

Fitting round pegs into square holes?

Did Balduin of Luxemburg, Archbishop of Trier use gunpowder artillery in the siege of Eltz castle 1331/33 ?

An analysis by Klaus Leibnitz

Abstract: This paper analyses a theory which attempts to show that a Loshult gun like artillery piece was used in Germany at the siege of Eltz castle in 1331/3.

Keywords: Medieval gunpowder , artillery, gun arrows, Loshult cannon, Milemete codices

1. Introduction

This paper is intended to stimulate further research into the very interesting topic of early gun arrows. The reason for presenting it is the publication of a series of articles by Wilfried Tittmannⁱ, in which a separate section is devoted to the postulated artillery of Balduin of Luxembourgⁱⁱ, Archbishop of Trier, and which contains some conclusions with which we disagree.

It is an undisputed fact that the first illustrations of gunpowder weapons in Europe appeared in the Milemete codicesⁱⁱⁱ, which can be precisely dated to 1327^{iv}. About their actual size there are many dissenting opinions, but as to their missiles there are none i.e. they are shown to shoot arrows.^v

After these illustrations there is a gap of about 70 years before new pictures of guns can be found^{vi}. During this period the more or less ineffective firearm as well as the gunpowder used in them had matured and developed along two completely different lines. On the one hand the gun developed into the small *Handbüchse* or hand gun and on the other hand in to the large *Steinbüchse* or bombard.

Gunpowder also improved further. From the simple, inefficient rough^{vii} mixed fine-grained so-called meal gunpowder it developed into the wet-mixed *Knollenpulver* or grained powder and it was soon found by trial and error that a ratio of saltpetre to sulphur to charcoal of 6 : 1 : 2 was the most efficient mixture, a ratio which has remained almost unchanged to this day.

As far as projectiles were concerned the small handguns fired small lead- or respectively iron hail shot, depending upon the diameter of the bore. The larger guns fired stone shot as well as other forms of ammunition such as scrap-iron and pebbles.

And both could and did shoot arrows

At present it is unknown when the use of arrows as projectiles for guns fell in disuse, if it was ever widespread. In the early gunnery manuals, the so-called *Feuerwerkbücher*,^{viii} dateable to

1370 – 1500, there are definite instructions as to what sort of projectiles were to be fired from guns, they fired spherical stone shot.

Charles V's three-barrelled wheel lock pistol of c. 1540 preserved in the Armeria Reale in Turin which fired steel darts instead of lead balls is an unique piece, an oddity.

Nevertheless, most of the early gunnery manuals also contain information how to shoot arrows, rods or stakes from guns, though this is missing from the later copies and seems to have stopped being recorded by about 1450.^{ix}

However, by the year 1400 two distinctly different types of guns had developed side by side, the small bronze handgun of *Tannenberg* type firing exclusively lead shot and the bombard which fired stone shot of large diameter.^x

2. The Eltz Gun Arrow Theory

As already mentioned, in 1994/5 a German researcher, Herr Wilfried Tittmann tried to show in a series of publications that the early guns were arrow-shooting weapons and developed from fairly small pieces, a theory not wholly unreasonable and in a broad sense most likely to be correct.

But how small is small? And did these guns only shoot arrows?

This theory was postulated by combining what in our opinion are two completely different artefacts, namely a group of hitherto unidentified arrows on display in Eltz castle, Germany, and a small cannon found in Loshult, Sweden.

The theory has been criticised by this writer^{xi} and by others^{xii} after it appeared in print. In my own case the criticism was based on a purely scientific analysis of the gunpowder available at the time and on the construction of the Loshult gun, because when dealing with guns, gunpowder and gunnery the laws of physics and chemistry must also be taken into consideration as well as the supposed military application of these devices.

At the time when criticising the theory firstly I did not consider these arrows to be particularly important and had mentioned them in my paper only in passing. Yet, since these arrows are the very key to what we may henceforth call the *Eltz Gun Arrow Theory* they, as well as the conclusions emanating from their existence, must now be scrutinised more carefully.

Mr. Tittmann wrote that his own reconstruction concentrated on the Loshult gun as a basis and he presented his theory that the Loshult gun might be an arrow-shooting gun at a meeting of the *Gesellschaft für Waffen-und Kostümkunde* in 1978^{xiii}, but the reception of this theory was, because of lack of proof, not very enthusiastic. After a visit to Eltz castle in 1984 however, Tittmann thought he might have found the missing link in the form of five arrows on display there.^{xiv}

Any firearm requires four things, firstly the gunpowder to propel the projectile, secondly the projectile to be fired from the gun, thirdly the gun itself and fourthly a target at which the

missile is to be shot at. In the following these four requirements will be scrutinised in more detail.

3. Gunpowder in the early 14th century

How the knowledge of gunpowder came to Europe is still uncertain, but it is an undisputable fact that in the first half of the 14th century it was already fairly well known in that area.^{xv}

Recipes for gunpowder have survived in quite a few manuscripts and give an indication that a functioning, dry mixed gunpowder was available at the beginning of the 14th century.

The most important ingredient of gunpowder is saltpetre. What has not yet been established (although some points have been cleared up experimentally) is what kind of saltpetre was used, the naturally occurring calcium saltpetre $\text{Ca}(\text{NO}_3)_2$ which can be produced under the climatic conditions prevailing in Europe, or potassium saltpetre KNO_3 produced by the conversion of calcium nitrate, or a mixture of the two.^{xvi}

The quality of the gunpowder depends primarily on the ratio of the individual components to each other, the purity of the materials used, the grain size of the individual components and the degree of mixing.

Experiments undertaken by this writer *et al* show that an increase in the percentage of saltpetre in a gunpowder mixture causes, up to a certain point, an increase in muzzle velocity.

4. The Eltz Gun Arrows; a new Piltown^{xvii} man ?

When the *Eltz Gun Arrow Theory* was postulated it was not certain what gun-arrows looked like. It is still uncertain. The picture of the arrow in the Oxford Ms is not clear on this point, especially not in early reproductions.

Four heads from missiles which can only have been intended for gun-arrows similar to the Milemete arrows have turned up in several locations in Germany. These finds were introduced to the public by a well known researcher on cut and thrust weapons, Gerhard Seifert, as early as 1989^{xviii}. The arrow heads were of such a size that they would almost have fitted the smaller Milemete gun, with an estimated calibre measuring between 40-50 mm. A fifth arrow, similar to those previously found was recovered in the same location later in the same year.^{xix}

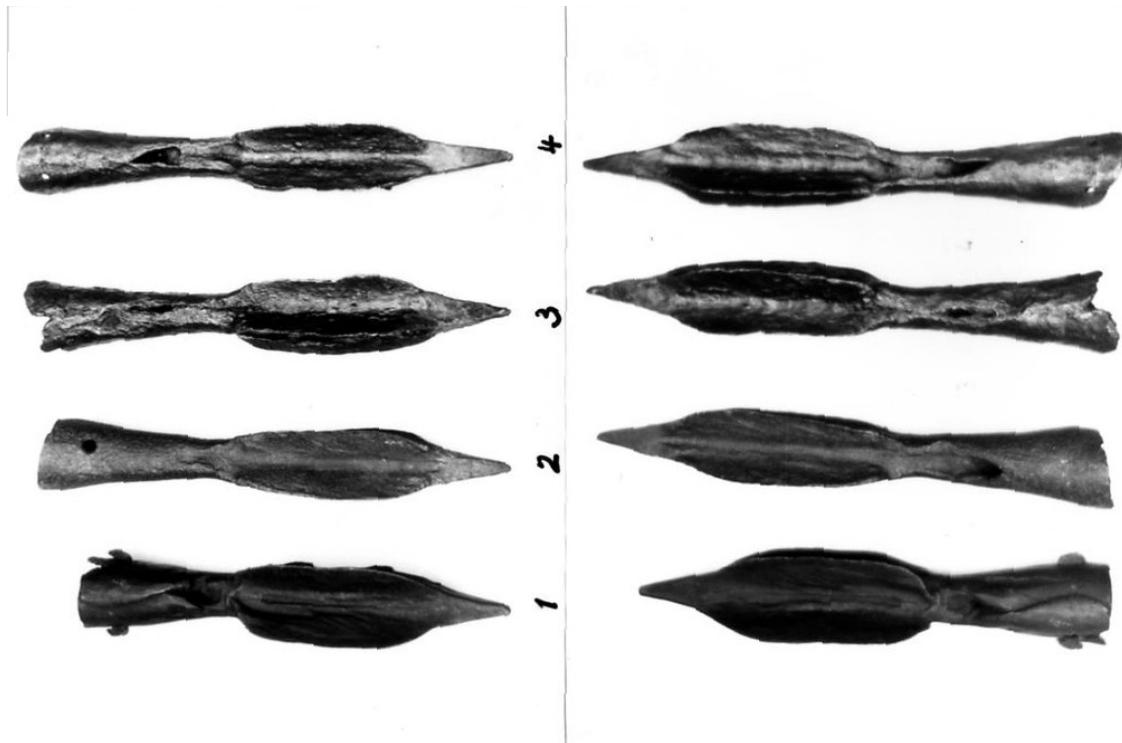


Fig. 1 Arrow heads, most likely from gun-arrows, found in Rodenbach(#1) ,Herborn (#2) and Dillenburg(#3 and # 4) , all in the county of Hesse, Germany. Photograph courtesy of Gerhard Seifert.

These above arrow heads measure between 216 mm and 248 mm, they weight from 375 g to 525 g, though it is very difficult to evaluate them precisely for due to heavy corrosion, they had after all been underground for more than five centuries, much material is missing.

The arrows exhibited at Eltz castle and the theory built upon them was introduced by Wilfried Tittmann five years after Seifert introduced the arrow heads he had found.

Although Tittmann was aware of the existence of the arrow heads published by Seifert, since I had mentioned them in a paper on the Milemete codices,^{xx} which he commented extensively upon^{xxi}, it is regrettable that he did not pursue this matter farther.^{xxii}

The origins of four of the Eltz arrows are obscure; but according to tradition they are trophies of the siege of Eltz castle 1331/3. They are regarded as having been used during the so-called Eltz Feud when soldiers in the army of the Archbishop of Trier, Balduin of Luxembourg, laid siege to Eltz castle and were allegedly kept in the armoury as a memento since that time.

Neither the chronicles of Archbishop Balduin nor those of Eltz castle mention that a new kind of weapon had been used in the siege, contrary to what one would have expected.^{xxiii} Furthermore, the history of the Eltz arrows as given in the paper on the *Eltz Gun Arrow Theory* is rather vague. Tittmann does not present any conclusive proof that the arrows really did originate from the time in question, let alone that were used in the 1331/3 siege.

The fifth arrow is purported to be the missing link between the other four arrows and the siege of the castle, as it was found in 1975 or 1976 (sic) under a heap of rubble in a demolished outer part of the fortification of Eltz. As can be seen , not much attention was given to this find by the staff of Eltz castle, it was not photographed *in situ* nor was it ever

examined by a competent expert. Additionally, it was restored by the keeper of Eltz castle who in doing so removed any potential evidence that it was really an arrow from the Eltz siege period, 1331/3.

All things considered it is very speculative to formulate the *Eltz Gun Arrow Theory* on the existence of just this one piece of evidence, which itself is of uncertain and uncorroborated provenance. The probability that this theory might be proved on the basis of just this one piece is statistically almost nil.^{xxiv}

Looking at the arrows on display at Eltz castle any serious historian would consider the statement that these arrows are gun-arrows and originated from the siege 1331/3 as biased evidence, they have absolutely no scientific value whatsoever. Indeed, what a correctly working researcher should have done, before presenting his discovery to the public as cogently and eloquently as Tittmann does, is three things:

Firstly, have the wood of all the arrows tested by the C₁₄ method so as to establish that the wooden shafts were actually made and possibly used at the time of the siege of Eltz.

Secondly, have the metal of the fletchings and of the arrow heads tested to establish if it is of a composition commensurate to the period.

Thirdly, have the rear ends of the arrows tested for scorching and possible gunpowder residue.

Until such time that it is scientifically proved that these arrows meet these criteria they must remain the alleged Eltz arrows and Dr. deVries and other researchers are vindicated in dismissing them as solid evidence.

5. The Loshult Gun, an arrow shooting gun ?

The second piece of the *Eltz Gun Arrow Theory* puzzle is the so-called Loshult gun. Therefore, let us recapitulate all known facts about it.

This small cannon-barrel was found in 1861 by a farmer when digging in a field near the small village of Loshult in the province of Skåne in the region of Christianstad, Sweden. This area was once Danish but was ceded in the treaty of Roskilde (1658) to Sweden and has since been in Swedish possession. After recovery the gun was sold to the Swedish Historical Museum in Stockholm. In 1924 it was put on display in the Military Museum, but later came back to the Historical Museum where it is still kept under the inventory number SHM 2891. The gun weighs 9,06 kg and is slightly over 300 mm long^{xxv}.

In 1942 it was described in detail by Col. Theodor Jakobsson, then director of the Military Museum in a paper in Swedish, one year later in an article in German.^{xxvi}

The gun was spectrographically analysed twice, once in 1941 and again in 1966 and was found to consist mainly of copper and tin^{xxvii}. The first analysis showed a high content of antimony (2 %) and for this reason the alloy was thought to have come from the Hungarian-

Bohemian mining region. The second analysis however showed an antimony content of only 0,63 % so in fact it can not be said with any certainty where the alloy from which the gun was cast originated nor where it was made.

Jakobssen considered on this metallurgical and other evidence^{xxviii} that the gun was made in the first half of the 15th century which puts its age more than 100 years after the Eltz Feud. The only thing which is absolutely certain about the date of the Loshult gun is that it must have been made prior to 1861, when it was found.

6. Mating the Eltz arrows to the Loshult gun: *Never the twain shall meet!*

The conditions which a gun-arrow and the gun to shoot it from must confirm to are apparently not fully understood by Tittmann, who writes [...] that a gun-arrow has two inherently incompatible features, firstly it must have large fletches to stabilise the arrow in flight and secondly it must fit tightly in the barrel of the gun [...].

I fail to see where and how these features contradict each other.

Ever since the Milemete codices, especially the Oxford Ms, were assessed by arms historians the question of how an arrow together with its fletches might have been fitted into a gun barrel arose.^{xxix} This argument was mainly due to the fact that at that time not many of those who wrote about the Oxford Ms had actually seen this manuscript with their own eyes. Thus they could not see that the gun was unfired; the gunner is just in the process of applying a light to the priming and the arrow has not left the barrel. Early researchers for instance Greenhill^{xxx}, Guttman^{xxxi}, Feldhaus^{xxxii} and Rathgen^{xxxiii} all had their own ideas how the fletches might have been fitted into the barrel and a lot of very weird and outlandish suggestions were made.

About the arrow itself also existed some misconceptions. Feldhaus and Guttman thought that the arrow had a ball-like protuberance just in front of the muzzle, Rathgen thought that the fletches were flexible and might have been wrapped around the shaft of the arrow, whilst Partington^{xxxiv} and Post^{xxxv} thought that the arrow was depicted as just leaving the muzzle after being fired etc.^{xxxvi}

Many years later Tittmann claimed to have been the first to realize and publish the fact that firstly the Oxford Milemete gun was shown as being not yet fired, in other words that it was in a *loaded and ready-to-fire-position* and secondly, that the fletches of the arrow terminated just in front of the muzzle, i.e. that they were never inside the barrel!

This statement is also not correct, it was Colonel Hime^{xxxvii}, an artilleryman, who noted already in 1906 that the arrow would probably have needed an extension to its shaft and he wrote[...] a magnified quarrel of a crossbow, fitted with a four-sided iron head and metal (probably brass) feathers. *A tampion must have been inserted between the end of the projectile and the charge (italics mine)[...]*

Later on, Pollard^{xxxviii} in his *opus magnum* noted also that [...] from the muzzle of which a large arrow is issuing^{xxxix}[...].

Thus it can be seen that the claim made by Tittmann that it was he who discovered that the Oxford Ms Milemete cannon was not yet firing and that the fletches of the arrow terminated in front of the muzzle prior to firing is quite unjustified.

That there is so much confusion about the size and shape of arrow and gun of the Oxford Ms is most likely due to the fact that, as already said, the early reproductions of this folio are not very clear. Anyone who has ever seen the original Ms and looked at the miniatures through a magnifying glass will see clearly two things, firstly that the gunner is just in the process of applying a light to the priming and secondly that the fletches of the arrow do touch the muzzle.

The most distinguishing feature of the Loshult gun is its two-stage barrel, only the part following the chamber is cylindrical over a length of c. 100 mm whereas the bore in the front part is conical in shape. This means that when a gun-arrow is fired from the gun it only has a proper gas seal for the first 100 mm it moves forward. After this point the bore area increases from 100 % to 135 % at the muzzle, in other words after every 20 mm the arrow moves forward the bore area increases by approx. 7 %, thus the pressure can escape around the arrow to the muzzle , so it effectively decreases and can no longer propel the arrow.

As a *non sequitur* I should like to mention here that the effect that two conical pieces fitted into each other can release pressure or liquids very efficiently and quickly is used in engineering for quick-release valves, because even lifting the sealing part only a short way up allows a maximum of gas or liquid to escape very quickly.

Another effect which can be seen is that after the arrow has left the cylindrical part of the barrel it loses not only the gas seal but also the proper guidance. It would leave the muzzle wobbling and no size of fletching would stabilise it so that it would fly straight.

It would be of interest to look at this point at the alleged Eltz gun arrows for their fit into a gun of the size of the Loshult cannon.

1. All five Eltz arrow shafts^{x1} have a different diameter, with the exception of #3 and #4, which are also almost of the same length , but then again they have different arrow heads. Does this imply that two or three small cannon of slightly different size were in use? If this presumption is correct then the numbers of arrows found and kept is, considering that the siege lasted almost three years, very small indeed.
2. The distance from the fletches to the ends of the arrows is also different, with again the exception of arrows #3 and #4. These relatively short arrows would reach into the cylindrical part of the barrel to only about 50%, which means that the arrow would neither have a proper gas seal nor guidance over the full length of the bore.
3. Arrow # 5 would fit the Loshult gun precisely, but this is alas, the one which been “restored” and as we have explained earlier it cannot have any value as reliable evidence.

4. All arrows on exhibition at Eltz have fairly small fletches, which would indicate a later date as the steering surfaces of a projectile can be the smaller the faster it flies, a well known law of aerodynamics. As can be seen from the Oxford codex the fletches of the small Milemete arrow sticking out of the gun are rather large, which would indicate a comparatively slow flying arrow.

7. The Oxbøl Experiments 2002: Can one really shoot arrows from the Loshult gun?

The historian proposes a theory, but has no means ever really to prove it, for regardless how many pieces of evidence he collects there remains always a shade of doubt. However, scientists and engineers do have at their disposal the means of the experiment to verify and prove (or disprove, as the case might be) their statements or the statements of others.

In recent years the concept of experimental archaeology has become a widely used method to accomplish this and by this means the *Eltz Gun Arrow Theory* could experimentally be tested. When rechecking and collecting facts and data^{xlii} about the Loshult gun I was informed by the Swedish Historical Museum, Stockholm that a group of Danish scholars^{xliii} had recently taken casts of the Loshult gun and were planning to make and shoot a replica. I contacted them, went to Denmark and the result was the founding of the Medieval Gunpowder Research Group^{xliiii}, combining gunpowder and artillery research into one group. The artillery school of the Danish Army was also interested in the experiments and sponsored them by providing the shooting range and the test and measuring equipment to record precisely the results of each shot.

As a basis of this verifying experiments an exact replica of the Loshult gun in a simple mount similar to the one shown in the Milemete Oxford codex “*de nobilitatibus...*” was used at Oxbøl^{xliv}.



Fig. 2 The Loshult gun loaded with the replica of an Eltz arrow ready to fire. In front on the right the head for measuring muzzle velocity and, higher a video camera can be seen. The radar antenna for measuring and recording the trajectory of the arrow can be seen in the upper right hand corner. Photograph by the author

For gunpowder two different recipes known to have been written down in the time of the Eltz Feud were used, one originating from Rouen, France and dated 1338. It consisted of a mixture of saltpetre 50 % to sulphur 25% to charcoal 25%.

The other recipe originated in Lille, France and dated 1350. It consisted of a mixture of 55,6% saltpetre to 22,2 % sulphur to 22,2 % charcoal.^{xlv}

The charcoal was made by the Middelaldercentret, Nykøbing, Denmark, using alder wood whilst the sulphur was refined from sulphur bearing minerals mined in Iceland by the staff of the centre. Almost 1,0 kg of calcium nitrate extracted by the traditional method from the detritus of old stables was available, but contained too much moisture which could not be removed to make this saltpetre useable in gunpowder. Therefore, commercial grade potassium nitrate was substituted instead. However, since calcium saltpetre $\text{Ca}(\text{NO}_3)_2$ contains the double amount of oxygen as potassium nitrate KNO_3 this would mean that a calcium nitrate, which is free of water and humidity, reacts more strongly in a gunpowder mixture. Therefore, these results must be taken with a pinch of salt until new experiments with a calcium nitrate, which is free of water and moisture, have been conducted.

All ingredients were finely ground in a wooden mortar with a wooden pestle and then mixed as thoroughly as possible by Lars Barfood : he and his ancestors have been making fireworks and gunpowder in Denmark for more than 200 years.

Two arrows were made, duplicating the given dimensions as closely as possible. They were made by craftsmen of the Middelaldercentret by methods in use in the 14th century.

However, even though we adhered as closely to the dimensions given we could not duplicate the arrows as exactly as they were listed and described. Our longer arrow #3 having three fletches and a longer head weighed 445 g, whilst the shorter arrow #4 , having two fletches and a shorter head weighted 420 g. According to the table in which the Eltz arrows are listed Eltz arrow #3 appears there as weighting 390 g, whilst Eltz arrow #4 is listed weighing 418 g. As this is unlikely it would appear that either in the records of Eltz castle or in the publication, these two values were reversed.

However, from the differences it can be seen that the copies were fairly close to the originals, as the difference in weight between the two Eltz arrows is 28 g and between our copies 25 g.

It was planned to use 20 g of either gunpowder first and then 50 g, the former being calculated by Tittmann from some old accounts for saltpetre^{xlvi}, sulphur and arrows and the latter had been found by experiment to be the proper charge for the Loshult gun. The 50 g charge filled the chamber almost fully.

In order to comply with safety regulations ignition was effected by a short piece of military fuse cord which was inserted into the chamber through the touch hole.

The arrows were forced into the cylindrical part of the barrel with a wooden mallet until the fletches almost touched the muzzle.



Fig. 3 The author loading the Loshult gun at the shooting range at Oxbøl. The arrow is seated with a wooden mallet. The fuse cord can be seen between gun and tyre. Photograph by Bob Smith

The most important part of any experiment is proper record keeping. In our case this was done with the most modern ballistic test equipment available, provided and operated by staff of the Artillery school of the Danish Army. For each shot there was a computer print-out recording all relevant data such as range, trajectory and muzzle velocity. Additionally the data for each shot were individually recorded by Bob Smith, editor of the *Journal of the Ordnance Society*.

8. The Results:

The results were by and large disappointing.

The first shot, using 20 g of Lille gunpowder and arrow #3 was a failure. After ignition the gunpowder exploded and the gas discharged through the touch hole with a shrill sound, blowing the remains of the fuse cord out, whilst the arrow remained in the barrel.

The second shot, using 20 g of Rouen gunpowder and arrow #4 ejected the arrow from the muzzle with a V_0 of 20 ms^{-1} to a distance of 43 m.

The third shot, using 50 g of Lille gunpowder and arrow #4 fired the arrow with a V_0 of 87 ms^{-1} to a distance of 360 m.



Fig. 4 The Loshult gun just after firing an arrow. As can be seen the gun remained quite stable. Photograph by the author

The fourth shot, using again 50 g of Rouen gunpowder and arrow #4 fired the arrow with a V_0 of 63ms^{-1} to a distance of 205 m.

The fifth shot, using 50 g of Lille gunpowder and a lead ball with a diameter of 32 mm fired the ball with a V_0 of 126ms^{-1} to a distance of 690 m.

The sixth shot, using 50 g of Rouen gunpowder and a lead ball as above fired the ball with a V_0 of 110ms^{-1} to a distance of 630 m.

The arrows flew very erratically, they could neither be aimed nor shot at any target with any precision.

The same held true for the lead shot, none of which could hit a target measuring 2m^2 at a distance of 200 paces repeatedly at the same spot. The question as to what gun arrows were used against is still open to speculation, according to the *Eltz Gun Arrow Theory* the arrow head suggested as target a man in armour, that was surely not impossible if the distance was not more than 25 m and the target stood still and would not move.

This shows that arrows fired with a gunpowder known to have been in use at the time in question could fly quite a distance, but neither flew fast nor accurately.

So for what purpose then was a gun of Loshult type and design possibly used at the time?

The answer to this question lies most likely in the deep ruts and scratches found on the inside of the barrel of the original Loshult gun. They almost certainly provide evidence that it was

used to shoot pieces of iron or similar things at attacking horsemen or infantry at close distance. That such weapons were very effective when used this way has been shown in other experiments conducted previously.^{xlvii}

9. Redesigning the arrow shooting gun of Balduin of Luxembourg:

It becomes now easy to see how a proper functioning arrow-shooting gun of Balduin of Luxembourg should have looked like, that is, if we presume he had been in possession of them.

If we furthermore presume that Eltz arrows #3 and #4 were the standard arrows the following changes would have to be undertaken:

1. The bore would have to be cylindrical along its full length. This would give the arrow a proper gas seal from chamber to muzzle and at the same time would have guided it straight along the full length of the bore.
2. The barrel would have to be shortened at the muzzle by about 50 mm. Then arrows with the dimensions of the Eltz arrow would fit into the gun in such a way that the fletches terminate a fraction in front of the muzzle and the shaft would close the chamber exactly.

It is planned to experiment at a later stage with a 2 : 1 scaled down version of the Loshult gun and Eltz arrows to prove the redesign of Balduin's artillery.

After these experiments have been concluded they will be appropriately reported in a separate paper.

10. Summing up:

As interesting as the *Eltz Gun Arrow Theory* may be, it suffers from a serious lack of corroborative evidence. The deficiencies in the reasoning can be listed as follows:

1. The arrows introduced as gun-arrows in various publications, allegedly originating from the siege of Eltz castle 1331/3 can not be shown by definite scientific proof to have been gun-arrows nor to originate from this period.
2. The Loshult gun is by its design and construction not suitable for shooting arrows. The evidence available indicates that it was used to shoot iron pieces like a shotgun.

3. Two of the alleged gun-arrows would, as far as dimensions are concerned, almost fit the Loshult gun, but provide neither adequate gas-seal nor guidance to the arrow.

4. The theory that a small Loshult-Gun like cannon was used at the siege of Eltz castle and that it fired arrows like those preserved in Eltz is purely speculative and cannot, in my opinion -and as I have shown-, be sustained. Further proof would be necessary, for instance a C₁₄ test to date the wood of these arrows to establish their approximate age.

In preparing this paper I am very grateful to my friend Claude Blair for offering many helpful hints and to Jan-Piet Puype for reading the draft and pointing out where improvements could be made. Any mistakes which still might have found their way in this paper are the sole responsibility of the author.

Footnotes and remarks:

ⁱ Tittmann, W. „Die Eltzer Büchsenpfeile von 1331/3“ in *Waffen und Kostümkunde* 36 (1994) and 37 (1995), and Tittmann, W. „, The guns of Archbishop Baldwin of Trier and the guns in the Milemete Manuscripts of 1326/7 some critical comments” in *Journal of the Ordnance Society* Vol 17 (2005) p 5-23

ⁱⁱ Balduin von Luxembourg, 1285-1354, since 1307 Archbishop of Trier, Elector of the German Empire

ⁱⁱⁱ There are two of these, one, called „de officiis regum“, with the full title “ de nobilitatibus,sapientiiis et prudentia regum”, it belongs to the Bodleian Library Oxford and has the signature Ms 92 . It is nowadays often referred to as the **Oxford Ms**. The other Ms is called “de secretis secretorum Aristotiles” and it belongs to the British Library, London, with the signature BM 47680 . It is also known as the Holkham Hall Ms, but is nowadays called the **London Ms**.

^{iv} About the precise dating of the Milemete Ms see Blair, C JOS 2004 and Leibnitz, K WKK 1992

^v Although some researchers are of the opinion that the arrow is a fire arrow, it appears to be just an ordinary oversized arrow.

^{vi} Norman, A.V.B. Vol 5 JAAS

^{vii} I use here the terminology agreed upon and used by the Medieval Gunpowder Research group in their first meeting. It was suggested by Bob Smith

^{viii} Of these about 50 Ms versions are extant, one of them the Freiburg Ms 362 has been translated into English. In this on fol.87 v these instructions appear as: “*How to fire a rod or an arrow from a gun*”.

^{ix} See, for instance the Hagley Hall Ms dated precisely to 1450 in which arrows and the shooting of them is no longer mentioned.

^x At the siege and subsequent destruction of Tannenberg castle in the county of Hesse, Germany there were the two different kinds of guns in action, the large bombard and the small handgun. Proof of this statement is the small handgun found in a well in the mid-19th century as well as a fragment of another such gun and it is known and documented that the castle was destroyed by heavy artillery in 1399

^{xi} Leibnitz, K „Kommentar zu: Die Eltzer Büchsenpfeile“ WKK 42 (2000)

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- ^{xii} DeVries, Kelly *JOS* 2003
- ^{xiii} Bericht der Tagung der Gesellschaft für WKK 1978 in Zürich, *WKK* 1979 Manfred (sic) Tittmann
- ^{xiv} About this statement there is also some doubt, because this writer has in his file a communication by another German researcher in which proof is presented in the form of dated photographs predating Tittmanns visit to Eltz . It appears that the arrows were pointed out to Tittmann by this researcher.
- ^{xv} Rathgen, B: „Das Geschütz im Mittelalter“
- ^{xvi} Kramer, Gerhard W: „Chemie und Waffentechnik im 15. Jahrhundert,“ 1995
- ^{xvii} A village in Sussex, England, where the skull of the „Eoantropus dawsoni“ was found in 1911, a composition of a modern human skull fitted with pieces from the skull of a monkey. This skull is still on exhibit in the Natural History Museum in South Kensington, London. An analysis made 1953 discovered the fake. At the time it was found the Piltdown man was considered to be the missing link in the evolutionary process of human species
- ^{xviii} Seifert, Gerhard : „Mittelalterliches Geschützprojektil“ *Deutsches Waffenzournal* Heft 6, 1989, *Haigerer Geschichtsblätter* Nr. 19, P 59ff
- ^{xix} Seifert, G.: *Haigerer Geschichtsblätter* Nr.24, 1991 P 60
- ^{xx} Leibnitz, K „ Die Manuskripte des Walter de Milemete“ *WKK* 1992 p 117 ff
- ^{xxi} Tittmann, W. Die Geschützdarstellungen bei Walter de Milemete, *Miszellen, WKK* 1993 , p 145-1 47 an article, which was obviously written cum ira et sine studio because it contains so many mistakes.. For instance the arrows which Seifert found in the county of Hesse are suddenly reappearing in the Rhineland ([...] aus dem *Siegerland* [...]) . Also Tittmanns knowledge of the Latin and German language seems not to be particularly good, as he criticised my translation of notabilitibus, which is the way I have translated it, no doubt correct, although notabilitibus (remarkable) is the wrong word, it ought correctly have been nobilitatibus (noble).No two publications agree on what is correct, but M.R.James in his book on the Milemete codices, which I have used as the only valid standard, writes “ nobilitatibus”.
- ^{xxii} Larger gun arrows would have negated his theory that early guns and gun-arrows were very small!
- ^{xxiii} See for instance the *Chronic of Cividale*, Italy 1331 which even recorded that the attack was without effect!
- ^{xxiv} A famous American arms historian once said to me, when discussing the *Eltz Gun Arrow Theory* : This is the same thing as if one reconstructed the whole *Tyrannosaurus Rex* skeleton in the Smithsonian from just one jawbone and one claw!
- ^{xxv} This is due to the fact that the rear end of the gun is uneven, at the highest point it is 303 mm long.
- ^{xxvi} Jakobsson, Th: “Ein waffentechnisch wertvoller Geschützfund im Armeemuseum in Stockholm 14/15 Jahrhundert, *ZHWK* NF 8, p 124 ff
- ^{xxvii} See Jakobssen *ZHWK* NF 8 p 124 and Oldeberg, A „Metalltechnik under Vikingatid och medeltid“, Stockholm 1966 p 222 ff
- ^{xxviii} for instance the absence of a distinctive pan to hold the priming.
- ^{xxix} This might have been due to the fact that the London Ms cannon shows an arrow of which only the head protrudes from the muzzle.
- ^{xxx} Greenhill, Prof. A.G., FRS „ An ancient cannon“ *The Kynoch Journal* Vol VII No. 36, 1906 p 170ff
- ^{xxxi} Guttman, Oskar: *Zeitschrift für angewandte Chemie* Heft 18 1904, p 1062
- ^{xxxii} Feldhaus, F.M. *ZHWK* Bd. 5 Heft 3 1909 p 92

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- ^{xxxiii} Rathgen, B. „Das Geschütz im Mittelalter“ passim
- ^{xxxiv} Partington, J.R. „A History of Greek Fire and Gunpowder“ passim
- ^{xxxv} Post, Paul: „Die früheste Geschützdarstellung [...] *ZHWK Sonderheft Artillerie* p 138
- ^{xxxvi} Though without explaining how the fletches had been in the barrel before!
- ^{xxxvii} H.W.I. Hime: „The origin of artillery“ London 1915 p 123 ff
- ^{xxxviii} Major H.B.C. Pollard „A History of Firearms“ London 1926 p 99 ff
- ^{xxxix} i.e. sticking out of something (NOD)
- ^{xl} See *WKK* 1995 p 58 Table 1
- ^{xli} Some of the dimensions given in Tittmanns series of articles in *WKK* 1994/5 are not precise, so for instance the diameter of the touch hole, the depth of the pan and the length and weight of the gun!
- ^{xlii} They came from the Middelaldercentret in Nykobing, Falster, Denmark, an open-air museum dedicated to the study and reconstruction of medieval technology, who also organised the experiments.
- ^{xliii} This group consisted, besides the director of the Middelaldercentret Peter Vemming Hansen and his staff, of Prof. Bert Hall, University of Toronto, Lars Barfood, , Jørgen Svender , an arms engineer from the artillery school of the Danish Army, Robert Smith, editor of the *Journal of the Ordnance Society* and his wife Ruth, Gunnar Bentzen, a fireworks expert from Norway and the author of this paper.
- ^{xliv} Named after the shooting range of the artillery school of the Danish Army#
- ^{xlv} See Rathgen, B. „Das Geschütz im Mittelalter“,
- ^{xlvi} Tittmann, W. „Büchsenwerk, mit einer Entgegnung auf Klaus Leibnitz“ *WKK* 2000, p 160, where Tittmann calculated the weight of the gunpowder charge to be 24,5 g. As a starter we used 20 g
- ^{xlvii} Vemming Hansen, Peter : „Rekonstruktion og skydeforsog med Lushultkanonen.“ Middelaldercentret 2001

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