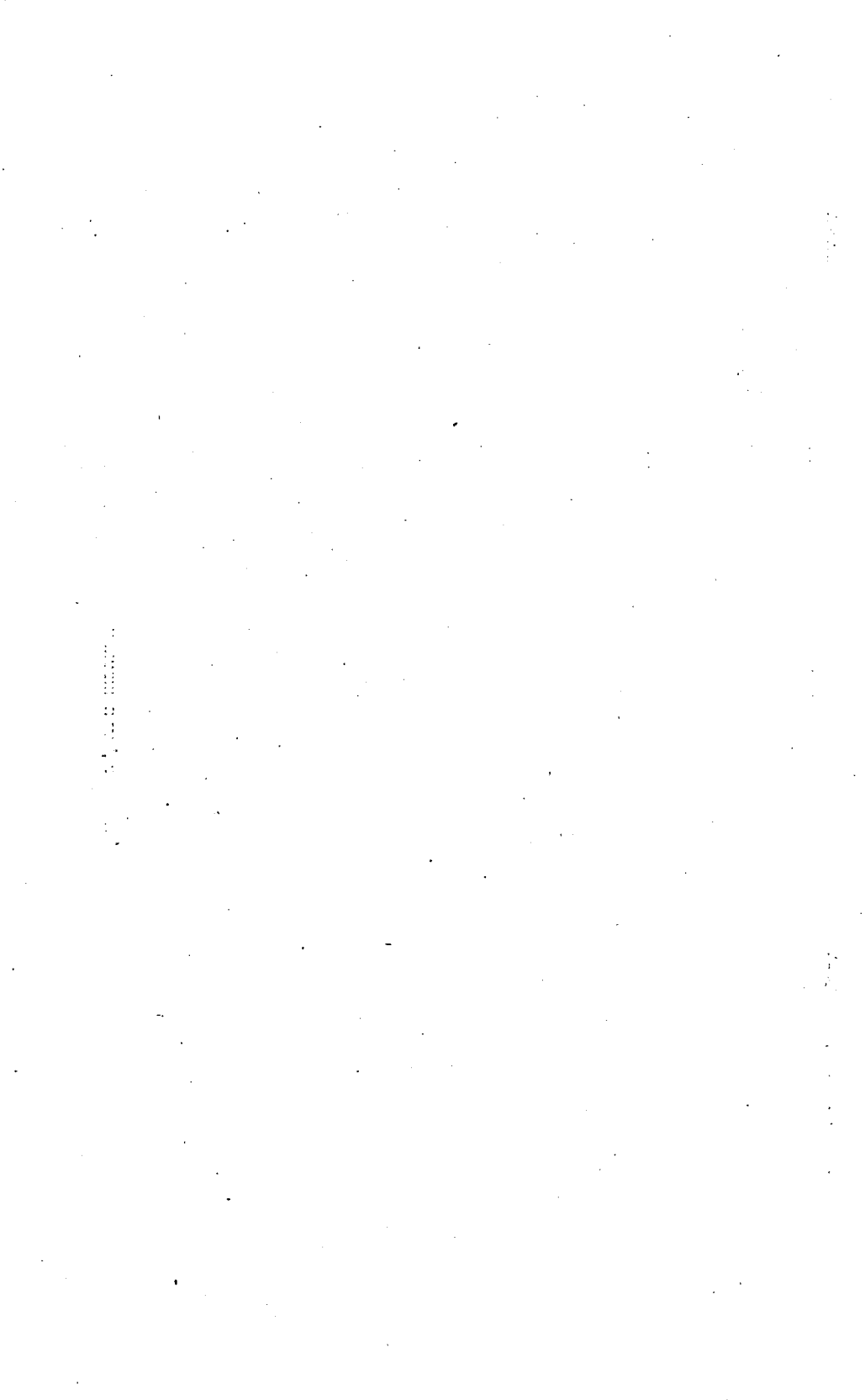
⁸² *History of Galloway* (Kirkcudbright, 1841).

⁸³ Vol. v. p. 470,

⁸⁴ 1473-1498, H. M. Gen. Register House, Edinburgh, 1877.



'MONS MEG,' AT EDINBURGH CASTLE.



century. The space at my disposal will not permit of giving any lengthy extracts from these records, however interesting; but a selection from them follows, sufficient to establish the point, which is important :—

1489.

'Item, gevin the gunnaris to drinksilver quhen thai cartit Monss,
be the Kingis commande⁸⁵ xviijs.'

1497.

'Item, that samyn day [x day of Aprill], giffin to Johne Mawar,
elder, in part of payment of the quhelis⁸⁶ making to the
bombardis and Mons iiiij*lib.*'

'Item, the last day of Maij, in Edinburgh Castell, at the casting⁸⁷
of Mons, gevin to the Kingis command to the gunnaris ... xviijs.'

'Item, [the xx day of Julij] for iiiij gret towis⁸⁸ to Mons, weyand
xvj stane five pund : for ilk stane iiij*s*'

'Item, to the menstralis that playit Mons doune the gait xiiijs.'

'Item, giffin for xij stane of irne, to mak grath⁸⁹ to Mons new
cradill, and gaviilokkis to ga with hir, for ilk stane ... xxviij*d.*'

In this year (1497), sir Robert Ker is master of the artillery. An item appears for conveying a great bombard from Edinburgh to the siege of Thrieve and back to Linlithgow; and it seems in every way likely that this was 'Mons Meg' herself; though there were, however, other large bombards in Scotland at the time, imported from Flanders; indeed, that country was then supplying most of the countries of Europe.⁹⁰ The Exchequer Rolls show payments for freight for a bombard called the 'Lion,' in 1430,⁹¹ and there is also an item for damage done by the great gun, when being hoisted on board the vessel. Another bombard from Flanders is mentioned under the year 1441-1442. Certain it is that guns similar to 'Mons Meg' were made in Flanders about the middle of the fifteenth century, as an instance the 'Dulle Griete,' now at Ghent, which bombard resembles 'Mons Meg' in every detail of construction. The sobriquet 'Meg' also looks like an importation, for 'Griete,' a popular name for cannon in the Low Countries, is the Flemish equivalent for 'Meg.' This is suggestive of the possibility

⁸⁵ This is the year of the siege of Dumbarton.

⁸⁶ Wheels.

⁸⁷ This must be for castings in connexion with the carriage.

⁸⁸ Ropes.

⁸⁹ Gear (?).

⁹⁰ Charles VII. bought a number of guns of Tournay in 1440. Monstrelet, chap. cclv.

⁹¹ Bower, *Fordun Scotichronicon*, lib. xvi.

that the gun may have been popularly known as 'Mons Meg' in the fifteenth and sixteenth centuries, though referred to in the official documents as 'Mons,' etc. We hear of 'Mons' as having been engaged at the siege of Dumbarton castle in 1489, and she was probably also at Norham in 1497.

'Mons Meg' was last discharged in 1682, firing a salute in honour of the duke of York, when she burst. It is not stated whether or not the charge was too large—perhaps it had been forgotten that a cannon lives its life like everything else—and this gun would not be able to bear much strain after a career of more than two centuries and a quarter. The old wooden carriage, though not the original one, for items appear in the Treasury accounts for 1497 for a new 'cradill' for 'Mons,' fell to pieces in 1835, and the present one of iron was cast at Woolwich in the following year. An inscribed stone, which formed part of a gate of Edinburgh castle, represents the cannon as mounted on an ancient carriage.

The calibre is about 20 inches, the length 13 ft. 6 ins., and the present weight of the gun about five tons. There is reason to believe that the projectile used was a granite shot, weighing 330 pounds.

I have no doubt that the barrel was screwed on to the chamber portion, for the holes in the hinder end for the insertion of levers for manipulating the screwing together and the reverse, observable in the case of the great Ghent gun, are present here also. Plate 1 gives a representation of 'Mons Meg' as she now is. It would not be safe to assign a higher antiquity to the cannon than the middle of the fifteenth century.

There is another 'Meg' in the bombard called the 'Holle Griete' of Diest, and it is thought to be only the chamber portion of a large gun. The present length is 1.67 m. The chamber portion of a large bombard could be, and, indeed, often was, used by itself.⁹²

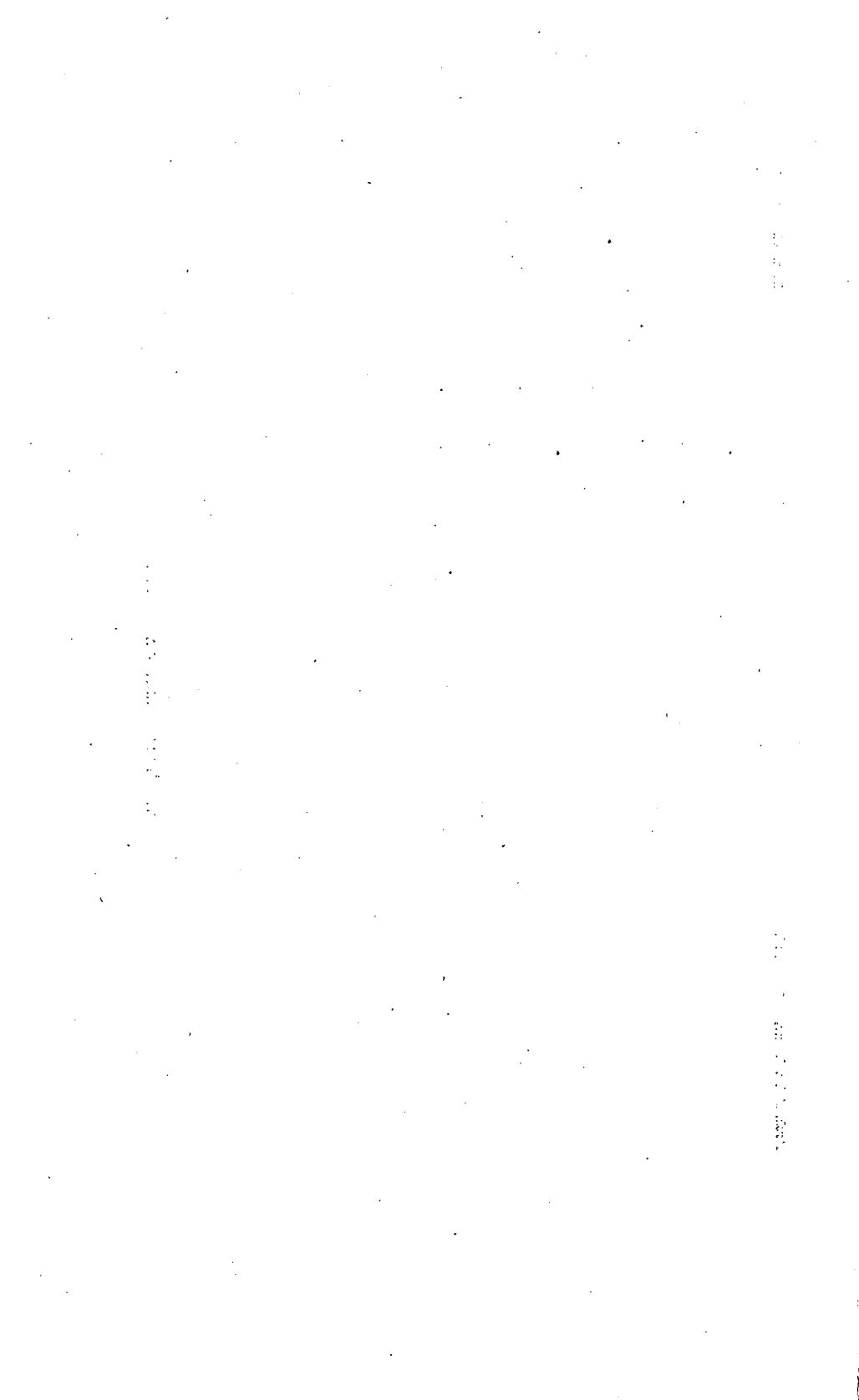
THE 'DULLE GRIETE' AT GHENT.

This great cannon closely resembles 'Mons Meg' in form and construction generally, but she is much larger. The name is literally 'Mad Margaret'; so also a 'Meg'!

⁹² An exhaustive account of 'Mons Meg' appears in the *Annales du Cercle Archéologique de Mons*, t. xxiv.; written by M. Armand de Behault de Dornon, Mons, 1894.



THE 'DULLE GRIETE,' AT GHENT.



Like her sister 'Mons Meg,' she is constructed in accordance with the methods prevailing about the middle of the fifteenth century, and is made entirely of wrought iron. The part containing the chamber is screwed to the barrel portion, and the small holes observable in the former are for the insertion of levers for screwing the parts together, or the reverse. The barrel is composed of 32 bars, each of which is 55 millimetres broad, by 30 mm. in thickness, welded together longitudinally, like the staves of a cask. These are covered with 41 rings of equal breadth, welded together, and their different thicknesses exhibit the barrel in four telescopic divisions, the outside diameters of which measure 1.00, 0.938, 0.880, and 0.820 m. respectively. The three rings comprising the muzzle are of different thicknesses, the last being the greatest.

The chamber is composed of twenty rings welded together. Three-fifths of its capacity correspond, nearly exactly, to the volume of 38 kilos. gunpowder, of a density of 0.9, being one-ninth of the weight of the projectile, the remaining two-fifths being taken up by the wooden wad and empty space.

The total weight of the cannon is 16,400 kilos; and the probable weight of the projectile used is about 340 kilos. The total length is 5.025 m., inside the barrel 3.315 m., and present diameter there 0.64, length of the chamber inside, 1.375.

The general arrangements of the 'Dulle Griete'⁹³ are those of the middle of the fifteenth century. It is therefore obvious that it could not have been used at the siege of Oudenarde in 1383, as is often stated to have been the case. Besides, the arms of Burgundy encircle the vent-field, and the princes of that house did not commence their rule in Flanders until 1384. It is recorded, however, that this bombard was used at another siege of Oudenarde, by the Gantois in 1452; on which occasion the defence was conducted by Simon de Lalain.⁹⁴ The town was relieved by the duke of Burgundy and the cannon fell into the hands of that prince. It was restored to Ghent

⁹³ 'Mons Meg' is 3^m 97 long; and greatest diameter 0^m 73. Compare these cannon with the 130 ton gun, fired recently at Sandy Hook. Length of gun 16 yards, charge of powder 600 lbs., trajectory over twenty miles.

⁹⁴ *Chronique de S. de Lalain*, chap. 81.

in 1578,⁹⁵ where it now lies. Plate 2 gives a representation of the bombard, where it stands at present.⁹⁶

Instances of the use of ordnance multiply as the fifteenth century advances, for by that time the influence it exercised on campaigning generally, and more especially on the assault and defence of fortified places, began to be of such importance that every chronicler of warlike operations has something to say about it. Many of these early writers are, however, both fanciful and inaccurate in their statements.

Several cannon were employed in the reduction of Bamburgh and Dunstanburgh castles in 1465. William Nele, 'gunnoure,' had a grant for life of sixpence daily for his good service in making cannon within the Tower of London and elsewhere, March 10, 1484.⁹⁷

Nicholas Merburg was master of ordnance in England in 1414,⁹⁸ Gilbert Parr in 1433,⁹⁹ Thomas Vaughan in 1455,¹⁰⁰ John Jedd, or Judd, in 1456,¹⁰¹ Raufe Bygood in 1483,¹⁰² sir Richard Gilsford in 1485,¹⁰³ sir Nicholas Appleyard in 1513,¹⁰⁴ sir William Skevington in 1523,¹⁰⁵ sir Christopher Morris in 1537,¹⁰⁶ sir Philip Hoby in 1548, and sir William Pelham in 1558.¹⁰⁷ The office was not abolished before 1852.

Trunnions, cylindrical pieces of wrought iron on each side of the piece, fitting into sockets, supported and balanced the cannon on its stand or carriage and prevented its being thrown off by the force of the recoil, as had been often the case with earlier appliances when not enclosed by heavy pieces of timber. Trunnions also assisted in the pointing of the gun. The invention probably dates a little before the campaigns of Charles the Bold (1474-1477). One of the accounts of the town of Lille, of the year 1465, contains an item for *one* trunnion, to be made for a big serpentine; and this looks like a replacement, for one trunnion on a gun would hardly answer the purpose required. A

⁹⁵ *Audenaerdische mengelingen*, t. i. p. 10.

⁹⁶ Fuller particulars of this bombard are given in *Histoire de l'Artillerie en Belgique*, par M. Paul Henrard. Brussels, 1865.

⁹⁷ Cal. of Pat. Rolls, 1 Richard II.

⁹⁸ Rymer's *Foedera*.

⁹⁹ Nicolas's *Privy Council Proceedings*, vol. v.

¹⁰⁰ Bayley's *Hist. of the Tower of London*.

¹⁰¹ *Excerpta Historica*, p. 10.

¹⁰² Harl. MS. No. 433.

¹⁰³ Grose's *Military Antiquities*.

¹⁰⁴ Holinshed.

¹⁰⁵ *Ibid.*

¹⁰⁶ Grose's *Military Antiquities*.

¹⁰⁷ *Ibid.*

serpent gun of the reign of Henry VI., now at Woolwich,¹⁰⁸ affords an early example of a gun with trunnions.

In the nature of things, there have been no very early stands or gun-carriages handed down to us, and we owe any knowledge we possess as to their form, substance and construction, mainly to references made to them in MSS. of a more or less contemporaneous character, and we are indebted to a few very rare drawings, and inscriptions on stone, for what we know of those of a somewhat later date. The ancient stands and carriages, of which there are actual examples, are doubtless renewals, for all information concerning them goes to show that they had but a very short life, owing to the proportionately heavy recoil of the guns to which they were attached. This influence was naturally much more destructive after, say, 1360-1380, when larger guns were made, and especially in the case of the stands or beds for great bombards. A contemporary chronicle of Nuremberg states that the baulks of timber, of which the stands were composed required renewal every three or four days!¹⁰⁹

There are specimens of stands and gun-carriages of the reign of Henry VIII., and probably also of a still earlier time, in the examples recovered from the wreck of the 'Mary Rose,' sunk off Spithead in 1545. Some of the guns preserved in the Swiss and other arsenals and museums go back to the middle of the fifteenth century, but it is very doubtful if any of the beds or gun-carriages preserved are contemporaneous with the making of the guns to which they are now attached. The Burgundian guns were continued in use by the Swiss, as shown by various inventories preserved, and as almost all of them were without trunnions, it was natural that when new beds or gun-carriages became necessary, they would be made on the old models, as being more suitable for pieces of that description than the newer fashion for guns with trunnions. The wretched condition of the roads of the period would alone tend to give gun-carriages but a short life.

Brackenbury¹¹⁰ reproduces from the *Etudes* the description of a bed for a cannon which follows below. The cannon and bed

¹⁰⁸ Appendix, No. 4.

¹⁰⁹ Boenheim's *Waffenkunde*, p. 434.

¹¹⁰ *Proceedings of the Royal Artillery Institution*, vol. v. p. 9.

were ordered to be made at Caen in 1375 by one of the king's councillors. The bed for the cannon comprises a large piece of elm to encase the body,¹¹¹ another portion for the side-pieces, a large piece of elm for the front side-pieces for lowering and raising the cannon when required, three pieces of wood for the *patrons*, etc., a piece of oak for the rear side-pieces, two great pieces of wood for the lower beams to carry the cannon, wood to make the long bands (*lons lyans*), etc., four pieces of wood for the *chappéaux* and *petits lyans*, etc.

The bed thus made would appear to have continued in the same fashion during the century following, for the description corresponds with contemporary illustrations of fifteenth century stands. Sometimes, more especially for ordnance of the last quarter of the fourteenth century, wheels were placed under the bed for mitigating the force of the recoil. Two cannon lying together on a rough bed with wheels are given in the Froissart illumination showing the attack on the town of Aubenton by the earl of Haynault—one of the wheels has fallen off. The siege took place in 1340, and therefore at too early a date for the large guns and beds represented, but it gives an idea of both the type of cannon and stand in use some thirty years later.

The early gun-carriage was rough and clumsy, with heavy wooden wheels and axle-trees of the same material, without gun limbers or gear, and drawn by oxen ; but it had much improved by the beginning of the second half of the fifteenth century.

The first mention of two-wheeled gun-carriages is, I believe, in *Chronicon Tarvisinum*, by Andrea Redusio, in connexion with the siege of Quero in 1376 ; and I have already referred to the *ribaudeaux* on wheels used in the battle between the forces of Bruges and Ghent in 1382, and when Jean-sans-peur invaded Vermandois in 1411 with an army of 40,000 men, he carried with him two hundred *ribaudeaux*, constructed to carry one or several cannon.¹¹² The early *ribaudequin* consisted of a rough carriage on two wooden wheels, carrying two or three small cannon. The projectiles employed were cannon arrows. A wooden mantlet protected the gunners in rear ; and the carriage bristled with spears fixed on to it. Originally the machine was

¹¹¹ That is to say, deeply grooved.

¹¹² *Chronique de Monstrelet*, chap. lxxxiv. p. 205.

intended for one discharge only, after which it fell to the rear. The guns were fixed on the carriage at an invariable angle, but later specimens show many improvements. Demmin gives an illustration of the engine in his book, copied from a drawing executed about 1505, in Nicholaus Glockenthou's work, now at Vienna. *Ribaudearivs* continued in use for long; they are mentioned in Elizabeth's reign.

The application of the rack principle, which took various forms, was a great step forward, more especially so when combined with a wheeled carriage. The cannon lay on a wooden plane, which was attached to the bed of the carriage in front by a pin passing through staples or by a hinge, and its tail rested on a bar passed through holes in the rack; or it was attached by the bar passing through the tail, as shown on plate III. The rack was connected with the plane in front, and on either side by rods for adjustment to the angle of elevation or inclination required; or by a directing bar of iron, holed at intervals, which was fixed to the bed of the carriage, and the tail of the plane worked up and down, the gun being secured at the necessary angle by a pin, as shown on fig. C. A gun-carriage, now at Woolwich, recovered from the wreck of the 'Mary Rose,' is grooved on the under side to slide on a directing bar. Drawings of the rack system are given in the *Zeitblom MS.* of the fifteenth century. The timbers of the carriage rested on a single shaft mortised into the axle-tree bed, and connected with the trail.

Quite a number of ancient guns, many of them stated to have been taken by the forces of the Swiss cantons during the period from 1474 to 1476, are spread over the arsenals and museums of Switzerland,¹¹³ and some of the reputed Burgundian guns are at Paris. Several of the guns, supposed to be Burgundian, are of very early date, half a century earlier than the battle of Granson, the explanation being that duke Charles lost most of his field artillery at Granson and Murten; and for the battle of Nancy, all the old fortress pieces and guns of position that could be laid hands on were requisitioned for the army; or it may be that some of the reputed Burgundian cannon are really Swiss or German pieces. The archives of the Canton de Fribourg contain inventories

¹¹³ There are fine collections, at Nauveville (canton Berne), Morat (Murten), Zurich, Bale, and Soleure.

of cannon as early as 1431 ; that of 1503 shows a remarkable increase in the number and variety of guns possessed by the Canton, over the one taken in 1474. Some of them are scheduled as *pièces conquises*, and this probably refers to the Burgundian cannon that had fallen to the share of Fribourg, at the division after the battle of Nancy.

A *feldschlange*, on its carriage, stated to have been taken at Granson, is represented in plate III. The gun is now in the excellent historical museum at Nauveville (Canton Berne) ; and I am indebted to the director for having had a photograph specially taken for the purposes of these notes. The rack arrangement is shown very clearly, but the gun-carriage is probably not the one used by the Burgundians, though made on the old model. The collection at Nauveville consists of seven pieces ; on carriages with two wheels, and of three bombards with their projectiles.

The cannon at the gymnasium at Murten (Morat) are as follows, viz. :—cannon, wrought iron, strengthened with rings, chamber portion wanting, two rings for haulage. Present length of cannon, 66 centimetres ; diameter at muzzle, 14 ; and behind, 7·5. Mounted on oak carriage, 253 centimetres long.

Small bombard, on low stand. Length, 44 centimetres ; calibre, 14. Plate IV. represents these two cannon.

Feldschlange, wrought iron breech-loader. Length, 140 ; calibre, 3 ; mounted on oak carriage, 255 centimetres long. The cannon is strengthened with fifteen rings, and has two rings for haulage.

Small mortar, without stand. Length, 48 ; calibre, 16, 5. Fig. D represents these pieces.

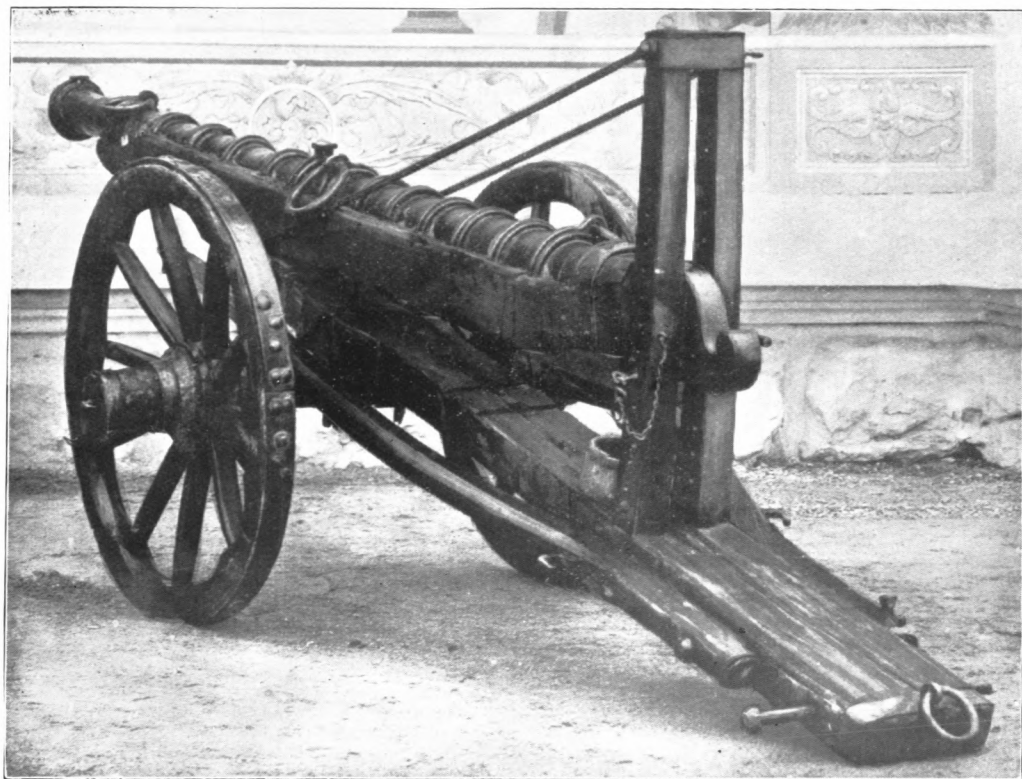
There is another *feldschlange* of bronze, much shorter and thicker, mounted on an oak carriage.

Two other cannon, one with carriage ; and another small bombard.

My best thanks are due to direktor S. Müller of Lowenberg, Morat, for his kindness in having had the guns specially photographed for the purposes of these notes, and also for sending me the dimensions.

Among the *veuglaires*, captured by the Swiss, is one at Nauveville without trunnions, showing three aiming sights ; but I am not aware of any of the other guns taken having fixed sights ; nor, in fact, do such sights appear, as a rule, on sixteenth century cannon.



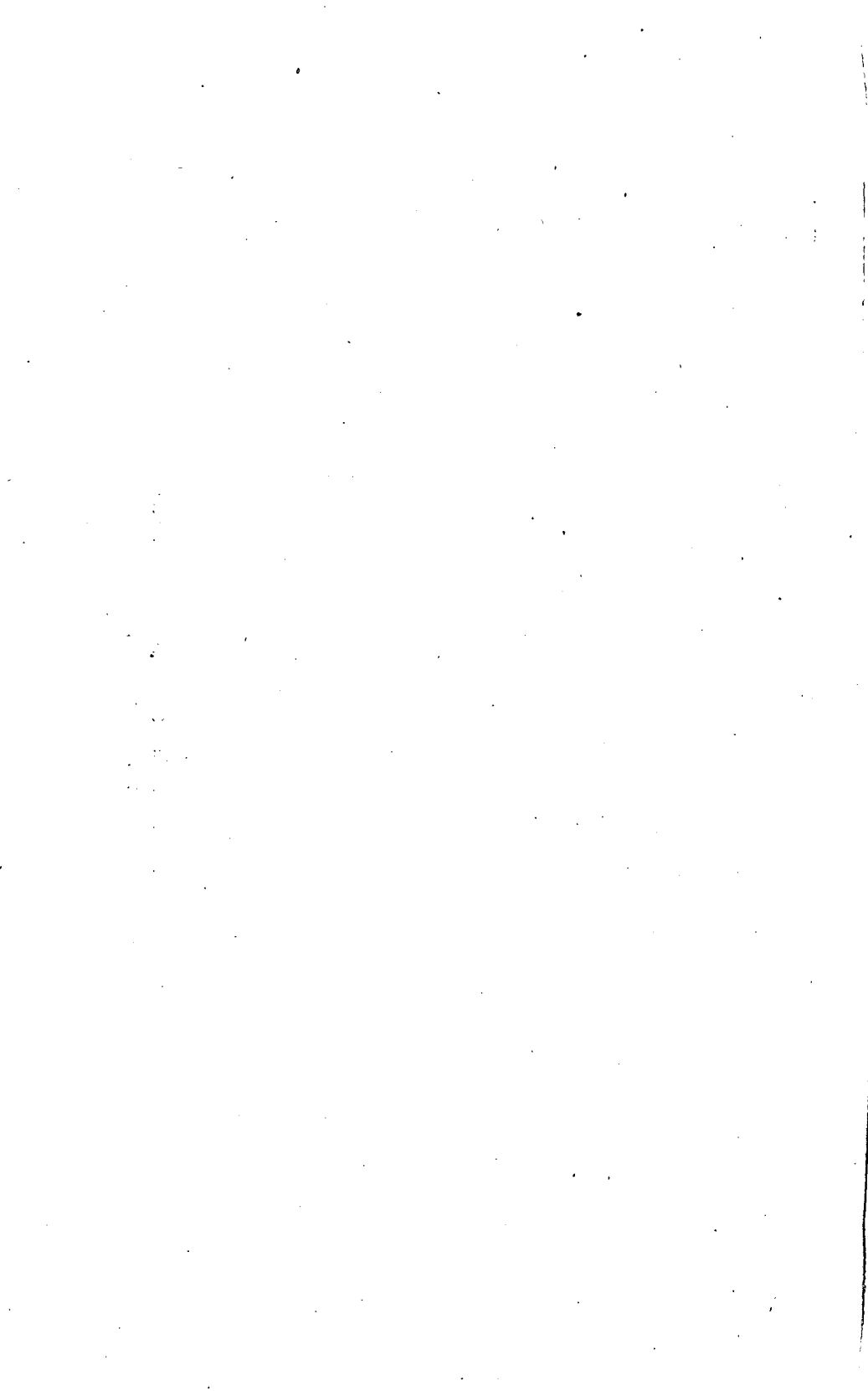


'FELDSCHLANGE,' FROM THE BATTLE OF GRANSON,
Now in the Nauveville Museum.



CANNON FROM MORAT (MURTEN); AND SMALL MORTAR.

Now in the Gymnasium, Morat.



The *Chronique bernoise de Schilling* states that Charles left 420 cannon, exclusive of hand guns, on the field of Granson; and among them were many heavy guns (hauptbüchsen),¹¹⁴ besides couleuvrines, and bombards (steinbüchsen?). These were divided among the Swiss cantons, and their allies; and in the course of time many of them have found their way to other parts of Europe.

A later form of gun-carriage consists of two strong side timbers, sloping gently to the ground, beyond the cannon behind. These are

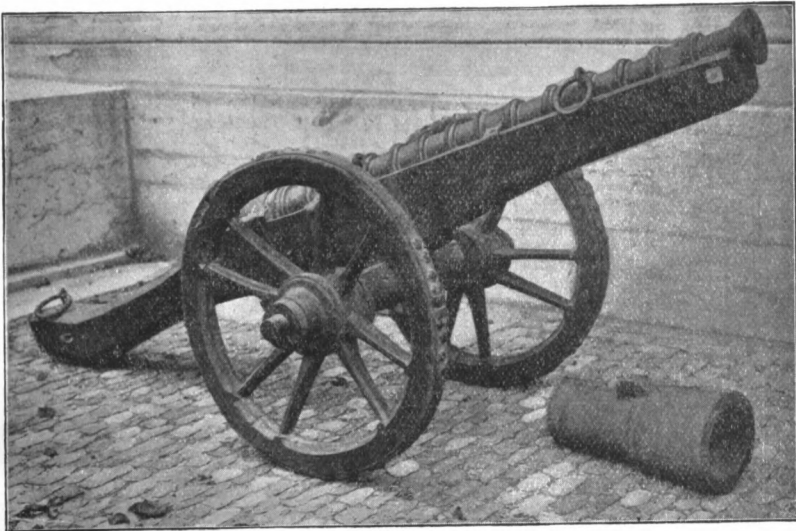


FIG. D.

united by the bed, in which the cannon rests on its trunnions. Holes for the insertion of a pin, at different altitudes, pass right through, and the adjustment of this pin, or bar, to which the tail of the piece is drawn, secures the angle of elevation required.

A representation of a Bavarian falconet, of the year 1524, on its gun-carriage, drawn by a single horse, is given on fig. E.¹¹⁵

Fronsperger in his *Kriegsbuch* of 1573, gives a drawing of a

¹¹⁴ Probably Courteaux.

¹¹⁵ *Studie über die Entwicklung des Geschützwesens in Deutschland*; by Custos Wendelin Boheim: published in *Zeitschrift für historische Waffenkunde*, vol. i. p. 61. The illustration was copied from *Das Büchsenmeisterbuch* of Christof Seselschreiber, of the year 1524: now in the Königl. Hof- und Staatsbibliothek, at Munich.

cannon, weighing 75 cwts., drawn by 25 horses. It furnishes an example of the loading rod of copper, and the square used in aiming.

Drawings of gun-carriages of the sixteenth century, from a work entitled *Entrée de Charles V. à Milan, avec le pape Clement VII.*, are, I understand, reproduced in De Vigne's *Vade-Mecum du peintre*. I have not been able to see the drawings.

The ancient cannon in the donjon of the castle, at Newcastle-upon-Tyne, are as follows:—5 ship falconets ; 1 cannon with trunnions ; and 3 guns brought from China, all in the so-called banquetting-hall ; 1 piece of ordnance, also from China, in the basement ; and 10 ship guns on the battlements.

The five ship falconets, were in all probability, worked on swivels.

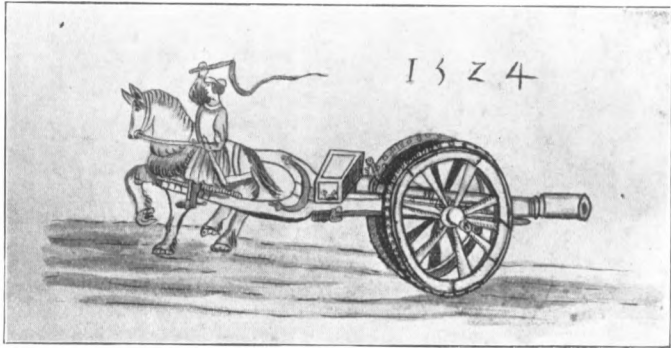


FIG. E.

The guns are in such a condition of dilapidation and corrosion, that it is extremely difficult to arrive at any very exact determination concerning the approximate date of make. They differ somewhat, though not very materially, in size—four have trunnions ; and these supports have been chipped off the fifth—these guns are made of cast iron, excepting the trunnions and tail-pieces, which are of wrought iron.

Two of them want the fore, and two the after, portions ; while but one retains part of its tail-piece. All are breech-loaders, but none of the breech-blocks has been recovered.

The original length of four of the guns must have been something over seven feet from the muzzle to the tip of the tail, length of chamber about 15 inches, length of barrel about 4 feet 2 inches ; the

fifth cannon has been larger, say, 7 feet 6 inches to 7 feet 10 inches, but the hinder end, with the tail-piece, has been broken off. The inner tubes are all more corroded away as the muzzle is approached, so that the present measurements at the mouths, which range from $1\frac{1}{2}$ to nearly 2 inches in diameter, are in excess of the original calibres of the guns. The bottoms are out of the chambers so that the arrangements for the reception of the breech-blocks cannot now be discerned, but a bolt ran through the latter and a tenon and mortice at the bottom secured the block, while the insertion of a wedge made the whole fast. The largest of these guns is very similar in form and size to one dragged up from under the sea by some fishermen near the Goodwin Sands in 1775,¹¹⁶ but that gun is of brass and consequently in a much better state of preservation than the cannon under review.

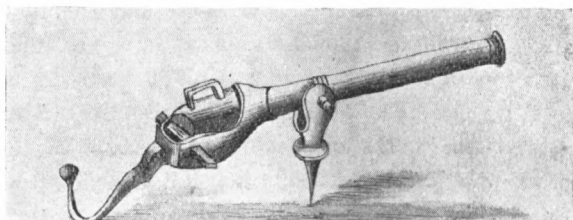


FIG. F.

Fig. F¹¹⁷ represents a ship falconet now at the Port de Hal, Brussels. Length of barrel, 5 feet 2 inches; calibre, nearly $1\frac{1}{2}$ inches. This piece presents its handled breech-block in position for firing, the swivel on which it pivoted, and the tail-piece, in this case bent downwards for the purpose of elevation. Another swivel falconet with a tail-piece straight, like the tail-pieces of the castle guns, is now in the Caerleon museum. This type of cannon, one of the attempts made to perpetuate the movable chamber system, was only suitable for a small charge of fine grain powder and it had no recoil to speak of. They were mostly employed on warships of small tonnage and hence the fact of their being always found in the beds of rivers and on the sea shore. Quite a number have been fished up. This type of gun is the pierier, perear, or pateros, mentioned in inventories. Mr. Gibson,

¹¹⁶ *Archæologia*, vol. v.¹¹⁷ Appendix, No. 42.

the warder at the castle, suggests that these guns had been thrown overboard in the Tyne, in the bed of which they were found, to avoid capture when Newcastle was besieged by the Scots in 1644. There is a tradition that king Charles attempted an escape from Newcastle in 1645 'by the passage of Lort Burn and that he got down as far as the middle of the Side, when he was caught in his attempt to force the iron grate at its outlet. A ship was said to be in readiness to receive his Majesty.'¹¹⁸ But, however this may be, the guns would appear to date from an earlier period, say in the sixteenth century, like the Brussels falconet, fig. F;¹¹⁹ but for all that it is far from being impossible that they were still in use in the century following.

BREECH-LOADING CANNON WITH TRUNNIONS.

This piece of ordnance is made of cast iron strengthened with wrought iron rings, shrunk on—the tail-piece and trunnions are of forged iron. I was of opinion that the body of this cannon was of cast iron, but could not be certain by reason of the corroded and rusty condition of the piece, but to make sure I consulted Mr. Towers, the manager of the works of Messrs. John Abbot & Co., Ltd., of Gateshead, who, on inspection, confirmed my views as to the manipulation of the iron employed. He was good enough to send one of his most experienced workmen to see the gun, who pronounced in the sense stated, remarking that there was a considerable percentage of copper in the mixture.

The length of the gun without the tail-piece, which is broken off short, is nearly 3 feet 2 inches; length of chamber, $8\frac{1}{4}$ inches and width about 5 inches. The opening at the muzzle is very large, partly, no doubt, increased by corrosion, but it was wide originally with a view to the missiles, which were probably nails or pieces of iron, spreading out like the buckshot from a blunderbuss of the eighteenth century; the diameter of the barrel next the chamber is very much smaller, being about 2 inches. The bottom of the chamber is out and the walls are about an inch thick. Guns were not cast in England, as far as is known, before the sixteenth century, but this looks like a Flemish gun of the *veuglaire* type and dates probably

¹¹⁸ Sykes's *Local Records*, vol. i. p. 100.

¹¹⁹ Appendix, No. 42.

somewhat earlier. The piece was sent to our society by the authorities of the Royal Arsenal at Woolwich in exchange for a gun presented to us by Mr. Joseph Price of Gateshead, in 1835. The gun given to us by Mr. Price is now in the Rotunda at Woolwich. It is of wrought iron and of comparatively late date. Calibre, 4 inches; length, 4 feet 4 inches.

GUNS FROM CHINA.

The swivel gun was presented to the society by Captain Coulson, who brought it with him from China. I think it is called a *jing-yl*. It is a breech-loader, socketed and shouldered in a wooden stock, working on a swivel something in the style of the sporting duck gun, and it greatly resembles sixteenth century specimens of this style of gun which may be seen in many collections, both at home and abroad. The length is about 8 feet, thus approximately divided—barrel, 4 feet; chamber, 17 inches; and tail portion, 2 feet 7 inches. The calibre is about an inch. A swivel serpentine, strengthened by 25 rings shrunk on. Calibre $1\frac{1}{2}$ inch. A cannon with 2 rings for haulage. Calibre, $2\frac{1}{4}$ inches; length, about 3 feet. It seems to be of no great antiquity. The serpentine and cannon with rings were presented by Mr. G. Rippon.¹²⁰ They were captured at Chusan. Like most guns brought from China these pieces, with the exception, perhaps, of the last mentioned, have a European aspect and really one cannot resist the impression that they came originally from Europe.

The gun in the guard-room is of no great antiquity. It has trunnions and cascabel; calibre, $3\frac{1}{4}$ inches; length, about 6 feet. The piece came from China but would appear to be of European make.

The ten pieces on the battlements are ship guns, probably dating from the first half of the eighteenth century; calibre, about 5 inches. They were placed on the battlements by the Newcastle corporation before our society had possession of the castle, for the purpose of being fired on occasions of public rejoicing. I believe they were last discharged when her late majesty queen Victoria declared the High Level bridge open for traffic in 1849.

Charles VIII. of France entered Italy in 1494, with a train of

¹²⁰ *Arch. Ael.*, new series, vol. i. p. ix.

brass cannon,¹²¹ drawn by horses ; while in the opposing Italian host oxen were used for the purpose. Favé states that Charles's guns for besieging fortresses were so dilatory that the besieged had time to repair the damage caused by each shot before another could be delivered.

At this time Italian ordnance consisted of *bombardes, mortiers, comunas, cortanas, passa volante, basilisk, cerbatanas, and espingardes*, ranging from 300 down to ten pounders.

The elbow-mortar, used in Italy early in the fifteenth century, was a tube fixed at right angles to another on a horizontal piece of wood. It was one of the attempts made with a view to obtaining a greater rapidity of fire ; but like many others it was soon cast aside.¹²²

The *Orgue*, the *Todtenorgel* of the Germans, so named from the barrels being placed in rows, like the pipes of an organ, was invented about the middle of the fifteenth century ; there are examples with forty barrels, and even many more. This piece is the prototype of the mitrailleuse, and of the Gatling gun. A very early example may be seen at Sigmaringen,¹²³ with its two-wheeled carriage, and others are at Berlin. There are a good many specimens preserved,¹²⁴ which vary very much in size ; some are very small hand weapons, prototypes of the revolver, of which an example is at Woolwich.

Howitzers, for the discharge of hollow balls, came into use in England during the second half of the sixteenth century ; and petards appeared in the Netherlands a little earlier.

The connecting link between artillery and hand guns is to be found in a weapon served by two or three men, used from the ramparts, and also with a stand in the field, called *harquebutt à chroche*. An inventory of arms and armour in the tower, and at Greenwich, mentions *Hagbusshes a croke of brass iij ; Hagbusshes a croke of irone, oone* : and among the ordnance scheduled in the Tower inventory of 1559, occurs the item 'harquebutts à chroche, 80.' The harquebus, or *hakenbüsche*, would appear to have derived its

¹²¹ *Histoire et Tactique des Trois Armes.*

¹²² Mr. Grose in his work on *Military Antiquities*, vol. i. p. 398, gives a drawing of an elbow-mortar, apparently taken from the *Institutionum reipublicae militaris, etc.*, by Nicolai Mareschalchi (Rostock, 1515).

¹²³ First half of the fifteenth century.

¹²⁴ One with forty-two barrels is in the arsenal at Soleure.

name from *hac* or *haken*, a spur (attached to the underside of the weapon for resting against a rampart or a stand), and *büchse*, a gun. Several of these weapons may be seen in the Rotunda collection at Woolwich. Other specimens are noticed in the appendix to these notes.¹²⁵

Rifled cannon, a principle, I believe, first applied in Germany, were introduced early in the sixteenth century. Examples of that period may be seen at the *Zeughaus*, Berlin; and also in the museums of Nuremberg, the Hague, and Zurich. Benjamin Robins, who published his *New Principles of Gunnery* in 1742, is often credited with this invention.¹²⁶

Many bronze and iron cannon were cast throughout the fifteenth century, notably in Italy, Flanders, France; and in Germany also, as instanced by the fine gun at the Invalides, Paris, cast by Georg Endorfer, inscribed with the year 1404. Jaques Dehornes began to cast cannon at Malines, in 1420;¹²⁷ and the arsenal at Bale possesses a fine cannon, with trunnions, cast in bronze, bearing the inscription *Jehann de Malines, ma fayt lan mcccclxxviii*, and the arms of Burgundy. The length of this piece is 2m. 520; weight, 2,000 liv.; and calibre 0m. 220. The diameter of the projectile is 200 m/m; and weight 20 livres; charge of powder, $4\frac{1}{2}$ liv., occupying $\frac{3}{5}$ of the capacity of the chamber. Fig. G is a drawing of this cannon.

It would appear that the first mention of any guns-cast in England is in the century following, when:—

“Master Hogge, and his man John,
They did cast the first can-non.”¹²⁸

This is stated to have taken place at Buxted, Sussex, in 1543; doubtless the place a few miles from Lewes, referred to by a writer in *Archæologia*, vol. x. p. 472; who remarks: ‘where it has always been understood the first guns were made in England.’ The writer of the notes in question gives a drawing of an early cannon, as probably having been made at the Buxted furnaces. The gun is

¹²⁵ Nos. 35 and 48.

¹²⁶ Robins reduced the practice of gunnery to a science, and he was the inventor of the ballistic pendulum.

¹²⁷ *Chronycke van Mechelen*.

¹²⁸ *Archæologia*, vol. xxxvii. p. 483.

represented as of wrought-iron longitudinal bars, strengthened with rings, without trunnions; and it is still fastened to an ancient wooden stand. The bombard at Eridge Green, in 1768, was fired on occasions of rejoicings. It would seem to have been of early fifteenth century date. Viscount Dillon, P.S.A., in his notes in *Archaeologia*, vol. li. pp. 167-172, on 'A Letter of Sir Henry Lee, 1590, on the trial of Iron for Armour,' mentions that a payment occurs in September, 1516, of £33 6s. 8d. to John Rutter of London, for 'hurts and damages by him sustained in a tenement to him belonging wherein the king's great gun, the 'Basiliscus' was cast, and for rent;' and that in 1532, Carlo Capello, the Venetian, writes that Henry 'visited the Tower daily to hasten the works going on there, and was founding cannon.'

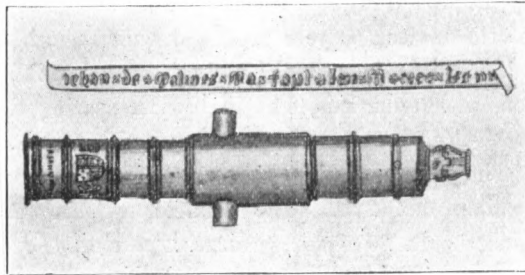


FIG. G.

In regard to gunpowder, an indenture, already referred to, as between John Starlyng and Helmyng Legat, dating in the twelfth year of the reign of Edward III. (1338), schedules *un petit barrell de gonpouder le quart' plein*.¹²⁹ Reference has been made in these pages to gunpowder, the first name it appears to have borne in England, as having been manufactured by Thomas de Roldeston for Edward III. In a *Book of Accounts of the King's Chamber* from 1344 to 1347, deposited among the records of the exchequer, the following entry occurs:—*Eidem Thomae super facturam pulveris pro ingeniis, et emendatione diversarum armaturarum, xl. sol.*¹³⁰

¹²⁹ Sir N. H. Nicolas's *Hist. Royal Navy*, London, 1847.

¹³⁰ In Mr. Joseph Hunter's 'Proofs of the Early Use of Gunpowder in the English Army,' *Archaeologia*, vol. xxxii. p. 381.

There are also entries in the accounts for quick-sulphur¹³¹ and saltpetre, costing eightpence and one shilling and sixpence per lb. respectively, though none appears for charcoal,¹³² but in 1369 an entry of six pounds of sea-coal occurs in the *King's Wardrobe Account* in connexion with sulphur and saltpetre, as if coal, called sea-coal then and much later, could be used as a substitute for charcoal in the making of gunpowder; close to this entry eighty-four pounds of gunpowder are mentioned. A *Tower Survey* of 1559 schedules 'salt petre, brimstone and coal powder to make powder.'

Some entries in the *Pipe Rolls of the Exchequer* of 1351 have been already given in these notes, and gunpowder is twice mentioned among them. It would appear that the ingredients saltpetre and sulphur were usually kept separately, ready to be mixed together when the completed compound was required for use, and that the charcoal was made when wanted. The ingredients were first separately weighed and then pounded together in a pestle and mortar, and an *Account of the King's Chamber* of 1374 mentions scales, brass mortars and iron pestles.

John Anderne, in his treatise *Practica, temp. Edward III.*, gives the following recipe:—*Pour faire un feve volant: Prenez j lib. de soufre vif; de charbones de saux ij lib., de saltpetre vj lib.*,¹³³ which is the Marcus Graecus compound over again, viz.: '*R. lib. i. sulphuris vivi, lib. ii. carbonis salicis, salis petrose vi. libras.* A certain quantity to be put into a long, narrow and well-compacted cover, and then discharged into the air.' This mixture is much superior in strength to the gunpowder used for cannon in the fourteenth century, which is said to have consisted of equal parts of the three ingredients mentioned,¹³⁴ and it would seem that the Marcus Graecus mixture of 846 A.D., well known as it must have been in the reign of Edward III. from the fact of its having been quoted by Anderne as well as by Roger Bacon and Ferrarius, was too strong for the ill-constructed ordnance of the period, and, in consequence, a less proportion of

¹³¹ Not the sublimate, commonly called 'flowers of sulphur.'

¹³² Charcoal and saltpetre in combination form a more or less powerful mixture, and the addition of sulphur is not absolutely indispensable for the making of an explosive powder.

¹³³ *Sloane MSS.* 335, 791.

¹³⁴ As given by Peter Whitehorne in his book printed in London in 1573.

saltpetre was used in the powder. Roger Bacon even suggests the use of gunpowder for warlike purposes. It would appear to have increased in strength towards the last quarter of the century, for the *Wardrobe Account, 1372-1374*, gives 320 lbs. saltpetre and 107 lbs. sulphur in connexion with the service of certain guns, and this is practically three parts to one. The cost of saltpetre in 1350 was about 3s. 6d. per lb., and sulphur about 2s. 7d., that is reckoning the *ecu* as valued at, say, about 14s.¹³⁵ An item is given, under the year 1433, in Nicolas's *Privy Council Proceedings*, vol. v. :—' Be there made a privy seal to Gilbert Parr, master of the king's ordinance of my lord of Somerset, 4,000 lbs. of saltpetre, 3,000 lbs. sulphur.'

Early in the fifteenth century the proportion of saltpetre had certainly risen to three, with two each of the other ingredients ; and by the middle of the sixteenth century the proportions for cannon were four, one, and one ; and those in a mixture made for hand guns, eighteen, three, and two, of saltpetre, charcoal and sulphur respectively.¹³⁶ Benjamin Robins says that a similar mixture was in use in his day, while towards the end of the century it had altered, viz., to six parts of saltpetre and one each of sulphur and charcoal; practically the same as the composition of Marcus Græcus in 846, reproduced by Roger Bacon about 1260, and by Anderne in his treatise *Practica, temp. Edward III.* It would seem therefore that the strength of the mixture used was mainly regulated by the ability of ordnance to withstand the strain. The English mixture of recent times contains seventy-five parts of saltpetre, fifteen of charcoal, and ten of sulphur, respectively. In judging these comparisons we must not, however, overlook the fact that very much depended on the purity of the saltpetre used, which ought to contain fifty-four parts of nitric acid and forty-six parts of potash, and we have no means of knowing the analysis of the saltpetre employed in the middle ages, nor even during the renaissance. The quality of the charcoal greatly affected the rate of combustion and we have seen that sea-coal was sometimes used as a substitute. The charcoal made from dogwood was considered the best for powder for handguns, while that from the willow or alder was preferred for ordnance, the

¹³⁵ *Etudes*, tome iii. p. 89.

¹³⁶ Tartaglia, *Quaestioni i Inventioni diversa*, Venice, 1546.

former being much more violent in its action than the latter.¹³⁷ Gunpowder bought in Spain in 1512 cost 3½d. and 4d. per pound, and we may perhaps infer from the large quantities purchased abroad, either that the quality produced on the continent was better, as it certainly was far cheaper, than that made in England, or that we were unable to make enough for our requirements in this country. Camden states in his *Life of Queen Elizabeth* that she was the first monarch to make powder in England 'that she might not pray and pay for it also to her neighbours.' A royal licence to erect powder mills in England was granted to John Evelyn in 1590. A MS. account of the Merchant Tailors company schedules gunpowder as costing a shilling a pound in 1549. Carlo Capello, the Venetian, states that king Henry VIII. made gunpowder at the Tower in 1532, but we do not know whether it was granulated or not. It certainly became so somewhat later, as shown in a *Tower Survey* of 1559; and the fine dust, divided from the projectile by a wooden wad, was replaced by coarse and fine grained powder, made for charging and priming respectively, 'Serpentyne, grosse corne and fine corne' for ordnance. The entry in the *Tower Survey* of 1559 runs:—'800 lbs. of serpentine powder at 8d. per lb. and 475 lbs. of corne powder at 10d. per lb.,' delivered by Anthony Bukman and Edward Castelyn of London, merchants.¹³⁸

The size and shape of the granulation exercised an important influence on the explosiveness of the powder and therefore on the quantity for a charge; the combustion of the grains, though apparently simultaneous, is in fact gradual. In the case of very small grained powder, in consequence of the lower rate of the combustion from grain to grain by reason of the interstices between the grains being so small, a considerable part of the powder would be blown out of the gun unignited, and much less gas would consequently be generated for the propulsion of the projectile, and its velocity proportionately reduced.

An old treatise of *Canonerie*, of unknown date, printed in Paris in 1561, states that the charge of powder was equivalent to occupying about two-thirds of the barrel.¹³⁹ Various substances were often added

¹³⁷ Robins, in a paper read before the Royal Society in 1743.

¹³⁸ The same people delivered 28 brass cannons with the powder and it would seem that they were merchants importing from abroad.

¹³⁹ *Archaeological Journal*, vol. x., p. 31.

to the three principal ingredients with the idea of improving the mixture, such as quick-silver, various salts, alum, arsenic, camphor, amber, and realgar,¹⁴⁰ brandy, vinegar. Distilled water of orange skins was used for watering the mixture. When coal-dust was used instead of charcoal a distillation of fish-paste was added.

It is stated in the *Etudes* that the brothers Bureau were the first to use iron instead of stone for cannon-balls early in the fifteenth century, but there was nothing new in the use of metal balls at that time, for instances of their employment are recorded at a much earlier date. They were first of wrought-iron or lead, but later of cast-iron or bronze. Sometimes, from motives of economy, a combination of stone and lead was employed. The change from stone to iron was an important one in the reduction in the size of projectiles and in the calibre and weight of the guns, which when thus reduced became more efficient in action and more easily transportable, having increased velocity and diminished mass. Metal balls were not so liable to fracture as those of stone. They did not come into general use before late in the fifteenth century.

Probably the earliest reference to iron shot is to be found in the passage in the archives of Florence of 1324-1326, already referred to, and a distinct allusion to balls of iron and of lead occurs in the *Practica* of John Anderne, *temp.* Edward III.:—*C'est poudre vault à gettere pelotes de fer, ou de plom ou d'areyne, ove un instrument qe l'em appelle gonne.*¹⁴¹ Balls of lead are referred to in a document of 1345¹⁴² quoted in the *Etudes*. Moulds (*formes*) of laton, iron ladles, and pincers often appear in accounts. The *Pipe Rolls of the Exchequer* of 1351 mention leaden balls. Small cannon balls were cast by Johann von Arau at Augsburg in 1372, and by Ulrich Becham at Memmingham in 1388. Mention of cast-iron balls occurs in the Swiss records of 1495-1499.¹⁴³

Favé, quoting from the accounts of the dukes of Burgundy, mentions, under the year 1451, that a waggon, drawn by six horses, conveyed three stone shot from Namur to Luxemburg; each weighing about 900 livres. At this period the weight of cannon in relation to

¹⁴⁰ Red sulphuret of arsenic.

¹⁴¹ *Sloane MSS.* 335, 795.

¹⁴² In the National Library, Paris.

¹⁴³ *Archives, etc., du Canton de Freiburg*, 1900.

their projectiles varied greatly. The proportion was more generally about 50 to 1 ; but it sometimes went down to as low as 25 to 1.

The invention of red-hot shot is often ascribed to Franz von Sickingen in 1525, but they were used as early as 1452, when the Gantois besieged Oudenarde.¹⁴⁴ The *Tower Return* of 1559 schedules 'cannon shot, cross-barred shot, and shot of stone,' and an inventory of the shot carried by the 'Eliza Bonadventure,' of 1575, schedules 'cross-barred shot, jointed shot, bare shotte of yron, hollow shot of lead, and stone shotte polished, and for fowlers roughe.' Iron balls were sometimes covered with lead, presumably to minimize the damage caused to the inner tube of the gun by friction. By this time the great majority of shot in use was made of iron ; still stone balls were retained for certain classes of guns, such as fowlers and peteraras. A return of shot in the Tower and aboard her majesty's ships, of the year 1578, taken from a curious collection of papers published by Francis Peck, M.A., in 1732, is as follows :—

In the Tower.

Cross-backed and iron shot, round and of several heights	...	47,000
Stone shot for cannon pieces, port pieces and fowlers	... ..	45,000

Aboard the Ships.

Iron shot	... ..	100,000
Stone shot	... ..	1,300

The whole amounting in money value to £5,475.¹⁴⁵

Nails and pieces of chain were sometimes employed as projectiles, but they often blocked the gun or caused it to burst. Boxes containing two or three hundred bullets, and missiles of an incendiary nature were also used in the sixteenth century.

Grenades are referred to in the Arabian treatise of the thirteenth century, written by Hassan Abrammah, wherein are mentioned balls of pottery or glass filled with a fiery mixture and thrown by hand ; and fire pots were employed at the siege of Harfleur in 1415. Valturius, writing in 1472, gives a figure of a hinged shell, but it is uncertain whether this hollow ball was made to contain Greek fire for incendiary purposes or was filled with an explosive mixture for bursting the shell itself into fragments. This latter supposition would seem to be the most likely. Père Daniel, writing in 1537, mentions grenades.

¹⁴⁴ *Chron. de S. de Lalain*, chap. 81.

¹⁴⁵ *Proceedings of the R. A. Institution*, vol. ii. p. 359.

In Stowe's *Annales* there is a reference to great preparations made in 1543 'for a war with *Fraunce*, and that one Peter Band, a Frenchman borne, a maker of Ordnance, and one other alien called Peter van Collen, a gunsmith, both the king's feed men, devised certain mortars, being at the mouth from eleven inches unto nineteen inches wide, for hollow cast yron shot, to be stuffed with fire-worke or wild fire, whereof the *bigger sorte* had screws of yron to receive a match to carry fire kindled, that the fier-work might be set on fire *for to break in small pieces the same hollow shot*, whereof the smallest piece hitting any man would kill or spoyle him.' Here we have the mortar and bomb. The *bigger sorte* discharged a shell upwards of a foot and a half in diameter.¹⁴⁶ The invention of the bomb is generally attributed to an artisan of Venloo in 1588, and Strada mentions this. It evidently existed, however, in one form or other, much earlier.

There is a hand mortar at Woolwich for discharging grenades from the breast or shoulder, probably dating from about the end of the sixteenth century, fired by a wheel-lock, calibre $2\frac{3}{8}$ in., length $2\frac{1}{4}$ ft.; and one formerly at Goodrich court, figured by Skelton, which has both a match-lock and a wheel-lock; indeed, weapons with the two locks are by no means rare. All the gun-locks we are accustomed to associate with handguns were sometimes used with ordnance; they were fixed to the vent-field by pins passing laterally through it or by side-screws. Père Daniel states that a petard was used by Henry IV. of France in 1579.¹⁴⁷

The art of the smith having made considerable progress, much better results were obtained. Long serpent guns were made with the idea of materially increasing the range, but as experience failed to bear this out, shorter pieces were reverted to. It must be borne in mind that improvements in ordnance, like changes in dress and in armour, took some time to travel, and the same standard of progress did not prevail in all countries alike; still, the constant state of warfare and preparations for war that characterised fourteenth and fifteenth century times, and even later, did much for a rapid assimilation of results among the nations of England, France, Italy, Flanders, Germany and Spain.

¹⁴⁶ *Archaeological Journal*, vol. xxiii.

¹⁴⁷ Grose, *The English Army*, etc., vol. i. p. 409.

It is impossible to classify, or even to identify, all the descriptions of cannon mentioned, for the names when referred to in chronicles are so often mixed up with those of mechanical engines, and the difficulty is intensified by reason of the practice of giving the guns nicknames, such as 'the Dirty Maid,' and 'Mons Meg;' and such guns are often alluded to in the records of the period by their popular *sobriquets*. In England we had bombards, mortars, curtalles, serpentine, slyngs,¹⁴⁸ culverins, demi-culverins, fowlers, falcons, falconets, and sacres,¹⁴⁹ the last three kinds mentioned being field guns; two, four, six and a half, and eight pounders; the heavier ordnance being siege and position pieces. In France the varieties were fewer in number: *bombards, basilisks, spirales, veuglairs,*¹⁵⁰ *mortiers, bombardelles, crapaudaux,*¹⁵¹ etc., were the designations of various pieces of artillery.

The ordnance books of Maximilian I., mention the following varieties, viz:—*scharfmetzen, basiliskus, vierteilbüchsen, singerinen, grosse schlangen, feld, or mittel, schlangen, haufnützen, falconetein, kammerschlangen, dorndrell or terrasbüchse, mörser and kleine mörser (lerchlein),* etc. No calibres are given. So many pieces of different weights and calibres, placed on clumsy carriages, made any effective employment of ordnance, in the open country, very difficult, and in fact it long continued a mere adjunct, rather than a component part of an army in the field. The carriages had no gun limbers, they were usually two wheeled, with wooden axle-trees, and were subject to frequent mishaps and breaks-down. The ammunition, the implements, and the tools, were carried in separate carriages. It was, therefore, only slowly and laboriously that the artillery train could follow the movements of an army. The gun was washed out with a mixture of water and vinegar after each shot; and eight to ten shots were fired in an hour.

It was in Germany, during the reign of Maximilian I. (1493-1519), when the most surprizing developments in artillery, and what was of scarcely less importance, the improvement of *personnel*, and means of transport, took place, under the guidance of the master of ordnance, Bartholmaus Freysleben. Maximilian and his advisers assimilated, and improved upon everything new from abroad, and especially from Italy, at that time constantly engaged in warfare.

¹⁴⁸ Snakes.¹⁴⁹ Hawks.¹⁵⁰ Fowlers, see Appendix, Nos. 20 and 37.¹⁵¹ Appendix, No. 39. *Crapaud*, a toad.

Field ordnance, as well as gun carriages, began to be made much lighter, and more mobile in every way ; horses were more generally used, especially for field guns, instead of oxen ; indeed the German short serpent gun was now drawn by a single horse.

Kings Henry VIII. and Francis I. also exhibited great energy in this direction, giving personal attention to details and improvements in ordnance, as well as in weapons and armour generally ; indeed much was achieved during the period covered by the reigns of these three remarkable monarchs, animated as they were by the rising tide of the renaissance, which made itself felt in all directions.

Tartaglia,¹⁵² a distinguished Italian mathematician, who wrote on gunnery, but without any practical knowledge of the subject, gives tables of the cannon used in the reign of Henry VIII. He defines the laws regulating the flight of projectiles, and devised the gunners' quadrant. Tartaglia dedicated his *Three Books of Colloquies concerning the Arte of Shooting* to king Henry ; and made the first practical attempt to base the theory and practice of gunnery on certain definite principles. He pointed out that a shot on leaving the gun could not proceed any distance in a straight line, and that the higher the velocity of the projectile the flatter the trajectory.

Many of the improvements and inventions of this period, some of them obviously tentative, were for long supposed to have been the work of very much later times ; but a number of the guns preserved got no further than the experimental stage.

Very large pieces, for fortress work and position purposes, continued in use over this period, one the 'Basiliscus,' made by Humphrey Walker for king Henry VIII.,¹⁵³ discharged a shot 75 pounds in weight. Sir Robert Wingfield, writing to king Henry from Vienna in 1515, says : 'The Emperor (Maximilian I.) gave the king of Bohemia a bombard which was carried to the water by thirty horses,'¹⁵⁴ and the Venetian ambassador reports to his government that king Henry possessed a bombarde, *colbren* or *postell*, as requiring thirty-six to forty horses, and sixty to eighty labourers assisting them, to

¹⁵² *La Nuova Scientia inventa* in 1537 ; *Quesiti e Inventioni diverse*, Venice, written 1546.

¹⁵³ *Archaeologia*, vol. li. p. 227.

¹⁵⁴ *Archaeological Journal*, vol. lix. p. 78.

draw it.¹⁵⁵ A contemporary account of the battle of Flodden (9th September 1513), states that the Scottish army 'was enclosed in three parties, with thre great mountaynes soe that ther was noe passage nor entre vnto hym but oon waye wher was laied marvelous and great ordnance of gones, that is to wit, v great curtalles, ij great colveryns, iiij sacres, and vi great serpentynes, as goodly gones as have bene sene in any realme, and besides there wer othir dyvers small ordenances.'¹⁵⁶ The guns now in the Tower probably include some of these pieces. In the same year the complement of artillery for the army for France was five hundred guns.¹⁵⁷

Early in the reign of Henry VIII. large quantities of ordnance were being drawn from abroad, and especially from Flanders, and many wrought-iron and brass guns, varying from 1,170 to 3,979 pounds, were ordered from maitre Hans Van Neürwerk, surnamed Poppen Ruyter, of Malines, in 1512, for the French war, and among them were 'the twelve apostles,' pieces of great calibre. The weight of the shot for ordnance of about this time was as follows: 'Each Apostle, twenty pounds; Curtow, sixty pounds; Culverin, twenty pounds; Lizard, twelve pounds; Bombard, two hundred and sixty pounds; Minion, eight pounds; Potgun, eight pounds.'¹⁵⁸ Later, king Henry would seem to have sought the assistance of foreign artisans for working in England in this branch as well as in that for forging body armour, for we find the names mentioned of Peter Baude,¹⁵⁹ a Frenchman 'borne,' casting guns at Houndsditch in 1525; Peter von Köln¹⁶⁰ and Franciscus Arcanus from Italy¹⁶¹; Englishmen like John, Robert and Thomas Owen,¹⁶² Ralph Hogge, Master Hugget, Humphrey Walker and others were making cannon in Henry's reign, and the king was having ordnance founded in the Tower itself.

The importation of cannon from abroad continued, however, for

¹⁵⁵ *Archaeologia*, vol. li. p. 225.

¹⁵⁶ *Proceedings of the Society of Antiquaries of Scotland*, vol. vii. p. 146.

¹⁵⁷ *Archaeological Journal*, vol. lix. p. 77.

¹⁵⁸ *Archaeologia*, vol. li. p. 262.

¹⁵⁹ A gun in the Tower is inscribed with the date 1520; and 'Petrus Baude Gallus, operis artifex.'

¹⁶⁰ The Peter van Cullen mentioned in Stowe's *Annales*.

¹⁶¹ Appendix, Nos. 7 and 9.

¹⁶² Appendix, Nos. 8 and 12.

in 1545 strong remonstrances were addressed by the French ambassador to the emperor Charles V., against the succours of arms and ammunition that were being rendered to England from Flanders.

Early in the reign of the emperor Charles V., Georg Löffler of Augsburg, did much to reduce the construction of ordnance to a system, and he and Georg Hartmann of Nuremberg instituted a standard for three sizes of larger guns. Cannon were 40 and 12; 'schlangen,' 24, 12, and 6; and 'falkens' $6\frac{1}{2}$ and 3 pounders respectively, the weight being reckoned on a stone basis; and the ranges were determined. Charles had a dozen cannon cast at Malaga in 1533: length, 18 calibres; weight about 33 cwt.; thickness of walls was $\frac{3}{8}$ of the calibre, at the barrel mouth; $\frac{5}{8}$ at the first reinforce; and $\frac{7}{8}$ at the second reinforce; the position of the trunnions was fixed at $\frac{1}{3}$ of the total length from behind. Diego Ufano¹⁶³ gives the particulars and measurements of the cannon, and he lays down the proportion of guns to an army, viz.: 24 heavy and 6 light guns to a corps of 6000 horse and 34,000 foot. Like the guns ordered by Henry VIII. from Poppen Ruyter of Malines, these Malaga cannon were named 'the twelve apostles.'

The Brander MS. is an inventory, taken at the beginning of the reign of Edward VI., of the ordnance and munition at the Tower, the ordnance and munition at various 'bulwerks' and castles in England, and the English possessions in France, the ships and their armament, the armoury at Westminster, and the armoury at Greenwich. Among the bulwerks and castles are mentioned Wark, Holy Island, Alnwick, Berwick, and Newcastle. The MS. also schedules jewels, glass, plate, etc. The ordnance and munition is that collected during the long and epoch-making reign of Henry VIII. This MS. was presented to the Society of Antiquaries of London by Gustavus Brander, esquire, F.S.A., in 1775. Selections are printed with viscount Dillon's notes in 'Arms and Armour at Westminster, the Tower, and Greenwich, 1547,'¹⁶⁴ and among these is the 'Ordinance Artillery' in the Tower of London, consisting of 64 guns of brass, and 351 of iron; and concerning the various classes of these some remarks are made in

¹⁶³ *Tratado dela artilleria, y uso della platicado, en las guerras de Flandes*, Brussels, 1613.

¹⁶⁴ *Archaeologia*, vol. li. p. 218.

Archæologia. Some of the guns mentioned in the inventory of 1547 have been identified with those now in the Tower and at Woolwich, and this would doubtless have been the case with a greater number but for the damage wrought by the Tower fire in 1841. The following passage has been copied from lord Dillon's notes :—¹⁶⁵

" In Elizabeth's reign, according to sir William Monson,

The cannon	weighed 6000 lbs., with a shot of 60 lbs.
„ demy-cannon	„ 4000 „ „ „ 33½ „
„ culverine	„ 4500 „ „ „ 17½ „
„ sacre	„ 1400 „ „ „ 5½ „
„ minion	„ 1000 „ „ „ 4 „
„ fawcon	„ 660 „ „ „ 2 „
„ demy-culverine	„ 3400 „ „ „ 9½ „
„ fawconnet	„ 500 „ „ „ 1½ „
„ robynett	„ 300 „ „ „ ½ „

Towards the middle of the sixteenth century, the French artillery, the most simple in Europe, consisted of six different calibres, the projectiles of which weighed, respectively, 33¼ lbs., 16¼ lbs., 8¼ lbs., 2½ lbs., 1½ lbs., and three 'quartenons.'¹⁶⁶

The following account of the ordnance in the Tower, taken on 13th September, 1559, appears in *Archæologia*, vol. xxxvii. page 480:—
'The store of all sorts and kinds of ordnance in the Tower, and a memorial of what was required for the next year':—

BRASSE ORDNANCE FOR THE FIELD.

THE STORE.	THE PROVISIONS TO BE NEW BOUGHT.
Canons mounted 7	To be new made 13
Demi canons ¹⁶⁷ 13	„ „ 4
Culverings 14	„ „ <i>nil.</i>
Demy culveryns 13	„ „ 7
Sacres 38	
Mynions 7	
Fawcons 30	
Fawconetts 5	„ „ <i>nil.</i>
Connemorters 2	
Baces 4	
A piece shooting 7 bullets ¹⁶⁸ ... 1	

134 pieces.

Total required 24

¹⁶⁵ Page 262, note.

¹⁶⁶ United Service Journal, 1853, page 577.

¹⁶⁷ A brass demi-cannon, culverin, sacre, and minion may be seen at the Rotunda, Woolwich. See Appendix, Nos. 8, 9, 10, 13.

¹⁶⁸ Probably an orgue.

Eleven pairs of horses were required for a field cannon, and seven or eight pairs for a demi-cannon.

It would seem that the calibres of the guns did not differ greatly from the cast S.B. ordnance of the first quarter of the nineteenth century.

The casting and making of the 24 new pieces of brass would cost £483 10s.

BRASS ORDNANCE, MOUNTED FOR THE 'ELIZABETH JONAS,'
AND OTHER SHIPS.

'Demi-canons, 8; canons pereares, 6; culverings, 3; demi-culverings, 5; fawcons, 2; to be new made, *nil*.'

CAST-IRON ORDNANCE.

'Demi-canons, 2; culverings, 2; demi-culverings, 12; sacres, 8; to be new made, 10; mortar piece, 1; fawcons, *nil*; to be new made, 12.'

The estimated cost for the 22 new pieces was £128. The cast iron cost only 10s. per cwt., while the brass was three pounds and ten shillings per cwt.; and it was on this account that one half of the new ordnance was proposed to be made of cast iron.

'Bombardes, 3; porte peces, 66; slings, 6; ¹⁶⁹ demi-slings, 36'; no new required.

FORGED ORDNANCE OF IRON.

'Quarter-slings, 6; fowlers, 43; baces, 137; harquebutts a croche, 80; harleshotte pieces, 80; harleshot pieces upon mytches, 5'; no new required.

The armament of the 'Eliza Bonadventure' is shown in the *Surveye of the Queene her Ma^{tyes} Shippes taken and viewed by The Officer of Th'ordnance*, 25 Jan., 1575,¹⁷⁰ is as follows, viz. :—

2 demi-canons.	2 fawcons.
2 canon piriars.	1 fowler, with two chambers.
6 culverings.	3 port-peeces of forged iron, with two chambers apeece.
10 demi-culverings.	4 fowlers of forged iron, with like chambers.
8 sacres.	
2 minions.	

In all 40 pieces of ordnance.

¹⁶⁹ Serpent guns.

¹⁷⁰ *Archaeologia*, vol. xxx. p. 324.

For these guns there was a great variety of shot on board, 868 balls in all, of which 759, 87, and 72 of iron, lead, and stone respectively, a tolerably clear indication that stone shot was rapidly falling into disuse. The more accurately dressed balls (polished, as it stands in the inventory), were used for the canon piriers, while presumably the coarser balls were for the port-pees and fowlers (roughe).

Pirier is a name handed down from the mechanical engine *pierrier*, and this kind of cannon impelled its projectile with a low charge of powder, so low, indeed, that these pieces were sometimes fixed as swivel guns without any provision for the recoil. Robynetts, mentioned as late as the reign of queen Elizabeth, afford another instance of this inheritance of names from mechanical engines.

In 1560, there were state armouries at Portsmouth, Southsea castle, Berwick, Hull, and Newcastle-upon-Tyne, besides the tower of London and Greenwich.

The *Kriegsbuch* of Leon. Fronsperger,¹⁷¹ with wood engravings by Jost Amman, gives much information of the German ordnance of his time.

In 1574 the names of English ordnance are commonly¹⁷² :—

Names.	Weight.	Diameter.	Weight	Scores of	Charge of	Height of
	Lbs.		Lbs.		carriage.	powder.	cullet.
		Inches.			Lbs.	Inches.
Robinet ...	200	1 $\frac{1}{4}$	1		$\frac{1}{2}$	1
Falconet ...	500*	2	2	14	2	1 $\frac{1}{4}$
Falcon ...	800*	2 $\frac{1}{2}$	2 $\frac{1}{2}$	16	2 $\frac{1}{2}$	2 $\frac{1}{2}$
Minion ...	1,100*	3 $\frac{1}{4}$	4 $\frac{1}{2}$	17	4 $\frac{1}{2}$	3
Sacre ...	1,500*	3 $\frac{1}{2}$	5	18	5	3 $\frac{1}{4}$
Demi-culverin ...	3,000*	4 $\frac{1}{2}$	9	20	9	4
Culverin ...	4,000*	5 $\frac{1}{2}$	18	25	18	5 $\frac{1}{4}$
Demi-cannon ...	6,000*	6 $\frac{1}{2}$	30	38	28	6 $\frac{1}{4}$
Cannon ...	7,000*	8	60	20	44	7 $\frac{3}{4}$
E cannon ...	8,000	7	42	20	20	6 $\frac{3}{4}$
Basiliske ...	9,000	8 $\frac{3}{4}$	60	21	60	8 $\frac{1}{4}$

In 1599, according to an ordnance return, those of the above descriptions of guns marked with a star were used in the navy; and besides these were Port-piece hull, and chambers; Fowlers hull, and chambers; besides Curtalls.

¹⁷¹ Frankfort, 1573.

¹⁷² *Proceedings of the Royal Artillery Institution*, vol. ii. p. 354.

There is another tower inventory of June, 1578.

Cannons, etc., remaining in store	...	...	...	...	104
Brasse ordnance remainyng aboorde the shippes	...	...	...	...	504
				M. C. XX.	
..... Amounteth in money	lvij	vij	iiij	vj ^{li} .	

Shot. In the Tower :—

Crossebarred and rounde shott of iron of severall heightes	47,000
Stone shott for canon piriars, portpeces, and fowlers	4,500

Abord the Shippes :—

Iron shott	...	...	...	...	10,000
Stone shot	...	...	...	...	1,300
Amountinge in money to the some of 5,475 ^{li} .					

Powdre, and Stuffe for Powdre. In the Tower :—

Corne and serpentine powdre...	...	...	...	55 lasts
Saltpeper	...	...	...	10,000 weight
Sulphur	...	...	...	20,000 "

Aboorde :—

Corne and serpentyne powdre, di.	...	...	...	last
Amountinge in money to the some of 6,617 ^{li} 10 ^{ss} 17 ³				

Sir James Turner, writing in *Pallas Armata* in 1670, remarks that a culverin that shot 16 pounds of iron had but a hundred pounds of metal allowed for every pound of her shot, and so she weighed then but 1,600 pounds, but now and long before this, she weighs 4,300 pounds, and consequently hath the allowance of near 270 pounds of metal for every pound of her shot.'

After the close of the sixteenth century, French ordnance, which continued the most simple in Europe, was as follows :—

Description.	Length of gun.		Weight of projectile.
	Ft.	In.		Lbs. Oz.
Cannon	10	0	33 8
Culverin	11	0	12 8
Bâtarde	9	6	7 8
Moyenne	8	2	2 12
Fawcon	7	0	1 8
Fawconneau	5	4	0 14 ¹⁷⁴

¹⁷³ *The Egerton Papers* (12 Camden Soc. publ.), pp. 68-69.

¹⁷⁴ Errard, *La Fortification*, 1620.

The following table is extracted from a work dedicated to the duke of Buckingham by Robert Norton, engineer and gunner, in the year 1643¹⁷⁵ :—

Names of the pieces.	Height of bore. Inches.	Length in diameters.	Weight in metal. Lbs.	Weight of powder. Lbs.	Length of the ladles. Inches.
Cannon of 8	8	15	8,000	40	24
Cannon of 7	7	16	7,000	25	22
Demi-cannon	6½	18	6,000	20	21
Culvering	5½	28	4,500	15	20
Demi-culvering	4½	32	2,500	9	18
Saker	3½	36	1,500	5¼	16
Minion	3¼	30	1,200	3	15
Falcon	2¾	42	700	2½	14
Falconet	2¼	48	500	1¼	12
Cannon-perior	9, 10, 12	8	3,500	3, 3½, 4	3
Demi-can, drake	6½	16	3,000	9	4½
Culvering, drake	5½	16	2,000	5	4½
Demi-culvering, drake	4½	16	1,500	3½	4½
Saker, drake	3½	18	1,200	2	4½

The lighter guns, such as falcons, falconets and sakers, were generally used for field service, while the heavier cannon and culverings were for siege or position purposes.

Specimens of early ordnance may be seen in many of the large collections of arms and armour in Europe ; in England notably in the Tower of London and in the museum of artillery in the Rotunda, Woolwich. The great continental museums and arsenals, such as those at Paris, Vienna, Berlin, Brussels, Dresden, Copenhagen, etc., contain examples of most of the many varieties of cannon of the fourteenth, fifteenth and sixteenth centuries ; and quite a number of the guns taken by the Swiss in their struggle with the Burgundians, under Charles the Bold, may be seen in the museums and at other places in Switzerland.

Some examples of the more distinctive of the earlier guns spread over some of the arsenals and museums of Europe are noticed in the appendix to these notes.

¹⁷⁵ *Minutes of the Proceedings of the Royal Artillery Institution*, vol. ii. p. 373.

APPENDIX.

THE MUSEUM OF ARTILLERY IN THE ROTUNDA, WOOLWICH.

1. A wrought-iron *bombard*, said to have been found in the moat at Bodiam castle, Kent. This gun is lined with cast-iron, and probably dates from late in the fourteenth century. The *Official Catalogue*, prepared by order of the Secretary of State for War, under the direction of the Committee of the Royal Artillery Institution, printed in 1889, gives the following particulars: 15 inch bombard, for throwing stone shot of about 160 pounds weight; calibre, 15·1 inches; interior diameter of chamber, 3·4 inches; length of chamber, 14·0 inches; capacity of chamber, about 3·5 pounds; length of chase, 34·0 inches; present weight, 6 hundredweights.

2. Wrought-iron cannon. Length, 24 inches; calibre, about 2 inches. It is without trunnions or cascabel, but has two rings for raising it.

3. Fragments of a *double cannon* were found in the same place as the last mentioned piece; the weapon had probably been originally about 10 feet in length, with a breech in the centre, and a barrel running in two directions; calibre, about 3 inches.

4. Wrought-iron *serpent* gun of the reign of Henry VI. (1422-1461). It is in excellent preservation, with two rings for raising it. Original length, 7 feet 6 inches; calibre, 4·25 inches; weight, 8 hundredweights. This gun affords an early example of trunnions, which are 3¼ inches long and 4 inches in diameter.

5. A breech-loading *petevaya* of Edward IV. (1461-1483), made of longitudinal bars of iron, hooped together with iron rings. The chamber with lifting handle is complete. Length, 3 feet; calibre, 2·5 inches; weight, 1 hundredweight 13 pounds.

6. Wrought-iron breech-loading gun and carriage. Recovered in 1836 from the wreck of the 'Mary Rose,' which sank off Spithead in 1545. Original calibre, about 8·0 inches; length, 9 feet 8 inches. The carriage, which is original, is grooved on the under side, to slide on a directing bar.

7. A brass *saker*, of the reign of Henry VIII., with the maker's name, 'Franciscus Arcanus,' inscribed on the chase. The external shape of the gun is twelve-sided. Length, 7 feet 11 inches; calibre, 3·92 inches, or that of a seven-pounder.

8. Another brass *saker* of the same reign, inscribed with the date and names of the makers, 'Ihon and Robert Owyn, bretheryn, made thys sacar, weying 1212. Anno Dni. 1538.' Length, 7 feet 9 inches; calibre, 3·75 inches.

9. A brass *culverin*, 1542, 'Arcanus de Arcanis Cesenen, fecit.' Length, 10 feet 11 inches; calibre, 5·20 inches; weight, 43 hundredweights 25 pounds.

10. A brass *demi-cannon*. Length, 11 feet; calibre, 6·4 inches; a thirty-two pounder.

11. A brass *culverin-bastard*. It is twelve-sided, 8 feet 6 inches long; calibre, 4·56 inches.

12. A brass *cannon royal*, inscribed with the name John Owen. Length, 8 feet 6 inches; calibre 8·54 inches.¹⁷⁵

¹⁷⁵ Nos. 10, 11, 12, were recovered from the 'Mary Rose.'

13. A brass *minion*, inscribed 'John and Thomas Mayo, brethren, made this pece, Anno Dni. 1554.' Length, 7 feet 6½ inches; calibre, 2·875 inches.

14. A brass *culverin*, inscribed 'Henri Pit made this pece, 1590, No. 4, 18 pr.' Length, 8 feet 6 inches; calibre, 5·57 inches.

15. Two cast-iron guns (1509-1547), both brought from Ireland. Dimensions of both: length, 10 feet; calibre, 6 inches; weight of one, 53 hundredweights 14 pounds, and of the other, 53 hundredweights 6 pounds.

16. A cast-iron gun of the same period, raised out of the Medway near Chatham. Length, 8 feet 9 inches; calibre, about 3·75 inches.

17. A gun formed of a cylinder of copper, surrounded with hempen cord, and enveloped in leather. Length, 6 feet 5 inches; calibre, 2·17; weight, about 1 hundredweight 7 pounds.

LE MUSÉE D'ARTILLERIE, PARIS.

18. Cannon, late fourteenth century; movable chamber; total length, 0·85 m. A tail piece has been nearly rusted away.

19. Cannon, of the beginning of the fifteenth century, of similar type but in better condition. The junctions of the outer covering, which is composed of six hoops, are covered by rings. Calibre, 0·055 m.

20. Veuglaire, first half of fifteenth century, without trunnions. Calibre, 0·182 m. Found in the old fortifications of Rennes.

21. Bombarde, second half of fifteenth century; with trunnions. Chamber, 20 centimètres deep, by 8 and 10 in diameter; barrel composed of 20 to 24 bars, much rusted away.

22. A ship falconet, similar to those in the castle of Newcastle-upon-Tyne.

23. Bronze cannon, of the second half of the fifteenth century; calibre, 0·072 m.

24. Large gun, of the end of the fifteenth century; apparently forged in one piece; calibre, 0·22 m.

25. French cannon, of the second half of the fifteenth century; inscribed as being cast in 1478, by Jehan Chollet, chevalier maître de l'artillerie. The piece has trunnions, and weighs 1,603 kilogrammes; length, 2·24 m.; calibre, 0·245 m.; diameter of trunnions, 0·180 m. It came from the Isle of Rhodes, and bears an Arabic inscription, placed there after the conquest of the island.

26. Serpentine of forged iron, with trunnions; close of the fifteenth century.

27. Hand coulevrine, of the second half of the fifteenth century. It was served by two men, one of whom supports the stock on his shoulder, while the other aims and discharges the piece. It is fixed to a wooden stock, with iron hoops, like a bombardelle. Length, 0·77 m.; calibre, 0·025 m.

28. Coulevrine, of the end of the fifteenth century; length, 1·035 m.

29. Bombarde of bronze, of about the same date, inscribed *Petrus Aubusson, M. Hospitalis Jerusalem.* Weight, 3,325 kilogrammes. The granite shot with the piece is 0·568 m. in diameter.

30. Large coulevrine of the commencement of the sixteenth century. Weight, 3,343 kilogrammes; calibre, 0·165 m.; length, 5·40 m. The ball would weigh 24 to 30 livres.

31. Quarter cannon, of the reign of Francis I.; calibre, 0·18 m.

32. Cannon of same reign; calibre, 0·110 m.

33. Bronze coulevrine of the same reign; calibre, 0·083 m.

34. Bronze fauconneau of the same reign.

35. Arquebuse à croc, of iron ; end of fifteenth century.

36. Bronze bombarde (German) ; inscribed in German, of which the following is a translation : *My name is Catharine : mistrust thou my contents : I punish injustice. Georg Endorfer cast me. Sigismund, arch-duke of Austria, anno 1404.* Weight, 4,597 kilogrammes ; calibre, 0.390 m. ; length, 3.65 m. This cannon came from Rhodes. It has handles and an apron over the vent.

THE PORTE DE HAL MUSEUM AT BRUSSELS.

37. A *Veuglaire*, with chamber ; of wrought iron strengthened with rings. Calibre, 0.19 m. ; length, 0.74 m. Fifteenth century. The gun-carriage is a reconstruction.

38. A *Bombardelle*. Calibre, 0.13 m. ; length, 1.30 m. Fifteenth century. Found at Courtray in 1882, at the demolition of an old bridge.

39. A *Crapaudeau* ; muzzle-loader of the first half of the fifteenth century. Calibre 32 mm. ; length, 1.03 m. It is a small iron tube, mounted in a thick piece of wood, which stands on a small square block, with side handles for transportation. The mounting is a reconstruction.

40. A *Couleuvrine*, breech-loader, first half of fifteenth century. Calibre, 0.045 m. Found at Luxemburg during the demolition of part of the rampart. It has a ring for hoisting.

41. A *Serpentine*, fifteenth century. Calibre, 0.04 m. ; length, 1.38 m. The piece is strengthened with 17 rings. The carriage has been reconstructed from an old print.

42. A *Fauconneau de marine*, early sixteenth century, breech-loader, turns on a swivel. Calibre, 0.035 cm. ; length 1.31 cm. The tail is bent, with a knot at the end.

DAS KÖNIGLICHE ZEUGHAUS ZU BERLIN.

43. A reconstruction from an old drawing of a short bombard of the end of the fourteenth century.

44. A breech-loading, wrought-iron cannon of the fifteenth century, strengthened with 25 iron rings. Present length, 245 cm. ; diameter of bore, next the chamber, 6, 5, and near the muzzle, 6 cm. Part of the barrel is fractured, and the breech-block is missing.

45. A cast-iron, breech-loading gun, of early fifteenth century date. Calibre, 15.5 cm. ; length, 91 cm.

46. A cast-iron breech-loader, 99 cm. long, with trunnions ; fifteenth century.

47. A wrought-iron muzzle-loader, with trunnions ; 238 cm. long. Fifteenth century.

48. A *Hakenbüchse*. Total length, 204 cm. ; length of barrel, 117 cm. ; calibre, 2.8 cm. ; fifteenth century.

49. A short *Kammerschütz*, with carriage ; fifteenth century. A great, wrought-iron mortar, strengthened with 14 rings—the first ring carries the trunnions. Calibre, 33 cm. ; fifteenth century.

50. Two small, bronze mortars ; fifteenth century.

51. An *Orgelgeschütz*, with 5 octagonal barrels ; fifteenth century.

52. A *Falconet* by Gregor Loeffler, about 1544 ; calibre, 7.5 cm.

53. A *Serpentinellen* of 1586, by Hans Christoph Loeffler, 1586.

IN TÓJHUSET, COPENHAGEN.

54. Several Bombarder or Skjœrmbroekkere, with breech blocks, Skerpentiner or Barser, all early pieces.

55. A Feltslange, 23½ Fod lang; 14-pounder, Danish. Ornamented with the arms of Oldenburg. Further inscribed: 'Antonius Grave tho Oldenborch und Dalmehorst heft mi lote gete'; and an account of Samson's fight with the lion: 'De starcke Samson min Name is Ick schete geweltiglick und kame gewis. Anno Domini MDLVIII Iar. Do got mi Matias van Norenbarch. Dat is var.'

THE ARSENAL, DRESDEN.

56. A Bombard, late fifteenth century; calibre, 14 inches; carriage of later date. It is called, *Die faule Magd*.¹⁷⁷

THE ROYAL ARMOURY, MADRID.

57. A Dragonneau, cast at Liège in 1503. Double-barrelled breech-loader. A most artistic piece of work.

HERRES MUSEUM, VIENNA.

58. A mortar, first half of fifteenth century. Calibre, 88 cm.

59. A mortar, second half of fifteenth century. Calibre, 31 cm.

60. Kammerschlange, fifteenth century. Calibre, 14 cm.; length of bore, 470 cm.

61. Falconet, early sixteenth century. Calibre, 6.5 cm.; length, 233 cm.

62. Small mortars (Böller), cast by Hans Penden, Siegen, 1538.

63. Small serpentines (Serpentineleins), by H. Chr. Loeffler, 1579.

64. Viertelschlange (Falken). Calibre, 10.5 cm., by H. Chr. Loeffler, 1583.

65. Schlange of the Republic of Ragusa, 1505, cast by Johann Baptist von Arbe. Calibre, 13 cm.; length, 449 cm.

¹⁷⁷ The dirty maid.