Archaeological Perspectives on the Battle of Waterloo
Analysing lead shot from the Waterloo Uncovered excavations 2015 and 2016

Emiel Robertus Josephus Gildas Picard
Student number: 2225196P

This dissertation is submitted in part fulfilment of the requirements for the degree of MLitt in Archaeology at the University of Glasgow

September 2016
Abstract

Lead shot analysis is still an undeveloped technique for analysing battlefields, although we can gain a lot of information from it. After an excavation, the lead shot is brought to a university, but is often then forgotten. Therefore, valuable information is lost. A methodology for analysing lead shot in the field can make a difference. But before you can start analysing the individual lead shot, you have to know who fought there and what type of weapons the forces were equipped with. Through the analysis you can match the lead shot calibre, with a specific type of weapon. With this information, you can create a distribution pattern, which can provide information on the battle. For example, pistol balls can suggest close combat. This research will not propose a new methodology for in the field, but it will try to increase our knowledge on lead shot analysis and what exactly happened at Hougoumont during the Battle of Waterloo.

Acknowledgement

I would like to thank Prof. Tony Pollard and Dr. Iain Banks for providing a wonderful and educational experience at the University of Glasgow. They made it possible for me to work on such an interesting research subject of one of the most famous battlefields in the world. My thanks also to the project Waterloo Uncovered and all its participants. It was an honour to work on such a special project with such an interesting group of people. As one team member said: “We worked hard, but we laughed hard as well.” It does not only do great work on conflict archaeology of the Battle of Waterloo, but also helps to aid wounded veterans in the recovery from injury and rehabilitation into life after the army. Also a special thanks to Dr. Stuart Eve, who provided the excellent and interesting images for the chapter on distribution patterns of the lead shot. Also thanks to Marc and Susan Conaghan for checking that this research is written in proper English. Without these people this research would not have become what it is now.
# Table of content

Abstract ........................................................................................................................................... 2

Table of illustrations ...................................................................................................................... 5

Introduction .................................................................................................................................... 6

Historical overview ....................................................................................................................... 10
  Before the Battle of 1815 ........................................................................................................... 10
  Battle of Mont-Saint-Jean 1794 ............................................................................................... 10
  Battle of Waterloo 1815 .......................................................................................................... 13
  After the Battle of Waterloo ...................................................................................................... 16

Weaponry ......................................................................................................................................... 18
  Who were at and in the surrounding of Hougoumont in 1794 and what weapons did they have? ...................................................................................................................................... 18
  Who were at and in the surroundings of Hougoumont in 1815 and what weapons did they have? .................................................................................................................................. 19

Pistols ................................................................................................................................................. 21

Canister or tin case shot ................................................................................................................. 21

Methodology in the field ................................................................................................................. 22
  Excavating lead shot .................................................................................................................. 22
  Analysing lead shot .................................................................................................................... 23
  Analysing lead shot distribution patterns ................................................................................ 26

The results (analysing individual lead shot) ................................................................................ 28
  General analysis .......................................................................................................................... 28
  Musket balls ............................................................................................................................... 29
  Rifle shots .................................................................................................................................... 32
  Pistol balls ................................................................................................................................... 32
  Canister or tin case shots ............................................................................................................ 33
  Special lead shot .......................................................................................................................... 34
  Battle of Mont-Saint-Jean 1794 ................................................................................................. 35
  The trailed methodology ............................................................................................................ 35

The results (analysing distribution patterns) ................................................................................ 36
  Attack through the forest .......................................................................................................... 37
  Fighting in the Kitchen Garden ................................................................................................. 38
  The Killing Zone ......................................................................................................................... 38
  Fighting in the orchard .............................................................................................................. 40
Fighting inside Hougoumont? ................................................................. 41
Locating the canister cannon .............................................................. 44
Conclusion ......................................................................................... 47
Bibliography ...................................................................................... 51
## Table of Illustrations

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Excavations outside the garden wall (Killing Zone) after metal detecting survey in July 2016 (Author’s collection, 2016)</td>
<td>1</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Location of the Battlefield in Belgium (New York Times, 2013)</td>
<td>6</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Location of Hougoumont on the far right of the Allied line and an outpost (Military History, 2011)</td>
<td>6</td>
</tr>
<tr>
<td>Figure 4</td>
<td>From left to right: British &quot;Brown Bess&quot; musket ball, a French Charleville musket ball and a pistol ball (Author’s collection, 2016)</td>
<td>8</td>
</tr>
<tr>
<td>Figure 5</td>
<td>The situation on July 6th 1794. The location of Hougoumont is marked in red (Cecille, Charlet &amp; Pattyn 2015, 62)</td>
<td>12</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Plan of Hougoumont with the positions and movements of the Troops (Glover 2006, 20)</td>
<td>14</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Ruin of Hougoumont, 1820-1850, anonymous (Rijksmuseum Amsterdam)</td>
<td>16</td>
</tr>
<tr>
<td>Figure 8</td>
<td>French Charleville 1777 musket (Wikipedia)</td>
<td>19</td>
</tr>
<tr>
<td>Figure 9</td>
<td>British Land Pattern &quot;Brown Bess&quot; (Wikipedia)</td>
<td>20</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Heavily deformed musket ball (BA15HOU 355)</td>
<td>24</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Scatter plot of all the lead shot based on weight</td>
<td>28</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Amount of lead shot for specific size.</td>
<td>29</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Limits from Sivilich’s research projected on the Waterloo assemblage</td>
<td>30</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Sivilich’s proposed limits for musket balls on the musket balls of the Waterloo assemblage</td>
<td>30</td>
</tr>
<tr>
<td>Figure 15</td>
<td>The writers proposed limits for the musket balls</td>
<td>31</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Limits for the rifle shots, as proposed by the writer</td>
<td>32</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Two musket balls fused together (probally canister shot) (BA15HOU 439)</td>
<td>34</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Pulled musket ball. The whole was left by the worm (BA15HOU 782)</td>
<td>34</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Overview of all lead shot with GPS-location at Hougoumont (Service Public de Wallonie (SPW), 2016)</td>
<td>36</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Distribution pattern in the forest. The old track is marked in green (as indication) (Service Public de Wallonie (SPW), 2016)</td>
<td>37</td>
</tr>
<tr>
<td>Figure 21</td>
<td>Lead shot distribution in the Kitchen Garden (Service Public de Wallonie (SPW), 2016)</td>
<td>38</td>
</tr>
<tr>
<td>Figure 22</td>
<td>The lead shot distribution in the Killing Zone (Service Public de Wallonie (SPW), 2016)</td>
<td>39</td>
</tr>
<tr>
<td>Figure 23</td>
<td>The possible location of the hedge is marked with the yellow box (Service Public de Wallonie (SPW), 2016)</td>
<td>40</td>
</tr>
<tr>
<td>Figure 24</td>
<td>Lead shot distribution in the orchard. Not the diagonal line of pistol balls in yellow (Service Public de Wallonie (SPW), 2016)</td>
<td>41</td>
</tr>
<tr>
<td>Figure 25</td>
<td>Mixed musket balls inside the garden. Also some pistol balls (Service Public de Wallonie (SPW), 2016)</td>
<td>42</td>
</tr>
<tr>
<td>Figure 26</td>
<td>First location. High density of french and British musket balls. Also pistol balls on the inside of the wall (Service Public de Wallonie (SPW), 2016)</td>
<td>42</td>
</tr>
<tr>
<td>Figure 27</td>
<td>Location 2. Many French musket balls, mixed with pistol balls (Service Public de Wallonie (SPW), 2016)</td>
<td>42</td>
</tr>
<tr>
<td>Figure 28</td>
<td>Proposed locations. Location 1 in yellow, location 2 in blue and location 3 in red (Service Public de Wallonie (SPW), 2016)</td>
<td>42</td>
</tr>
</tbody>
</table>
Introduction

The Battle of Waterloo is perhaps the most famous battle on the European continent, otherwise the most famous battle of the Napoleonic Wars. Primarily because it brought an end to the reign of Napoleon and the Napoleonic times. The events of that day have been described in numerous books, but also in many biographies of soldiers and officers from both sides.

In 2015 it was the bicentenary of the Battle of Waterloo, which resulted in more funding for restoration of building that played an important role during the battle, attention and of course festivities. The focus of these celebration was Hougoumont. The farm was restored to make it a long term visitor attraction purpose, and this offered also the possibility to do some archaeological research at the battlefield (Project Hougoumont website). The project is quite unique in the sense that there has never been a comprehensive archaeological survey of the battlefield (Waterloo Uncovered website 2016).

Waterloo Uncovered is the project that is archaeologically investigating the battlefield and started at Hougoumont and its surroundings in 2015. The small castle-farm Hougoumont was not only chosen as starting point for the excavations because it was the central point for the bicentenary celebrations, but also because it played an important role during the battle.

Hougoumont was located at the far right of the Allied lines, and occupied by British forces and Hanoverian and Nassau soldiers around it. The farm is surrounded by a wall, what provides a good fortification for its defenders. Throughout the day of the battle, numerous attacks were unleashed by the French on the farm. You could consider Hougoumont to be a battle in a battle. It is thought that Napoleon attacked this farm to drain forces from Wellington’s centre to weaken it (Paget & Saunders 2001, 40). However, the farm was attacked by the French until the late afternoon, with a great cost of French life’s. The French launched their attacks from a forest, in the direction of the southern wall of the farm. To reach this wall, the French had to cross a small patch of open ground.
This ground would later be named the Killing Zone, as it had a high density of bodies (Adkin 2001, 332).

Hougoumont is also the location of one of the great heroic stories of the battle. Although the many attacks it suffered, it remained in Allied hands despite de farm was set ablaze during French artillery bombardment (Adkin 2001, 329; Glover 2006, 26; Paget & Saunders 2001, 63). There was only a brief moment were some French troops managed to open the South-Gate and enter the complex. The gate was quickly closed and the Frenchman inside killed (except for a drummer boy according to the legend) (Glover 2006, 27). This moment has now been memorialized during the bicentenary with statues.

The renewed interest in battlefields, such as Waterloo, and other sites related to conflict fits in the recent trend of approaching these sites from a new archaeological perspective. The discipline of conflict archaeology is a relative young discipline in the field of archaeology. Over the past decades the discipline evolved from a small group of hobbyist and archaeologists into an acknowledged academic discipline (Pollard 2007, III). The start of the professionalization of conflict archaeology in Britain can be set around 2000 with the first international conference on conflict archaeology held in Glasgow. With the founding of The Journal of Conflict Archaeology in 2005 and the establishment of the Centre for Battlefield Archaeology in 2006, the discipline placed itself firmly in the academic world (Pollard & Banks 2010, 414-415).

Because the discipline is still quite young, a lot of aspects from the discipline are still in its infancy. One of these underdeveloped aspects is our knowledge of lead shot. The acceptance of conflict archaeology as a valid academic approach, combined with the bicentenary, provided the right environment to organize an excavation of the battlefield of Waterloo.

This work will use the term lead shot or (lead) projectile throughout, because not all the objects are from the same type of weaponry (Pollard 2009, 144). The assemblage recovered during the Waterloo Uncovered excavations contains musket balls, pistol balls and canister or tin case shot. Unless particularly referred to, it will be named as group.

The acceptance of conflict archaeology as a valid academic approach, combined with the bicentenary, provided the right environment to organize an excavation of the battlefield of Waterloo. This research is set in the framework of the Waterloo Uncovered project and excavations.

Although the Waterloo Uncovered excavations have recovered a great variety type artefacts, this research will only discuss the excavated lead shot. The reason why this research will only focus on lead shot, is that it is the most ubiquitous and reliable group of artefacts to be retrieved from the Waterloo and Hougoumont battlefield. An issue which has impacted on the nature of the archaeological record are annual re-enactments, with participants up to 800 people. The 5-year anniversary re-enactments even see the participants reach numbers up to 2000 participants. The re-
enactment during the festivities of the bicentenary of the Battle of Waterloo had 6200 participants, the largest of its kind (Sawyer, Shute & Bridge 2015). Sadly for the archaeological record, so many reenactors pollute the ground with re-enactment material. The reenactors drop buttons, coins and other artefacts which look similar to the objects carried and worn by the men from the real battle in 1815. Some on purpose, some by accident. But reenactors do not use live ammunition. This would be too dangerous for the reenactors and bystanders. It is therefore more likely that the lead shots that are excavated, and are similar to ammunition from 1815, are original artefacts from the Battle of Waterloo. This is harder to conclude with other artefacts such as buttons.

This dissertation has several research objectives to increase our knowledge on lead shot from the Napoleonic Wars, but also to increase our understanding of the Battle of Waterloo and specific the events around Hougoumont. It will discuss analysing lead shot from the Waterloo Uncovered excavation of 2015 and 2016.

The first objective is to provide a methodology for analysing lead shot in the field. It is the writer’s opinion that the analysing of lead shot is still an underestimated source of information for conflict archaeologists. There have not been thorough investigations on lead shot so far. Only Glenn Foard, A. Schürger and Daniel M. Sivilich have written books on lead shot of English Civil War sites, the battlefield of Lützen and American Revolutionary War sites (Foard 2012; Schürger 2015; Sivilich 2016). This is because the lead shot is excavated, but not analysed in the field. When it is brought back, it is often forgotten. Therefore the writer would like to provide a low-cost and fast methodology for analysing lead shot in the field.

The second objective is to compare written accounts with archaeological evidence. What happened during the Battle of Waterloo on the 18th June 1815, has been put down on paper by many soldiers, officers and other eye-witnesses. These accounts have been the primary source of information for the many researches that have been done over the past 200 years on the Battle of Waterloo. On almost every subject imaginable on Waterloo, a book has been published. Conflict Archaeology can provide new evidences but it has already proven that it can also “disprove” certain aspects of battle that are settled as common knowledge of the battle (the French did not get inside) (Field 2015, 1). The Duke of Wellington said: "The history of a battle, is not unlike the history of a ball. Some individuals may recollect all the little events of which the great result is the battle won or
lost, but no individual can recollect the order in which, or the exact moment at which, they occurred, which makes all the difference as to their value or importance” (Keegan 2004, 117). The fog of war, personal opinion and the traumatic experience of the battle can all influence the memory of someone. Archaeological evidence however is not subdued by these things.

The third objective is to provide a clear database of the lead shots recovered during the Waterloo Uncovered excavations of 2015 and 2016. At the start of this dissertation, approximately 50 of the approximately 370 possible lead shots were analysed of the 2015 excavation. This dissertation aims to provide a clear overview of all the lead shots that are recovered during the excavation of 2015 and 2016. The overview or database will be a clear list where information is clearly set out and easily found, and will come with images of all the objects. It will also provide a map of the locations where all the lead shots were found.

The last objective is to increase our knowledge on lead shot on battlefields from the Napoleonic Era. As stated before, only the battlefields from the English Civil Wars and the American Revolutionary Wars have been subdued to investigation on lead shot.

To achieve these objects we will first have a look at the history of the Hougoumont surroundings. This chapter will therefore discuss the history of Hougoumont farm, and all the relevant events that happened there. The focus of this chapter will lay on the Battle of Waterloo in 1815, but also on the Battle of Mont-Saint-Jean in 1794.

Before we can start analysing the lead shot, we have to know who fought in and around Hougoumont. When we know what regiments fought there, we can argue what kind of weapons were used. With this knowledge we can then compare the lead shot that was recovered during the Waterloo Uncovered excavations with the calibre and type of lead shot that the weapons of the present regiments fired.

Before we start analysing the lead shot retrieved during the excavations, this chapter will discuss the methodology that was used for recovering and analysing the lead shot. This chapter shall also discuss a new proposed methodology, that was created and trailed during the Waterloo Uncovered excavation of 2016. This methodology was created so analysis of the lead shot could be done in the field, rather than waiting for someone to analyse the assemblage back home.

Finally we can discuss the results from the analysis. This research shall discuss the results in two different chapters. The fourth chapter will discuss the analysis of the individual lead shot. The fifth chapter will discuss the analysis of the lead shot distribution patterns. This decision was made so the research can present the results in clear and orderly way. Also because the results from the individual lead shot analysis enables us to analyse distribution patterns.
Historical overview

Before we can start analysing any objects recovered from the Hougoumont surroundings, we have to first know the history of the site. We have to know what kind of objects we can expect to find. In the case of this research specifically, we have to know if any fights, skirmishes or battles have been fought. This chapter shall therefore discuss the history of Hougoumont, from the first time it was mentioned in records until the current time.

Before the Battle of Waterloo 1815

The property of Gomont dates back to the fourteenth century. It is named in court records for the first time in 1358 and then in 1386 its mentioned as a tenancy and house of Gomont in the lordship of the manor of Braine L’Alleud. In 1474, the Order of Malta had acquired the land from Jean del Tour – Tarlier et Wauter (Logie 1984).

The estate was then acquired by the father of Pierre du Fief, a lawyer for the Council of Brabant. By 1562 the estate was in hands of Pierre Quarré. In 1637 the estate was acquired by Arnold Schuyl van Walhorn (1602-1679). He presumably built a castle and farm (Logie 1984; Arrazola de Oñate website).

The estate is than sold to Jean-Jacques Arrazola de Oñate (1615-1688) Gomont in 1661. Together with his second wife Isabelle de Renialme (née Cordes) and their young son, they moved to the castle and farm. The estate would grow with the addition of a chapel, an orchard and a formal garden (Logie 1984; Arrazola de Oñate website).

Jean-André Arrazola de Oñate de Gomont died as the last lord of Gomont without any children in 1780. Without any heirs, the estate was passed on to his wife Anne Eugenie de Vicq de Cumptich. She later remarried Philippe Gouret de Louville, an Austrian officer. De Louville preferred to live in Nivelles (Nijvel) and the farm was therefore worked on by Antoine Dumonceau in 1815, and the formal garden was tended by Jean-Joseph Cartier (Bosse 1999; Arrazola de Oñate website).

Battle of Mont-Saint-Jean 1794

When someone says Waterloo or Hougoumont, one most likely thinks of the battle in 1815. But that was not the only battle fought at the surroundings of Waterloo and Hougoumont. From the limited sources that are available, we know that the battle (or at least some fighting) took place on the battlefield of 1815. The sources name Hougoumont specifically.

After the French Revolution (1789), the restrained powers of the royalty, nobility and catholic clergy caused tension between the French state and other European countries. The
execution of King Louis XVI, combined with French expansions, would eventually lead to war between the new French Republic and the First Coalition. France would remain almost continuously in a state of war until the banishment of Napoleon to Saint Helena in 1815 (Connely 2006, 22).

A tidal movement of victory and defeat keeps on going until the end of 1793 when almost all the areas conquered by the French are gained back. The French believe that they have to be victorious, or the results of the Revolution will be lost and France will return to the Ancien Régime. The coalition only needed one major victory to defeat France. But the eyes of the major countries, such as Prussia, Austria and Russia, were no longer focused on France, but on Poland. Only Great Britain, Austria and the Dutch Republic were pursuing the French defeat (Cecille, Charlet & Pattyn 2015, 16).

The coalition wanted to achieve this by massing all their troops around Valenciennes and marching to Paris. However, the French have a more sophisticated strategy. They have three armies in the north: Armée du Nord (following the coast to Ypres), Armée des Ardennes (Charleroi as objective) and Armée de la Moselle (Liège as objective). The force going to Charleroi was the main force; the other armies were for deviation purposes (Cecille, Charlet & Pattyn 2015, 20).

On April 16th, hostilities began. The coalition managed to take Landrecies, but lost Menin on their right. Although some small battles were fought, not much changed. From June 17th onwards, the French started to win some battles, and eventually the Moselle army reached Charleroi. On June 24th 1794, a major battle was fought at Fleurus between the Austrian Prince of Cobourg and the French general Jourdan of the Moselle army. The French would win this battle, which saw the first use of an air-balloon for reconnaissance. The Austrian army retreated in the direction of Brussels (Cecille, Charlet & Pattyn 2015, 20).

Jourdan reunites the main force of his army just behind Nivelles (Nijvel) and decides to search and pursue the Austrian army in three columns. He receives the information that scouts can hear trumpets and sounds of the cavalry. The column under command of Lefebvre was going in the direction Braine L’Alleud, Morlot heads for the road Charleroi-Brussels, and the cavalry of Dubois supports both. The Prince of Cobourg had united his troops around Waterloo (probably Mont-Saint-Jean) and was heading eastwards. He also decided to move his army into three columns. The first column headed to Ottignies via Chapelle Saint Lambert. The second column has to go to Onze Lieve Vrouw van Bonsecours (Ceroux-Mousty) via la Papelotte and Lasne. The last column headed for Wavre via Tombeek. The troops of Nauendorf and Hadik have to form an uninterrupted line between Bousval and Villeroux to protect the troop movements (Cecille, Charlet & Pattyn 2015, 53-54). The Dutch corps, the legions of Béon and Damas, are sent to the castle-farm Hougoumont and are joined (or received later, Croatian jaegers as support). Bernard van Corbehem, who was in Damas’ legion, wrote: “arrived at the castle-farm Hougoumont, which was a huge and beautiful farm, we had to
silence a piece of light artillery which the enemy had positioned on the heights that dominates the south. I suffered at this occasion a great danger. When we marched in two’s in front of the main building, and we passed the right side of the chambers, a bullet, fired at the height of my belt, passed a foot in front of me and punctured the wall on my left. As soon as the troops had passed, we layed in an ambush along the hedges that grow in abundance in this area, and we waited for the enemy who did not expect us there. He would even retreat when the night fell. Some days passed in this position in which we were disturbed regularly by their light cavalry and by fire of their artillery, without seriously attacking or suffering us (Cecille, Charlet & Pattyn 2015, 54).”

The French were pursuing the Austrian rear through Genappe. They managed to free the road to Mont-Saint-Jean. The Dutch Prince Frederick of Orange said that the area can be well protected. Outside Braine-L’Alleud are platforms constructed for Dutch artillery, and he states about Hougoumont: “The castle of Hougoumont (a pompous name for a castle in bad condition) has its property protected by a strong wall in which the men of Béon and Damas constructed loopholes for its defence (Cecille, Charlet & Pattyn 2015, 56).” The Prince of Orange regroups his men near Braine-L’Alleud. Damas was responsible for covering the retreat, while his outpost stayed as long as possible in their position. The castle is evacuated in good order by the émigrés and Croats (Cecille, Charlet & Pattyn 2015, 59).

Eventually the French have the advantage in this battle. But they were stopped just outside Braine L’Alleud. After a day fighting, both armies are tired and sound the retreat. The French decided to camp in the forest of Hougoumont. In general, the French were able to gain new ground, but lacked a lot of resources. The Prince of Orange retreated the next day to Brussels, but because of the lack of
resources the French do not pursue them. But the road to Brussels was free, which was captured on the July 9th 1974 (Cecille, Charlet & Pattyn 2015, 62).

Although the battle caused some damage in its surroundings (Henry Boucqueau, the farmer of le Caillou, suffered heavy damages on the farm-building and land) the Hougoumont farm itself did not suffer much from damage. But Austrian forces pillaged the farm first, followed by Croat chasseurs who then occupied the farm. Bernard de Corbehem states that they chased away the inhabitants of the farm to Braine-l’Alleud. Then they started to destroy the rooms, break down windows and doors, discover and steal silver objects and fight mutually with sables. Their officers administered judgement after some complaints and hanged two delinquents from trees in the orchard as examples (Cecille, Charlet & Pattyn 2015, 81).

The Battle of Mont-Saint-Jean is not the correct name for the battle, but a name that was recently given. There are several contemporary sources that mention a Battle of Waterloo. In a report from December 3rd 1794, the people’s representative Gillet announces that: “The army of the Sambre-et-Meuse (…) has conquered the coalition: at Fleurus on June 26th; at Mont-Palisel in front of Mons on July 1st, at Waterloo, before Brussels at July 6th” (Cecille, Charlet & Pattyn 2015, 82).” Also Jeanne van Beughem writes in his journal about “a bloody battle at Waterloo” (Cecille, Charlet & Pattyn 2015, 82).

It is not that surprising that the battle at that time was named after Waterloo instead of Hougoumont, Mont-Saint-Jean or another local place name. Waterloo was quite well known as it was the largest village in the surroundings, but also because of the many inns, many travellers passed by or stayed at Waterloo.

Nowadays we speak of the Battle of Mont-Saint-Jean, because 21 -years later a more famous battle occurred. The Battle of Waterloo would overshadow this smaller and insignificant battle, but also take its name. Now Waterloo is synonymous for the battle in 1815 and not the battle in 1794.

**Battle of Waterloo 1815**

After Napoleon’s return from Elba, he retook the French throne in 100 days (Adkin 2001, 18). Allied nations such as Great Britain, Prussia and the new United Kingdom of the Netherlands could not accept Napoleons return, and started grouping forces in Belgium. Napoleon knew that he had to act first or the Allied armies would meet and merge. On June 16th 1815, the French army was slowed down at Quatre-Bras by Dutch and British forces, but the Prussian army at Ligny were defeated. Both armies retreated north. In particular, the Anglo-Dutch army of Wellington retreated from Quatre-Bras to a ridge just south of Waterloo. This would be the place where the famous Battle of Waterloo
was fought. As many books have already described the events of that day, this section will only discuss the events at and around Hougoumont. Although this section describes the events in and around Hougoumon by discussing the main attacks, we have to mention that there was almost constant fighting at Hougoumont.

It is still not clear at what time the battle started exactly, but it is commonly accepted to be at 11.30 am (Paget & Saunders 2001, 43). However, we do know that the first attack was the attack on Hougoumont under the command of Prince Jerôme Bonaparte. He attacked the farm from the south and had therefore to cross the forest to the south of Hougoumont. This forest was occupied by Hanoverian and Nassau troops. These Allied troops were supported by an artillery battery on a ridge in the north of Hougoumont. This slowed down the French attack. Eventually Jerôme got support in the forest from Baudin’s brigade. The French forces pushed the Allied troops out of the forest in the direction of the south edge of the orchard of Hougoumont. The French reached the northern edge of the forest and were visible from the farm. They were easy targets for the Allied troops who fired from the loopholes, over the wall and from windows in the Gardeners house (Paget & Saunders 2001, 46; Adkin 2001, 329).

The Nassau and Hanoverian troops who were pushed back to the orchard were pushed back even further, across the orchard to the Hollow Way or Sunken Road. They received reinforcements from the British troops inside Hougoumont and attacked the French troops who were now in the orchard. The Allied forces managed to push the French out of the orchard and back into the forest (Paget & Saunders 2001, 46).

The attacks on Hougoumont were supposed to just be a deviation, but Jerôme sent in a second attack (Adkin 2001, 336). It was decided to attack Hougoumont from three directions. Jerôme would attack from the west, Soye’s brigade would, as the first attack, attack from the forest in the south of Hougoumont. Piré’s light cavalry would make a flanking movement and swing in from the north (Paget & Saunders 2001, 48).

At this point in the battle, a detachment of the light company of the 3rd Guards under the command of lieutenant-colonel Charles Dashwood was at the south-west corner outside Hougoumont. They
were pushed by the French attack in the direction of the north gate of the farm. The retreating light company entered Hougoumont through the north gate, but the French attackers followed closely (Glover 2006, 19; Paget & Saunders 2001, 49). They tried to breach the half-open gate and eventually forced it open. A group of approximately 30 to 40 men entered the courtyard (Adkin 2001, 330; Paget & Saunders 2001, 51). They did not stand a chance as the received fire from all directions. The gate was quickly barricaded by officers of the Coldstream Guards. According to the legend, this was the only time French troops managed to enter Hougoumont. After this close call, the remainder of the 2nd battalion Coldstream Guards was sent to Hougoumont as reinforcements. They pushed the French back from the north gate all the way to the woods in the south (Paget & Saunders 2001, 54).

Jerôme, still determined, sent a third attack around 12.45 pm. Foy’s division and Gautier’s brigade started to outflank the defences in the orchard. Two companies of the 3rd Guards were send to repulse the attack. The French were successful and pushed them back out of the orchard (Paget & Saunders 2001, 54).

As the French attacks were not sufficient to capture the farm, it was decided to bring in a howitzer. According to the writers Adkin, Paget and Saunder, the location of the howitzer was in the north-east corner of the forest (Adkin 2001, 340; Paget & Saunders 2001, 58). Lord Saltoun, who was in charge of the Allied troops in the orchard, decided that the howitzer should be captured or silenced in a different manner. But his troops were already engaged since the beginning of the battle and were therefore tired. The attack was repelled and they were even driven back again to the Hollow Way. It was decided to retreat the men and replace them with fresh troops from the 2nd battalion of the 3rd Guards. They successfully drove back the French from the orchard. The 3rd Guards received more fresh troops, one Brunswick battalion and two Kings German Legion battalions (Paget & Saunders 2001, 58-59).

Between 2 and 3 o’clock, a new attack was launched by general Bachelu. But this attack was broken up before it reached the orchard. The attack came from the direction of La Belle Alliance in a north-east direction of Hougoumont. It diagonally crossed the battlefield and came under heavy Allied artillery fire (Adkin 2001, 333; Paget & Saunders 2001, 61).

The French then decided to shell Hougoumont. The idea was to set the farm on fire so the Allied troops had to abandon it. However, even after the shelling, the Allied troops stayed as long as possible in the burning buildings but never left the estate (Adkin 2001, 329; Glover 2006, 26; Paget & Saunders 2001, 63).

The shelling was followed by another attack. Two regiments of Foy’s division and the remnants of Bachelu’s division came from a north-easterly direction to the orchard. Again, the Allied troops were pushed back to the Hollow Way. Thanks to the fire of the Coldstream Guards from the garden wall, the Allied troops managed to retake the orchard (Paget & Saunders 2001, 68).
The last attack came from remnants of Foy’s division. Although the Old Guard were already retreating in the centre of the battlefield, nobody noticed it due to the ongoing attack. The news of the retreating French army, and the ensuing pursuit of the Allied line reached the Allied troops at Hougoumont. The 3rd Guards joined the pursuit of the French. But the men, who fought the whole day at Hougoumont, stayed at the farm and watched the event in awe (Paget & Saunders 2001, 73).

We can say that Napoleon and Jerôme got dragged away by Hougoumont, as he did not want to capture Hougoumont. Eventually the French lost 23% of their infantry around Hougoumont (Adkin 2001, 336). That is a high cost for just a deviation. It is estimated that around 210,000 rounds were fired around Hougoumont that day (Adkin 2001, 342-343). And these are the objects that we will analyse.

After the Battle of Waterloo
The farm was heavily damaged after the bombardment as it set ablaze many buildings on the estate. De Louiville found it impossible to restore the damaged buildings and decided to sell the estate to Comte François-Xavier de Robiano in 1816. He promised that he would preserve the remaining buildings. After some inheritances, the estate came into the ownership of the d’Outremont family (Waterloo Uncovered 2015, 5).

![Figure 7. Ruin of Hougoumont, 1820-1850, anonymous (Rijksmuseum Amsterdam).](image-url)
In 2013, the estate was sold by Comte Guibert d’Outremont to the Intercommunale 1815. In light of the bicentenary of the Battle of Waterloo, the Project Hougoumont raised to money to renovate the estate. The renovation was finished in 2015, and Hougoumont became the centrepiece for the Waterloo 200 commemorations (Project Hougoumont website).
Weaponry

The excavations at Hougoumont have retrieved a large amount of lead shot. To identify the weapon it came from, we have to match the calibre/seize lead shot to a weapon. But before we can actually start matching them, we need to take some preliminary steps. First, we have to know who were present at Hougoumont, not only during the battle of 1815, but also during the battle of 1794. The fighting of this battle will also have left lead shot trails. With that information, we then can argue what kind of weapons these regiments carried at that time and place. Finally, we have to have a look at the weapons themselves; what kind of projectiles did the weapons fire, and more importantly, what size are the projectiles. With this information to hand, we can start appointing individual lead shot to a possible individual weapon. To make this chapter better organized, we shall discuss at each section the Allied information, followed by the French information.

Who were at and in the surrounding of Hougoumont in 1794 and what weapons did they have?

In the previous chapter we already named the forces that were present at Hougoumont during the Battle of Mont-Saint-Jean. The legions of Béon and Damas were in under Dutch command. They were reinforced by Croatian jaegers, mostly likely from the brigade of Field marshal Beaulieu battalion of Slav Freikorps (Cecille, Charlet & Pattyn 2015, 33). It is difficult to say what weapons these forces were equipped with, especially for the legions of Béon and Dumas.

There is limited information about the Austrian army in the early Napoleonic Era, let alone on the Croatian jaeger freikorps. We do not know exactly what type of weapons they carried. However, the name jaeger suggests they were equipped with some kind of rifle. However, we know that in the early 18th century, German and Suisse rifles were in favour (Stutzenberger 2014, 4). Given the popularity and geographic closeness of these regions to Austria, it is not unthinkable that these types of weapons could have been used by Austrian forces. If this was the case, the calibre of the weapon would be 15.75 millimetres.

Another option is the Girandoni air rifle or Windbüchse. This Austrian air rifle was introduced in 1780 and had a calibre of 11.68 millimetres although some claim it was 11.75 (Beeman website). As an Austrian product, it is possible that the Croat jaegers were armed with this weapon.

It is difficult to determine what weapon the legions of Béon and Damas were equipped with because these troops were formed out of so-called émigrés, but under the command of the Dutch. Émigrés were Frenchmen who fled France after the Revolution (Zelm van Eldrik 2003). They joined foreign forces to fight back and restore the French monarchy. This poses a problem regarding their equipment were they armed by the Dutch army, or did they have their own weapons? Analysis of
Dutch, or so-called Generaliteits weapons from the period before 1794 showed a large variety of weapons and calibres. But we can distinguish three calibre sizes: the first group ranges from 16.20 to 16.50 millimetres, the second is following the French Charleville for example with a calibre of 17.50 millimetres, and the third group are quite large calibres with sizes around 19.20 millimetres. The Netherlands did continue to have a very large variety of calibres, as an inventory in 1817 produced a list with at least 10 different calibres (Visser & Puype 1996; Vries & Martens 2001, 27).

However, if the émigrés brought their own weapons or preferred the weapon that they were accustomed to, it is most likely that they were armed with the French Charleville weapon. If that is the case, then they were using the same musket as the French army in 1794, but also in 1815.

The French infantry was equipped with the Charleville 1777-IX musket. The French weapons are all codified under the reign of Louis XVI in 1777. The weapons of the infantry, the dragoons, the artillery and the cavalry, have in general the same mechanisms and calibres (Tulard 1987, 110). As the year 1777 already suggests, these weapons were already used during the Battle of Mont-Saint-Jean in 1794. The name originates from the arsenal in Charleville-Mézières that was the main arsenal that produced this musket. As stated before, the mechanisms and calibres of the weapons used by the different French forces were standardized. Most of these weapons had a calibre of 17.53 millimetres (Tulard 1987, 111).

Who were at and in the surroundings of Hougoumont in 1815 and what weapons did they have?

Because of the many accounts produced on the Battle of Waterloo and the fighting at Hougoumont, we know quite precisely which troops were located there. However, this does not mean that we know which weapons they were equipped with.

Adkin provides a detailed list of troops present at Hougoumont throughout the day. These units included:

- 1st Foot Guards Light Company
- 2nd and 3rd Battalion
- Coldstream Guards 2nd Battalion
- 3rd Foot Guards 2nd Battalion
- 2nd Kings German Legion
- Hanoverian Battalion Saltzgitter Landwehr
- Brunswick Battalion Advance Guards  
- Brunswick Leib battalion  
- Brunswick 1st Light Battalion  
- 6 companies of Nassau troops

The French Army attacked with:
- 1st Légère  
- 2nd Légère  
- Baudin’s Brigade  
- Soye’s Brigade  
- Jerômes 6th Infantry Division  
- Foy’s 9th Infantry Division (Adkin 2001, 337-341).

This research did not find any sources about the equipment of the Hanoverian and Nassau troops who were in the forest slowing down the first attack of Jerôme. But it is reasonable to argue that they would have the same arms as Great Britain and Prussia. Hanover was in a personal union with George III after the Congress of Vienna. With the Congress of Vienna the Dutch king had exchanged Nassau for Luxembourg, but the Nassau troops were still part of the Dutch forces (Simpkin 1988, 86). It is therefore likely that they used the same weapons.

The British troops were equipped with the “Brown Bess”. The New Short Land Pattern ‘Brown Bess’ was already manufactured in 1730. It was created to standardize the British armaments (Haythornthwaite 1998, 23). The type that was used at Waterloo was the India Pattern ‘Brown Bess’. It had a calibre of 18.30 millimetres. These weapons were also distributed in 1812 and 1813 to Allied nations such as Prussia, but also to the Netherlands since 1813. Almost all the muskets of the Allies at Waterloo were therefore Brown Bess muskets. This was very useful because the Allied forces could now use each other’s ammunition (Vries & Martens 2001, 36).

The Hanoverian and Nassau troops in the forest were Jaegers. These troops were equipped with rifles. Because of the rifling in the barrel that gives the projectile a spin, the projectile will follow a more precise flight course and is therefore more precise (Haythornthwaite 1998, 24). The British army used the Baker-rifle, which had a calibre of 15.62 (Stutzenberger 2014, 5). It is therefore likely that the Hanoverian and Nassau troops had the same rifle.

As stated before, the French troops were equipped with the Charleville musket from 1777 onwards, and the same at Waterloo. However, officers were armed with the infantry’s carbine model XII. The major problem with this weapon was
that it did not have a bayonet. After discharging its weapon, the officer would be defenceless against aggressors. The carbine was smaller and lighter than the Charleville musket, and fired 14.40 millimetre projectiles (Tulard 1987, 111).

**Pistols**

So far only three French pistols have been found with calibres that deviate from the standard 17.53 millimetres. The first one is the model XIII cavalry pistol. As the name already suggests, this pistol was assigned to the cavalry. Although very close to the standard calibre, its projectiles were 17.10 millimetres. The second pistol was assigned to the gendarmerie. It was a modified version of the model IX, but it fired smaller projectiles. The calibre was only 15.20 millimetres. The mamelukes of the French army had another calibre pistol. This pistol had a calibre of 14.40 millimetres. Although most of these groups were not active around Hougoumont, it provides an indication of the calibre pistol balls that were used by the French army at the time of the Battle of Waterloo (Tulard 1987, 118).

A different option could be that many officers carried their own private pistol, both in the French and Allied forces. A pistol was not only a weapon, but also a symbol of power and prestige. Many of these pistols had a calibre ranging from 14.50 to 8.00 millimetres. This shows the great variety of calibres that these private pistols had. It is therefore possible that that there are even smaller pistol calibres (Visser & Puype 1996).

**Canister or tin case shot**

Although this section gets ahead on the subject, we have to discuss the canister or tin case shot. The Waterloo assemblage contains multiple canister shots. However, the written accounts do not state the use of this type of shot in this area. Canister shots are fired by canons, and can be compared with a large shotgun. A cylindrical tin case is filled with lead balls, the size comparable to that of musket balls. It is used as antipersonnel weapon against infantry as the many balls can harm a large group of men. When fired, the musket ball sized balls scatter in a wide fan out of the muzzle (Sivilich 2016, 92; Schürger 2015, 194; Pollard 2009, 147). As we do not have any written sources, we do not know who fired the canister. It could therefore be French or British.
Archaeological Perspectives on Waterloo

Emiel Picard – 2225196P

As stated in the introduction, the analysis of lead shot is an underestimated source of information, but this also has something to do with the fact that the study of lead shot is still underdeveloped (Pollard 2009, 144; Foard 2012; Sivilich 2015; Schürger). The first attempt to systematically analyse lead shot in the UK was not until 2008, when Glenn Foard published a book on English Civil War lead shot. Some similar work has been done by Sivilich on assemblages of American Revolutionary battlefields and encampments (Sivilich 2016). Their publications on lead shot are quite unique, but are still focusing on specific eras. Often, excavations in Great Britain produced great assemblages of lead shot, but they were not or not often analysed and published (Schürger 2015, 124). The Waterloo Uncovered project is a good example of this as well. The lead shots (and other artefacts) of the excavation in 2015 were brought to Glasgow University for analysing. However, they were not analysed until someone volunteered to do the analysing as a dissertation project. This means that useful information has been lying about for over a year, which is valuable time wasted.

By producing a methodology that allows analysing lead shot in the field, lead shot will prove itself as a useful source of information already during an excavation, but more importantly, we do not have to wait for someone who is willing to analyse the lead shot. As a researcher, you would want to have the most important information available as fast as possible.

During an excavation time and money are essential, but limited. The field methodology should therefore be quick, cheap, but at the same time thorough. It also should not disturb the recording process of other artefacts during the excavation. The methodology for analysing lead shot in the field has specifically been produced for and trialled during the Waterloo Uncovered excavation of 2016. Certain problems and other findings that came forward during the trial are discussed below. The field analysis methodology has been divided into two main stages: analysing lead shot itself and analysing lead shot distribution patterns.

Excavating lead shot

Metal detection has long been a controversial technique in archaeology due to its relation with looters of archaeological grounds. It is now an accepted technique in archaeology and has proven its value for conflict archaeology when it was used en masse at the excavation of the Battle of Little Bighorn (Scott & Bozel 1989, 25). Metal detectors are effective on battlefields due to the fact that many artefacts related to conflict are made from metals (Scott & McFeaters 2011, 106)

The battlefield of Waterloo is a protected area by the Walloon authorities. This means that it is illegal to metal detect this area without permission from the Walloon authorities. But there is still...
Archaeological Perspectives on Waterloo

Emiel Picard – 2225196P

evidence that this was ignored by metal detectorists. Hougoumont in particular is probably a good victim, as its walls and trees provide a good cover to work unobserved. When the Waterloo Uncovered team conducted a geophysics survey in 2015, two metal detectorists were seen metal detecting. When the metal detecting survey went further away from the wall into more open spaces, more artefacts were recovered (Waterloo Uncovered 2015, 28).

The metal detectorists walked in intervals of 5 metres next to each other across the field. Whenever the metal detectors received a signal, the practitioner marked the location. Sometimes an experienced metal detectorist can tell what kind of metal it is just by the signal (Sutherland 2005, 21). Before removing the object from its context, it is mapped with a GPS system. This will later be processed into a map to see clearly where it was found, and if certain patterns can be identified.

When the metal detecting survey worked on the Killing Zone, it was obvious that unauthorised and illegal metal detecting had had a profound impact on the archaeological record in and around Hougoumont. One would expect a high concentration of metal objects in the topsoil, considering the heavy fighting and high casualty numbers in this zone. However, only two musket balls were retrieved (Waterloo Uncovered 2015, 27). This was a pessimistic omen for the project. It was then thought to remove the topsoil, so that metal detectors could detect deeper into the ground. This had a positive result, as many more objects were then detected.

**Analysing lead shot**

As mentioned before, an excavation is always under time and money pressures. Analysing objects can be a time consuming occupation, which can slow down the registration process during an excavation. It is therefore useful to make a distinction in analysing the objects between information that is useful and easily obtainable in the least amount of time, and information that can be gained after thorough analysis, sometimes with special instruments. As we all can understand, the low-tech short time analysis of the lead shot can be achieved in the field already. Therefore, we divide the analysis of the objects between in the field analysis and off the field analysis.

In the previous chapter we discussed the various weapons and calibre of the ammunition used in and around Hougoumont. During the Waterloo Uncovered excavation of 2016, we focused on identifying the type and nationality of the shots. We can answer that question in the field by weighing and measuring the lead shots with a simple scale (in decimals) and a calliper.

In most of the research on lead shot, the preferred and primary choice of identifying the type of lead shot is to measure the lead shot. One would measure the length and perpendicular direction of the object with the calliper, so a cross measurement is taken. In ideal circumstances, one of the measurements is taken on the mould seam, if visible. Simply measuring the lead shot would provide
the calibre that we can match with one of the weapons. It would be very easy if all the lead shots were still perfectly round without any deformation, but sadly 76.9% of the lead shots recovered during the excavations of 2015 and 2016 were deformed. Therefore, measuring the lead shot is a secondary method of identifying lead shot for the objects recovered during the Waterloo Uncovered excavations.

We need a different primary way to identify the type of lead shot from Waterloo. Weighing the lead shot can identify it, but we need some extra stages. In 1995, Dan Sivilich developed a formula to calculate the diameter, and therefore the calibre, of lead shot that had been completely flattened and deformed (Sivilich 1996, 104). The Sivilich formula is:

\[
\text{Diameter in inches} = 0.223204 \times (\text{weight in grams})^{1/3}
\]

This research did not have the equipment nor the time to calculate the exact density of each individual lead shot. Therefore, it used the exact formula that Sivilich used for its calculations. To test the accuracy of Sivilich’s formula, the formula was used on undeformed lead shots from the Waterloo Uncovered assemblage. The results from the formula were close to the measured diameter of the lead shots, often deviating only a few hundredths of a millimetre. It was therefore concluded that the Sivilich formula was useable to calculate the diameter of deformed lead shot, and therefore to identify the calibre and the weapon it was fired from, and from that information we can identify the nationality of the lead shot. With the results from weighing and measuring the lead shot, we can identify what type of lead shot (musket ball, pistol ball or canister shot) it is, and also which nationality the lead shot has.

It is noteworthy to mention that this research only uses the results from the Sivilich formula as indicative values. Without the equipment to measure the exact lead density of each individual lead shot, the results might deviate from the calculated diameter when using the measured lead density of an individual lead shot.

This fast identification of lead shot in the field is essential for a successful excavation. By identifying round or deformed lead shot, we can quickly see who shot what individual projectile. The resulting data can then be used to identify clusters and concentrations of same type calibre fire.
Again, these distribution patterns can identify certain areas of interest for an archaeologist and the excavation. These distribution patterns will be further discussed below.

The next step is to analyse the individual lead shot for deformations and markings. These markings can tell us several things, such as the manufacturing process, firing, impact, and much more. This research focused on the markings on the lead shot if they were fired or dropped, the severity of deformation, special features and the patina. To observe these features and deformations, the lead shot should first be cleaned. This can be done in water, as lead shots are made of lead, and lead does not rust as other metal and iron objects do. Lead is a soft metal, so to make sure no damage is done to the lead shot, no brush is used. Just by rubbing the lead shot in between the fingers, it will clean the object sufficiently for further analysis.

Another aspect that most of the time can easily been observed if is a lead shot is fired or dropped. This is interesting because one mostly loads his musket when standing still. As we have discussed before, 76.9% of the retrieved lead shot was deformed. In general, deformation is the result of firing and impacting, so that means the lead shot was fired. A ramrod mark is also a sign of firing, as the ramrod is only used when the lead shot is already in the barrel. The most common deformation or marking is the banded bullet or barrel band. This band is formed when the shot is leaving the barrel. It forms either because the lead shot was too big for the barrel and had to be rammed down, or it forms when the lead shot is fired and bounces against the barrel. The banding often happens at the widest part of the lead shot, either all the way around or just on a part of it. In the band linear striations are visible, which sometimes can be confused with rifle marks from a rifled barrel (Sivilich 2016, 49; Foard 2012, 106-107).

So markings can also help us identify the type of lead shot. Not just rifle bullets can be identified by inspecting the markings. Canister or tin case shot have very specific markings on them as well. Canister or tin case shot is a type of antipersonnel artillery ammunition, formed by small lead shot in a cylindrical tin-box. The amount of lead shot in the case can vary based on the calibre of the canon. But the rule is that the weight of the canister or tin case shot should be the equivalent of a lead round shot for that canon (Sivilich 2016, 93; Foard 2012, 87; Schürger 2015, 194). As described by Otto de Scheel in 1800, the musket ball canister shot was mostly used for 12 and 16 pounders (Williams 1984, 78). The small lead shot from the tin case is easily identifiable because of the shape and the impressions on the lead shot. De Scheel states on the lead shot: “These balls were observed to adhere one to another; sometimes they remained so, melted in the oddest forms, and they did their full effect in one lump” (Williams 1984, 79). The shapes of canister lead shot are often odd, but if they stay relatively in their spherical shape, then they often carry the resemblance of hexagonal dice. The combination of heat and pressure on other lead shots in the tin-case causes these deformations (Foard 2012, 89).
The deformation and markings do not only provide information on if the lead shot was fired or dropped, but it can also provide information on what the lead shot had impacted on. However, this research did not look into what the lead shot possibly hit. When conducting this research, the only publication that provided limited information on deformation of lead shot was from Glenn Foard (Foard 2012). It however did not discuss any information on how to tell what a lead shot had impacted on. This was only published in March 2016 by Sivilich, but it was too late to use that information in the analysis of the 2015 and 2016 Waterloo Uncovered assemblages.

Other features are also visible on a lead shot and tell us something about the production of the lead shot. These features are a mould seam, sprue and when the sprue is visibly removed, the sprue snip. However, these features do not play a role in this research, as they do not provide any information to the events of the battle. If you are interested in the logistical aspect of the battle and the production of lead shot, these features are very interesting.

**Analysing lead shot distribution patterns**

Douglas Scott, seen by some as the father of conflict/battlefield archaeology, saw the importance of analysing bullet and bullet casings and how they were distributed over the battlefield. In 1980, he excavated the battlefield of Little Bighorn (1876) in the United States. Through analysing bullets and bullet casings, he searched for which bullet matched which casing. Through this analysing he was able to match the found casings and bullets, and so could conclude that they came from one particular weapon. He could now draw the routes that the men had followed during the battle, following the trace they left by the distribution patterns of bullet and casings (Scott & Bozel 1989).

Of course, in the surroundings of Hougoumont and the Battle of Waterloo as a whole, bullet casings did not exist yet. But the excavation of Little Bighorn shows us how distribution patterns can provide new information and expand our knowledge of events.

Although in a different way, the distribution patterns of lead shot in and around Hougoumont can provide us also with new insights in the fighting around Hougoumont. Without the matching bullets and casings, we cannot recreate the routes for individual men. But the combination of location, density, the identification and analysis of lead shot, can recreate the routes of individuals. The fact that investigating distribution patterns can help us understand battles has already been proven by numerous battlefields such as Culloden, Edgehill and Monmouth (Pollard 2009; Foard 2012; Svilich 2016). For example, clusters of small arms fire suggest that there was close-quarter fighting. The range for these types of weapons was very limited. But a high concentration of lead shot in a given space would suggest centres of heavy fighting.
This information, combined with the written sources that are available, can help us understand certain concentrations of patterns, but also can match the archaeological record with the written records. We can match the centre of fighting with certain passages of an eyewitness account. We can put people’s story in the landscapes, and locations in the accounts.
The results (analysing individual lead shot)

The Waterloo Uncovered excavations of 2015 and 2016 provided a large and varied assemblage of lead shot. Through the methodology discussed in the previous chapter, the lead shot was analysed. The assemblage from the excavation in 2015 was analysed at the University of Glasgow, where most of the recovered artefacts were brought for analysis. The lead shot recovered during the 2016 excavation were analysed at Hougoumont itself, also to trial the newly designed methodology. As discussed in the previous chapter, measurements will not be our primary criteria to identify lead shot. Because of the many deformed lead shots, we will be mostly using weight, and corresponding that to a size. A complete overview of the individual lead shot analysis can be found in Appendix I.

General analysis

The excavations of 2015 and 2016 produced a large assemblage of lead shot. A total of 650 objects has positively been identified as lead shot or as possible lead shot. Of these lead shots 361 were recovered during the excavation of 2015, and 289 were excavated during the excavation of 2016 last July. For a quick observation, the weight of each individual shot was put in a scatterplot (Figure 1).

![Figure 1](scatter_plot.png)

*Figure 1. Scatter plot of all the lead shot based on weight.*

The scatterplot shows two distinctive bands. This means much of the lead shot’s weight is about the same. The heaviest band is around 30 grams per individual shot. The other band is around 24 grams. Through the Sivilich formula and our knowledge of used lead shot calibres, we can
conclude that the 30 grams band is from Brown Bess muskets. The 24 gram band is from the Charleville musket.

But this is only a quick observation. To be more precise, we have to have a look at more precise weights, but also how many shots we have recovered in 2015 and 2016 with a specific weight. Instead of weight, we will now use sizes, converted with the Sivilich formula (Figure 12). In this bar chart there are two extreme peaks at 30.0 grams and at 23.5 grams. Furthermore, is there a small grouping around 19.0 grams, and also some very small groupings around 10.0 grams, 8.0 and 6.4 grams.

To make our analysis more organized and clear, we will take a look at different types of lead shot discussed in the previous chapters, and see if they compare with the peaks in this bar chart. The groups that we will analyse are musket balls, rifle shots and pistol balls.

**Figure 12. Amount of lead shot for specific size.**

**Musket balls**

The first group to discuss, are the musket balls. Sivilich has done thorough investigation of multiple American Revolutionary War encampments. Because this research does not work with inches, but also because the diameter is not the primary criteria to identify the lead shot, this research changed the measurements from inches to millimetres and has to recalculate to weight for identification purposes.

Sivilich’s research came to the conclusion that typically, musket balls with a diameter between 15.24 millimetres and 16.76 millimetres were used by the French Charleville musket. Lead shot with a diameter greater than 16.76 were used by the British Brown Bess (Sivilich 2016, 28). The
limits used by Sivilich are projected on the Waterloo assemblage in Figure 13. This research will use these limits from Sivilich’s research. However, this research will criticise these limits if the results from the analysis show differences from Sivilich’s work.

According to the limits used by Sivilich, the divide between French Charleville and British/Allied Brown Bess lead shot should be at 16.76 millimetres (Figure 14). However, it seems that for the assemblage of Waterloo, this divide is misplaced because it breaks the downwards trend from 16.25 millimetres and the upwards trend towards 17.62 millimetres. The gap at around 16.99 millimetres is therefore more likely to mark the divide between Charleville and Brown Bess projectiles. Musket balls with a size from 17.00 millimetres upwards, fits in the rising trend to the peak of the Brown Bess projectiles, while from the 17.00 millimetres towards the peak of the Charleville projectiles is also logical.
The idea that 17.00 millimetres is the dividing mark is plausible. As discussed in previous chapters, we have seen barrel band markings. These markings arise when the musket ball just fits in. Taking into account that the muzzle of the Charleville musket is 17.53 millimetres, it is not surprising that musket balls only had 0.53 millimetres of space in the barrel.

Another point of critique is the lower limits that Sivilich uses to mark the lowest size/weight for the Charleville projectiles. Although not unthinkable, the lower limit of 15.24 millimetres conflicts with the upwards trend towards sizes smaller than 15.24 millimetres. The upwards trend really starts at 15.74 millimetres, but the calibre of the British Baker rifle is 15.62 millimetres. Musket balls between 15.74 and 15.62 could be a mixture of Baker and Charleville projectile. However, rifle projectiles have to have a tight fit, as the rifling should have a grip on the projectile when fired. But it is the writer’s opinion that the projectiles smaller than 15.74 millimetres are not Charleville musket balls, as they do not fit in the upwards trend and the gap.

It is therefore most likely that musket balls of the Waterloo assemblage with a diameter between 15.62 and 17.00 millimetres are Charleville musket balls, and lead shot with a diameter greater than 17.00 are Brown Bess musket balls (Figure 15).

Figure 15. The writer’s proposed limits for the musket balls.
Rifle shots
We had criticized Sivilich’s limits for the divide between rifle projectiles and Charleville musket balls. The fact that the Waterloo assemblage suggests a different limit than Sivilich’s is not surprising. Sivilich based his limits on the projectiles from the American Revolutionary Wars (1775-1783). We set the extreme limit for this group at 15.62 millimetres, as this is the calibre of the British Baker rifle, and the lower limit at 14.48 millimetres, as this fits in the trend of the assemblage (Figure 16).

The analysis of the Waterloo assemblage for rifle projectiles came to a surprising result. So far, the excavations only has identified six possible rifle projectiles. As stated in a previous chapter, the markings caused by a rifled muzzle can sometimes be confused with the striations of a barrel band. However, after weighing and measuring the projectiles, it was clear that most of the were too large to actually be rifle projectiles. Therefore further analysis is necessary.

Pistol balls
The Waterloo excavations have so far produced 60 possible pistol balls. As stated before, it is not possible to provide a nationality for pistol balls as they were not standardized. But it is interesting to see the groupings of projectiles around certain weights. This suggests that there were some pistols that fired approximately the same projectiles. The largest groupings can be found around 14.29, 13.60, 11.43, 11.24 and 10.63. The largest peak of pistol balls of the same weight is at 8.69
millimetres, where 3 pistol balls had the same weight and size. But without a mass produced pistol, or standard issued pistol, it is almost impossible to assign a specific pistol.

We have to take into account that men, especially officers, had their private pistols. It is often seen at other older battlefields where officers sometimes carried their own pistols (Pollard 2009, 146). These pistols were not only used as weapons, but were often a sign of prestige. We therefore have to take into account the personal pistol. This research found that most of the personal pistols that were produced had a calibre ranging from 15.50 millimetres down to 6.00 millimetres (Visser & Puype 1996). This is seen in the Waterloo assemblage, where the smallest ball has a diameter of 7.14 millimetres.

We have to be careful in naming them pistol balls. Some of them, especially the smallest projectiles of the assemblage, are heavily deformed and could therefore be fragments of musket balls that broke off on impact. Although they appear to be complete pistol balls, it is not certain.

Canister or tin case shots
So far, the Waterloo assemblage contains 11 or 12 canister or tin case projectiles. One of them will be discussed further below, as it is not certain if it is a genuine canister projectile. These projectiles all showed the characteristic hexagonal deformations. These deformations occur when the canister is fired. Due to the pressure and heat, the balls in the canister are pushing against each other (Pollard 2009, 147). The weight of the projectiles varies from 23.2 grams up to 30.3 grams. Using the Sivilich formula, it calculates from 16.17 up to 17.67 millimetres.
Special lead shot

Although this chapter attempts to identify the weapons the projectiles came from and therefore provide a nationality, there are some projectiles that are noteworthy to mention. One of these special projectiles was a lead shot of 55.3 grams. Although identified as canister or tin case shot, it is not certain that it actually is that. This projectile is two musket balls fused together. This could have happened when it was fired as canister.

Another possibility is that the musket it came from was double loaded. When firing the musket, the heat and pressure of the combustion causes the musket balls to melt together. But the projectile is definitely not a “dumbbell”. A dumbbell is a projectile that is purposely casted as two connected musket balls (Foard 2012, 111). There are several reasons why a soldier would fire two musket balls at the same time. One is to produce two projectiles to cause more damage. Another reason could be that the soldier simply forgot in the chaos of war that he already had loaded his musket.

Another quite interesting feature we have seen on 3 balls was the so called “pulled” musket balls. These balls were jammed in the barrel and had to be removed. Another reason to pull a musket ball was for safety reasons. When in camp, it was safer and quieter to pull the musket ball rather than firing it. The musket was not only equipped with a ramrod, but also a worm that could be screwed on to the other end of the ramrod. You can compare the devise with a cork opener. The worm screwed itself into the musket ball and could then be pulled back with the ball attached (Sivilich 2016, 38; Foard 2012, 105).
Battle of Mont-Saint-Jean 1794

As noted, this research and analysis acts from a Waterloo-only perspective. It is possible that certain excavated lead shot belongs to the battle of 1794. However, without complete knowledge of the events and scale of the battle in and around Hougoumont, it is impossible to add this information to the analysis. Even if we knew exactly what happened during that battle, it is still too complicated to tell from what battle a particular lead shot came from. As we have seen in the previous chapter, some weapons were used in both battles, like the Charleville musket. Lead isotope analysis might offer a solution, but with a difference of only 21 years might be too small for lead isotope analysis to bring clarity to this question (Hall et. al. 2010). Also, with around 650 lead shots recovered, it would be a costly and time consuming occupation.

The trailed methodology

Due to the high number of artefacts recovered during the excavation of 2016, the find registration and analysis was under high pressure. Therefore it was quickly decided to abandon the complete analysis of objects, as it started to interrupt the process of registration. The decision was also made to not clean the lead shot with water. It was, like all the other objects, left to dry and then brushed and cleaned with toothpicks.

It was decided to only focus on identifying the type and the nationality of the lead shot through weighing and measuring. However, an exception was made for lead shot that remained mostly spherical. When cleaned, these shots will most likely still have markings and other features visible. This can help us determine, for example, if a musket ball is actually a rifle shot.

It is not impossible to analyse lead shot in the field. It is still the writer's opinion that this could be achieved with this methodology. But it can only be effectively used when there are a lower number of artefacts retrieved, or if there is one person on a team specifically appointed for analysing lead shot. If one of these two criteria is not met, it will be difficult to have a thorough analyses of the lead shot. To analyse for markings and specific features, the lead shot has to be cleaned with water. Also, analysing lead shot for markings and features takes time. One has to be very careful during analysis, as some markings are just a scratch, and some are markings actually made by a rifled weapon. So time is essential for one to be sure of their decisions. But it will take some time, especially with the Waterloo Uncovered excavations which produced such a large number of lead shot. Focusing on identifying the type and nationality of the lead shot can provide valuable information for the excavation and distribution patterns, and produce tentative conclusions.
The results (analysing distribution patterns)

Through the analysing of the lead shot, we can now say what type of shot each object is, but also which nationality an object has. This information, combined with the location that the lead shot was recovered from, enables us to revise the events that happened in and around Hougoumont. Not all of the lead shot have a known location. Some of the lead shot were recovered from the spoil heap and thus were out of context. These objects are not included in the distribution patterns that will be discussed in this chapter. Figure 20 provides a total view of all the lead shot that had a GPS-location.

![Figure 20. Overview of all lead shot with GPS-location at Hougoumont (Service Public de Wallonie (SPW), 2016).](image-url)
Attack through the forest
The first attack on June 18th 1815 by Prince Jerôme’s forces came through the forest to the south of Hougoumont. The forces were slowed down by Nassau and Hanoverian troops, but the forest was eventually taken by the French (Paget & Saunders 2001, 46; Adkin 2001, 329). Although just a small portion of the forest has been surveyed, the area that has been surveyed provides a good view of the fight. The presence of 13 pistol balls suggest fearful fighting and close combat in the trees. The green line represents (as indication) a track that was there in 1815, also visible in Figure 6. This track is also mentioned by Clay when they attacked the French in the woods from the north (Glover 2006, 18). As can be seen, the scatter of pistol and musket shots seems to be on either side of this track. The implication of this pattern is that the track played a role in the fighting in the wood. It was probably used for the French to advance quickly. Rather than walking on the track, the troops were probably aside of the track when fighting ensued to use the trees as cover and not walking in the open to be easy targets.

Figure 21. Distribution pattern in the forest. The old track is marked in green (as indication) (Service Public de Wallonie (SPW), 2016).
Fighting in the Kitchen Garden

The Kitchen Garden is located to the east of the farm. This sector was mainly the location of fighting during the first attack and the attack that resulted in the breaching of the north gate. During the opening of the battle, French skirmishers fired from the field next to the Kitchen Garden in the direction of Hougoumont (Glover 2006, 17). This is represented by the French and Allied musket balls in this area (Figure 22). It could also be the result of the Allied attack to push back the French troops into the wood. The pistol balls suggest that the opposing forces got close to each other.

The Killing Zone

The Killing Zone is an area of open land between the forest and the southern wall of Hougoumont. This strip of open land saw heavy fighting, as it had the highest body count after the battle (Adkin 2001, 332). This fighting is represented by the large number of lead shot that were excavated at this location.
The French attack is represented by the large amount of French musket balls close to the south wall. Most of these muskets hit the wall and fell down to the ground close to this wall. This is proven by the fact that many musket balls are heavily deformed by impacting on a hard surface, but also because some musket balls contain an orange substance. This orange substance probably comes from the brick wall that the shot hit.

Another interesting observation is that there is a gap visible with just a few lead shots, between the musket balls located close to the wall and musket balls located to the direction of the woods. If we take a look at Figure 10, we can see a hedge at that location. This hedge might have been used by the French attackers as cover, but also by the Allied troops to receive the French attack from the woods. Clay mentions that the troops were preparing the hedge so they could fire through it (Glover 2006, 17). The presence of these Allied balls on the wood-side of the Killing Zone is indicative of fire delivered at the base or into the hedge to hit the French attackers, but the fire missed and hit the ground in front or behind them (Figure 24).
The metal detector survey retrieved a total of 15 pistol shots from the Killing Zone. We know that close combat occurred in this area because the Killing Zone itself is only 30 to 40 metres wide. The French tried to reach the wall to attack, and it is therefore not surprising that in these close quarters-fighting pistols were used. But we do not know who fired which pistol ball. Were the Allies firing their pistols from over the wall and through the loopholes to hit the attacking French troops close to the wall, or were the attacking French troops firing at close range at the Allied troops who were firing from over the wall and the loopholes?

**Fighting in the orchard**

We already have discussed the fighting which took place in the orchard. This sector of the battlefield changed hands many times. This is represented by the mixed distribution of French and Allied musket balls on the field. However, there is one notable feature in this area, and that is the distribution pattern of pistol shots. We can see in Figure 25 the diagonal pattern going from the south-west of the field to the north-east. This might suggest that the French attack tried to push the Allied troops in a north-west direction into the Hollow Way. We know that the Allied troops were
pushed back into the Hollow Way on some occasions. This might be done to isolate the Allied forces in Hougoumont even more, as it was already an outpost. The diagonal line of pistol balls could be the location where the two armies met and close-quarter fighting occurred. However, it could also be the other way around that this was a counterattack of the Allied troops to push the French attackers out of the orchard.

![Figure 25. Lead shot distribution in the orchard. Not the diagonal line of pistol balls in yellow (Service Public de Wallonie (SPW), 2016).](image)

**Fighting inside Hougoumont?**

One of the stories about Hougoumont was that the farm, except from the attack on the north gate, was never entered by the French. However, the archaeological and historical records suggests different. Matthew Clay states that he saw the attack on the Lower gate (north gate) which is the known story. But he also mentions that “The enemy’s artillery having forced the upper gates, a party of them rushed in who were as quickly driven back, no one being left inside but a drummer boy without his drum (Glover 2006, 17).” The story of the drummer boy is considered to be part of the attack on the north gate. However, Clay distinctly makes a difference by naming the Upper gate (south gate). Earlier in his writings he mentions the Lower gate, so he makes a particular difference
between the gates. This might be the second time that the French managed to get into the farm. Also, Clay mentions the breaching of a building wall: “After this we were posted to defend a breach made in the wall of the building, it being up stairs and above the gateway, the shattered fragments of the wall being mixed up with the bodies of our dead countrymen (Glover 2006, 27).” This statement suggests a breach was made in a building, but no images shortly after the battle shows any breach in the building. Therefore it could be a breach in one of the walls surrounding Hougoumont.

The idea that the French got into the farm more than once is not only supported by the historical sources, but also the archaeological record suggests this. The presence of multiple lead shot in the formal garden suggests that there was fighting there (Figure 26). French and British musket balls have been found in the walled formal garden. Also, two pistol balls have been found in this area. And again, pistol balls suggest that close quarter-fighting did take place in the formal garden, and therefore the French managed to enter the walled area of Hougoumont.

That the French were able to get into the formal garden is also supported by two locations at the wall where it might have been breached. If we take a look at our first location (Figure 27), we can see that a high density of French musket balls and some pistol balls can be found near the wall. It might be the location of a loophole were French troops managed to fire through. However, a few

Figure 26. Mixed musket balls inside the garden. Also some pistol balls (Service Public de Wallonie (SPW), 2016).
metres to the right of this location, we find a high density of British musket balls inside the walled area. Why would British-fired musket balls be here? These British musket balls could be fired at French troops that breached the wall and tried to enter the garden through that gap.

![Figure 27. First location. High density of french and British musket balls. Also pistol balls on the inside of the wall (Service Public de Wallonie (SPW), 2016).](image)

The second location (Figure 28) of a possible breach is on the eastern wall, separating the Formal garden from the orchard. Both locations show French and British musket balls in high density. Again, pistol balls have been recovered there as well. There is also a single pistol ball about 25 metres to the left of these locations. This means that close quarter-fighting took place here as well.
Locating the canister cannon

As we already mentioned, the Waterloo assemblage contains 11 or 12 canister or tin case shots. As we can see in Figure 29, most of these shots were found in the orchard, but 2 shots were recovered in the Killing Zone and one close to the end or beginning of the Hollow Way. Due to this spreading, it is not possible to include all the shots in our hypotheses that this section will propose. We have to keep in mind as well that most of the shots were recovered from the orchard, which means that during the battle in 1815 there were many trees at this location. These trees could have received many shots which are now gone and impossible to include in our research. Also, this area was not excavated in the way it was done during the excavation of 2016, by removing the topsoil and then metal detector surveying this sector. It is therefore possible that if the project will use the methodology of stripping the top soil at this location and then metal detect survey that area, more shots will be recovered. We also need to keep in mind that not every section of the surroundings of Hougoumont has been excavated. These theories and conclusions are therefore based on the information that we now have and might change in the upcoming years of the project.

Figure 28. Location 2. Many French musket balls, mixed with pistol balls (Service Public de Wallonie (SPW), 2016).
This section will propose multiple locations where the canon that fired the canister stood. The first location is close to the location of the howitzer. The howitzer cannot be used for firing canister or tin case shot, but if a howitzer was brought to this location, a canon could also be brought here (or somewhere else close to the fight). From the possible location of the howitzer, the canon could fire in the direction of where the bulk of the canister shots have been found. The implication of this pattern is that it played a role during one of the fights in the orchard. It could therefore be used during one of the French attacks pushing back the Allied troops to the Hollow Way.

The second proposed location is the south west of the south gate. This location is not only a possibility because of the canister shot, but due to what Matthew Clay from the 2nd battalion Third Foot Guards wrote. He said: “The enemy’s artillery having forced the upper gate (south gate) (...) the enemy’s artillery still continuing their fire, at length a round shot burst them (the south gate) open (Glover 2006, 27).” Although Clay does not mention where the fire came from, it might be the same canon that fired the canister. The canon had to be quite in front of the south gate to be able to hit it. This positions the canon in the south-west of the gate. From that location, canister could possibly have been fired in the direction alongside the southern wall, as canons can both fire round shot and canister shot. This could be done to hit the Allied troops who were defending this wall by firing over
it or through loopholes, with remnants of the shot landing in the orchard. This could also explain the two canister shots in the Killing Zone.

The previous proposed theories assume that the canon which fired the shots was French, but this is not a fact. As with pistol balls, we cannot determine the nationality of the canister shot as all sizes were used by both armies. The last proposed location therefore assumes that the canister was fired by an Allied canon. The third location is like the first location but from an Allied perspective. The implication of this pattern is that it played a role during one of the fights in the orchard. It could therefore be used during one of the French attacks. However, instead of pushing back the Allied troops, it would then be used to push back the French attackers. It is even possible that the two canister shots in the Killing Zone were from the same canon that flew off the walls from the formal garden.
Conclusion

The renewed interest in battlefields such as Waterloo, and other sites related to conflict fits in with the recent trend of approaching these sites from a new archaeological perspective. The discipline is still relatively young and some techniques are still underdeveloped. Lead shot analysis is one of these underdeveloped techniques. Only a handful of researchers have published on this topic. The bicentenary of the Battle of Waterloo provided the right circumstances to organise an excavation, especially the location of Hougoumont, which was renovated for the bicentenary and played an important role during the battle.

Archaeologists often underestimate the information that can be gained from analysing lead shot. The lead shots are often brought back to the university for analysis but are then forgotten or not published. The field methodology used for this research can change this problem.

The main question a project has to ask itself is if it warrants a complete and thorough investigation or an analysis to determine the type of weapon the lead shot was fired from, and the nationality of the lead shot. To facilitate a complete and thorough analysis, this research advises to assign a specific person for this task, so the finds registration is not interrupted. The analysis to determine the type of weapon and the nationality is quicker and will not interrupt the find registration.

Before we can start analysing the lead shot, we had to go through some stages such as the history of Hougoumont. The historical investigation found an interesting fact that is often forgotten when one talks about Waterloo. Not one, but two battles were fought in and around Hougoumont. The Battle of Mont-Saint-Jean was fought in 1794, and was part of the Wars of the First Coalition. The armies of the revolutionary French and Austrian-Dutch army fought a battle on the location which would later become famous for the Battle of Waterloo. Sources mention Hougoumont, where French émigrés legions of Béon and Damas of the Dutch army, together with Croatian jaegers from the Austrian army, were positioned and fought. However, we do not know the scale of the fighting at Hougoumont.

We also had to know what type of weapons were used during both battles, so we could compare the calibre of the lead shots with the calibre used by the armies, to provide a type of weapon and nationality to an individual lead shot. It is not clear what type of weapon was used by the Austrian-Dutch forces located at Hougoumont. In both battles, the French used the same type of gun, the Charleville 1777 with a calibre of 17.53 millimetres. The French émigrés could have used the Charleville musket as well, as they were perhaps accustomed with it. If they had weapons provided by the Dutch, then there are three possible calibres that they could have used: a calibre ranging from 16.20 to 16.50 millimetres, a calibre of 17.50 millimetre, or a calibre of 19.20 millimetres. The
Croatian jaegers had probably a rifle, as jaegers suggest. Therefore, they were likely armed with a German or Suisse rifle, which were in favour at that time. If this was the case, the calibre of the weapon would be 15.75 millimetres. However, they could also be armed with the Austrian Girandoni air rifle, which had a calibre of 11.68 millimetres.

The Allied forces during the Battle of Waterloo were all equipped with the Brown Bess, which had a calibre of 18.30 millimetres. The Hanoverians and Nassau jaegers, who were in the forest to the south of Hougoumont, were probably equipped with the British Baker rifle, which had a calibre of 15.62 millimetres.

We now knew what size of calibres we could expect and which identity they had. The Waterloo assemblage contains 650 lead shots. More than three quarters of the lead shot were heavily deformed. With a formula provided by Sivilich, this research was able to calculate the size and calibre of the deformed lead shot from their weight. By processing the information into a bar chart, we could determine the limits for each type of lead shot. Also, the limits that were proposed by Sivilich for identifying the type of weapon through size were used as an indication. However, the limits proposed by Sivilich did not match the results from the Waterloo assemblage. Therefore, this research proposes to set the limits differently.

The first group were the musket balls. This group was again divided into Charleville and Brown Bess musket balls. This research proposes to set the limits for the Waterloo assemblage with a diameter between 15.62 and 17.00 millimetres for Charleville musket balls, and lead shot with a diameter greater than 17.00 millimetres are Brown Bess musket balls. The second group were rifle shots. This research set the limits between 14.48 and 15.62 millimetres, which again conflicts with the limits proposed by Sivilich. The last group were the pistol balls. We could not match a specific pistol to a specific lead shot, because pistols were not standard issue during both battles. Officers often carried their own private pistol into battle. But the analysis showed peaks at sizes around 14.29, 13.60, 11.43, 11.24 and 10.63. The largest peak of pistol balls of the same weight is at 8.69. These groupings suggest that pistols had a great variety of calibres, but some standard calibres were used.

The Waterloo assemblage also contains canister or tin case shots and other interesting lead shot. The assemblage contains 11 or 12 canister shots. These are identifiable through their hexagonal deformations. The analysis also found two musket balls merged together. Whether these are canister shots or double loaded, is not clear. Another interesting feature was observed on three musket balls. These balls were pulled musket balls. These balls did not leave the muzzle when fired, and had to be removed using a worm.
Through the analysis of individual lead shot, we now know the type and identity of the lead shot. Combining this information with the GPS location of the lead shot, we can look at the distribution patterns.

Attack through the forest to the south of Hougoumont showed musket and pistol balls on either side of a track. The implication of this pattern is that the track played a role in the fighting in the wood to allow troops to advance quickly. The troops probably used the trees as cover. The fact that 13 pistol balls have been recovered suggest close quarter combat.

The Kitchen Garden showed numerous French and Allied musket balls, probably from the first attack and the attack that resulted in the breaching of the north gate. It could also be the result of the Allied attack to push back the French troops into the wood.

The Killing Zone saw heavy French attacks throughout the day. Most French musket balls were recovered from the wall side or the forest side of the Killing Zone. Many shots were heavily deformed and contained an orange substance, which suggest that these balls were fired at the wall and ricocheted. It is also thought that a gap divided the Killing Zone in half, as a gap is visible in the pattern. This hedge was probably used by French to take cover, as many Allied musket balls can be found around the location of the hedge and the edge of the wood.

The orchard changed many hands during the battle. This is represented by the mixed distribution of French and Allied musket balls on the field. One notable feature can be observed the distribution of pistol balls in a diagonal line. This might suggest that the French attack tried to push the Allied troops in a north-west direction into the Hollow Way. However, it could also be the result of an Allied counterattack to push the French out of the orchard.

One of the famous legends of Waterloo and Hougoumont, was that the French never got in (with the exception of the breaching of the north gate). However, a historical source mentions the breaching of the south gate as well. But the archaeological record shows three locations that support the theory that the French got into Hougoumont more than once. First, the Garden as a whole. The distribution pattern showed many French musket balls in the Garden, but also two pistol balls, which suggest close quarter fighting.

The distribution patterns also showed two locations where French troops could have breached the walls. The first location is at the wall alongside the Killing zone. A grouping of French musket balls were found on the inside of the wall. This might be the location of a loophole where French troops managed to fire through, but Allied musket balls were found a few metres next to it. These Allied musket balls could have been fired at French troops that breached the wall and tried to enter the garden through that gap.

The second location is on the eastern wall. On this location, we have also found a high density grouping of French and British musket balls on the inside of the wall. Again, pistol balls have
been recovered there as well. There is also a single pistol ball about 25 metres to the left of these locations. This means that close quarter-fighting took place here as well. All this evidence suggests that the French did manage to enter Hougoumont more than once.

The last distribution pattern that this research analysed was the distribution pattern of the canister shot. Three possible locations have been identified based on the spreading of the canister shots. The first location is close to the location of the French howitzer. If a howitzer can be brought to the frontline, a canon be brought as well. From this location, the canon was able to fire into the orchard, where almost all the canister shots have been retrieved. The pattern implicates that the canister was fired during one of the French attacks in the orchard.

The second location is to the south-west of the south gate. We know that a round shot was fired through that gate. This canon can also fire canister, and it is therefore possible that the canister was fired alongside the wall from this location. The canister was then used to hit the Allied troops that were firing from over the wall, with remnants of the shot landing in the orchard. This could also explain the two canister shots in the Killing Zone.

The previous proposed theories assume that the canon that fired the shots was French, but this is not a fact. Therefore, the last proposed location is from an Allied perspective. It is assumed, like the first proposed location, that the canister was used to push back the French attackers. It is even possible that the two canister shots in the Killing Zone were from the same canon that flew over the walls of the formal garden.

We have to clarify that this research was not able to distinguish lead shot from the Battle of Waterloo in 1815, and the lead shot from the Battle of Mont-Saint-Jean in 1794. Both battles saw fighting in and around Hougoumont. The same type of weapons were used during both battles, but there is also very limited historical sources available on the battle in 1794. Therefore, we do not know the exact scale and location of the fighting in and around Hougoumont. Further research is needed to clarify these questions. Also, other techniques such as lead isotope analysis could help distinguish the lead shot from both battles.

We should also mention that this research is based only on the Waterloo assemblage that is now available. The conclusions and hypothesis proposed in this research can be altered in the upcoming years, when a larger portion of the area around Hougoumont (and hopefully the rest of the battlefield) is surveyed. Lead shot that will be excavated might change the limits that are proposed and used in this research. But this research is a good basis for further research on this topic.
Bibliography


Online sources
Archaeological Perspectives on Waterloo

Beeman website 2006. [online] Available at:
<http://www.beemans.net/images/Austrian%20airguns.htm>
[Accessed on 27-8-2016]

Family website Arrazola de Oñate [online] Available at:
<http://www.arrazoladeonate.be/verhalen/brussel/gomont/>
[Accessed on 18 June 2016].

Project Hougoumont [online] Available at: <http://www.projecthougoumont.com/restoration.html>
[Accessed on 22 July 2016].

Sawyer, P., Shute, J. & Bridge, A. 2015. Battle of Waterloo relived: the sound a fury of a Napoleonic war re-enactment. The Telegraph, [online] 22 June 2015. Available at:
[Accessed on 2 May 2016].

[Accessed on 9 July 2016].

[Accessed on 23-3-2016].

Waterloo Uncovered [online] Available at: <http://www.waterloouncovered.com/>
[Accessed on 12 April 2016].

[Accessed on 29-3-2016].