Battle of Barnet - Survey for Battle Archaeology

1. Survey Methodology

Detecting was principally undertaken using the systematic transect methodology which has been applied successfully to numerous battlefield surveys in the UK, USA and mainland Europe. Crucially however, it was also applied successfully at Bosworth in the first properly systematic survey of a battlefield of this period. The other well-known investigation, at Towton, whilst well organised, did not apply the same focused detecting methodology as at Bosworth. Bosworth demonstrated the potential for this technique to identify a well distributed scatter of 15th century roundshot, defining the broad area in which the main action of the battle was fought. However, it also exposed the limitations of the technique. Due to the sheer amount of ground that needed to be covered, initial surveys at Bosworth were undertaken using transect spacing of 10 metres, an intensity which had proven adequate on 17th century battlefields. This proved inadequate to detect the more ephemeral artefact scatter of a 15th century battlefield, and it was only upon revisiting fields which had been already detected at greater spacing, that it became clear more intensive coverage was needed if more than just the occasional artefact would be recovered by chance. It would be possible to detect on the true site of a battle without realising if the detecting coverage was not sufficient to recover most artefacts. More recent work undertaken at Bosworth in advance of the excavation of a wetland habitat for migrating birds has demonstrated that even areas already intensively detected may still yield additional artefacts and even artillery rounds[1]. This clearly demonstrated that while transects at 2.5m spacing are able to provide sufficient coverage to confirm the location of a projectile scatter, it does not provide 100% coverage of a site.

When comparing the detecting assemblages recovered from Bosworth and Towton, there is a stark contrast in their nature. In all likelihood this can be explained by the very different conditions under which the battles were fought, the number of high status individuals involved and the duration of the fighting, however consideration of their nature in comparison to the potential assemblage at Barnet was a key element of determining the correct detecting strategy. There is very little evidence of artillery from Towton in comparison to the large Bosworth assemblage, perhaps simply because there was little artillery on the field at Towton, or that the poor conditions prevented their widespread use. We know that the weather had a detrimental effect in the use of guns during the period, most well known in the guns at Northampton struggling to fire due to the rain. However, Bosworth lacks the abundant assemblage of personal objects, such as spurs, buckles and badges present at Towton, with the exception of a few notable examples. Again, perhaps this is the result of the very different nature of the two battles, with the large armies at Towton in sustained close quarter combat for a long period causing more objects to be lost and broken, while at Bosworth a sustained artillery barrage on a wide flat plain on a summer's day, is followed by only a relatively brief period of sustained combat before Richard is killed and the battle is over.

When considering the detecting approach that would be utilised at Barnet, it was fairly apparent that, based on the contemporary accounts, artillery played a key role in the battle with even sustained periods of bombardment noted – far more detail about artillery than in the contemporary accounts of Bosworth. In addition, the three roundshot housed in Barnet museum seemed to suggest that a roundshot scatter was clearly present somewhere and it was just a matter of finding it. Barnet benefitted greatly from the learning curve that the detecting team had undergone at Bosworth and it

[1] Archaeology Warwickshire, *Shenton Wetland, Bosworth Battlefield, Mill Lane, Shenton, Leicestershire, Metal Detector Survey and Watching Brief*, Unpublished Client Report No. 1776

was determined that the entirety of the Barnet survey would be undertaken using transects at 2.5m spacing. While this would not recover every single artefact, it was hoped that it would prove sufficient to indicate a broad scatter of projectiles, as at Bosworth. The only exception to this was during detecting in a number of small wooded areas (Field 3) where trees made marking parallel transects with flags impossible, and a more random method had to be adopted as the only viable alternative.

It was also of great importance to be able to test the successful Bosworth methodology on another site and directly compare the data between two sites of a similar period. Such a comparison would in a more general sense have significant impact in enhancing understanding of late 15th century military assemblages and provide more general development within the field of battlefield archaeology. As discussed, the work at Towton was undertaken using a different approach, and the ability to directly compare data from two Wars of the Roses sites, would be significant. Forthcoming fieldwork at Mortimers Cross will provide additional opportunity to do this.

The detecting approach involved dividing up each field into a series of parallel transects, 2.5m apart along the field to be surveyed, in a manner reminiscent of fieldwalking. Two parallel baselines, perpendicular to the direction of detecting were initially set up using cross sight poles and then marked ropes or tape measures were set up along them. Transects were marked along these baselines using flags, which were colour coded to assist the individual detectorist in staying on course and to minimise deviation onto another transect. The transects were then extended to the boundaries of the field by simply sighting along the two baseline flags of the same colour and placing another flag, often done several times before the field boundary was reached. The flag colours used at Barnet were ordered, red, yellow, red, yellow, green, red, yellow, red, yellow, green, in repetition along the baseline which, on other sites, has proven to be effective at minimising detectorist deviation, making it easier to sight along flags of the same colour on a single transect. Volunteer detectorists were trained in this survey methodology and with experience and familiarity, began forming an effective team.

2.5m spaced transects provide approximately an 80% ground coverage. Positioning the transects even closer together could provide an almost total coverage however, when the detector sweeps of individual detectorists start to overlap this can skew information about individual artefact recovery rates if being collected. 2.5m is the preferred spacing simply because it is easy to compare data on artefact recovery with other sites and areas if detected at 5m or 10m spacing. Some detectorists will naturally be more skillful than others and it can be possible to see this reflected in their artefact recovery rates. If monitored closely this can highlight the need for additional training or a re-organisation of the team. It is crucial to monitor individual detectorists over a large scale survey as at Barnet - working unchecked or unnoticed, a poor detectorist can leave vast areas of land not properly searched and when you consider the sparsity of the artefact scatter to begin with, this can potentially amount to the difference between a successful project and a failure. When dealing with the difficult task of locating a late 15th century battlefield, the development of a skilled and trustworthy team is of paramount importance.

2. Survey Progress 2015-16

During the course of the 2015-16 project detecting was under taken across 69 individual areas within 17 fields, covering a total area of approximately 65.7ha. With the exception of a small patch of woodland within Field 3, all detecting was undertaken using 2.5m spaced transects, resulting in over 2500 transects being detected. The detecting team was comprised of experienced detectorist volunteers who operated under the supervision of the fieldwork Director who was also responsible for determining survey locations, liaising with landowners and tenant farmers over land access, permissions and training the team on site so they were able to follow the archaeological methodology.

The size of the team fluctuated with the seasons and individual availability but averaged in the region of five detectorists on each survey day. It was during the 12 month survey period, spanning 2015 to 2016 that the majority of the survey work was undertaken. The location of surveying on any particular day was dictated by the season and field conditions, with arable locations only able to be surveyed during a limited window in the summer months. Pasture fields formed the bulk of the surveyed area and were reserved for times when arable land was unavailable. The recently cultivated ground was naturally favoured above long standing pasture due to the greater likelihood of artefacts being brought to the surface through ploughing action, although these conditions came with their own set of challenges as discussed further below. During late 2017 a second, more limited phase of detecting was undertaken, seeking to fill in the remaining gaps in the previous phase of survey. As detecting took place throughout the year, a variety of field conditions were encountered which are summarised in Table 1 below.

Insert Figure 1. Investigated fields and current land use

Field No.	Transect spacing (m)	Ground conditions	Detecting conditions	Approximate coverage of field?
1	2.5	Med/long pasture	Fair	Near complete
2	2.5	Short pasture (golf course)	Good	Complete
3	2.5/random in woodland	V. rough long pasture and woodland	Bad	Partial c. 50%
4	2.5	Short pasture (grazed)	Good	Near complete
5	2.5	Cereal crop stubble	Good	Complete
6	2.5	Long pasture	Poor	Complete
7	2.5	Long pasture	Poor	Complete
8	2.5	Long Pasture	Poor	Complete
9	2.5	Long Pasture	Poor	Complete
10	2.5	Med pasture	Fair	Complete
11	2.5	Short pasture (grazed)	Good	Complete
12	2.5	Long Pasture	Poor	Complete
13	2.5	Short pasture (grazed)	Good	Near complete
14	2.5	V. roughly ploughed	Bad	Partial c.50%
15	2.5	V. roughly ploughed	Bad	Partial c. 40%
16	2.5	Cereal crop stubble	Good	Near complete
17	2.5	Ploughed & harrowed with short regrowth	Good	Partial c. 50%

18	2.5	Cereal crop stubble – green waste!	Good conditions, bad contamination	Partial c. 5%

Table 1. Conditions of surveyed fields

3. Survey Conduct and Results

A total of 1007 finds of possible archaeological interest were recovered during the metal detecting (Figure 2). The position of these artefacts was recorded using sub-metre GPS (Topcon GRS-1) and allocated a unique daily registered artefact number. In post excavation all finds were then allocated with a sequential and unique overall project number (BARxxx). The position of all detected transects was also recorded using GPS and these formed the basis for calculating the areas covered by a single detecting day. These finds represented only a small fraction of the total number of recovered objects, most of which were identified as modern 'junk'. These 'junk finds' were collected by survey area and consisted largely of modern rubbish or unidentifiable metal fragments with no discernible archaeological value. This first level of finds assessment, in deciding whether and object was of potential archaeological interest or not, was down to the individual detectorist. It was therefore important that the team consisted of competent, experienced detectorists who would be able to make such judgements. Any uncertainty about the importance or identity of an object was generally resolved collectively by the team or by the site Director.

Upon completion of each survey day, the finds were returned to Barnet Museum where they were housed temporarily in order to be cleaned and initially processed by volunteers under the guidance of museum staff. Museum staff had been trained in finds cleaning and processing by the site Director and were then in turn able to supervise other volunteers at weekly finds processing sessions. A number of local school groups also took part in the finds processing and a lot of enthusiasm was generated in the local community. Although the metal detector survey required practice and experience which precluded many members of the general public, the finds processing sessions meant that they were still able to feel part of the project and engage directly with their local history, be it battle related or not. All cleaned finds were re-bagged and labelled ready for analysis while the 'junk' finds were sorted and quantified. The fieldwork Director assessed all the junk finds to ensure that nothing important had inadvertently been missed and then the vast majority were discarded.

An initial rapid assessment of the individually recorded finds was undertaken by the fieldwork Director, and a total of 139 selected for additional expert analysis by finds specialists at Cotswold Archaeology. The remainder were either easily identifiable or obviously post-medieval/modern in date and so no further analysis was required.

A small handful of areas were subject to 're-survey' meaning that they had effectively been surveyed twice. In all cases, additional finds were recovered from the re-surveyed areas which provides a clear reflection on the inability even for intensive metal detecting to remove all objects from the ground. The eastern edge of Field 5 was perhaps most stark in its abundance of finds recovered over two phases of survey. This is likely explained by the fact it was ploughed between surveys, causing more artefacts to be brought closer to the surface by the turning over of the soil. Field 5 and the small area of Field 14 were the only arable fields subject to two phases of survey, although Field 14 was surveyed under roughly ploughed conditions which were considered generally unfavourable. The remainder of the re-surveyed areas were under long-standing pasture. The re-survey of Field 4 is notable by the almost complete absence of additional artefacts. Both phases were undertaken under the same conditions and with the latter exclusively by the experienced Bosworth team. This

occurrence is difficult to explain and although the obvious suggestion is that the initial survey was very effective in removing the vast majority of objects within detectable depth, the almost wholesale removal of objects seems unlikely. Perhaps more plausible is that it is a reflection of the differing artefact 'selection policy' between two different teams of detectorists. A very experienced team of battlefield detectorists are likely to be more confident and rigorous in their selection of objects which merit being individually located. A less experienced team is likely to be more uncertain and cautious in their object identification.

The main bulk of the survey was undertaken as part of the research project, but was also supplemented by a small amount of commercial archaeological work within the boundary of Old Fold Golf Course (Field 2). The Golf Course were planning a programme of landscaping and an archaeological condition placed upon their application due to its location within the registered battlefield. The survey was undertaken by the overall project fieldwork Director which meant that consistency was maintained across this area too, which was subject to detecting at 2.5m transects as with the rest of the site. However, all the finds recovered were of post-medieval date and the field contained notable metal contamination from numerous golf-related objects which were found abundantly[2].

Insert Figure 2. All finds

4. The Finds

Of the 1007 finds recorded as being of possible archaeological interest, only 17 were positively identified as being of medieval date, with a further 36 finds of possible medieval date or only broadly dateable to the late medieval/early modern periods.

Insert Figure 3. Distribution plot of all medieval finds

The majority of finds were of early modern or modern date and a single fragmentary brooch of Roman date was also recovered.

An assemblage of 124 spherical lead bullets was recovered during the survey, widely distributed across the survey area. It is possible that such bullets were fired from small arms during the battle however, with the absence of any other obviously battle related objects of medieval date, it has to be assumed that the bullets post-date the medieval period. By examining the variety of bullet weights present within the assemblage (Figure 4 & 5), it may be possible to identify trends which shed further light on the origin of the bullets.

[2] Wilson, S. 2015. *Old Fold Manor Golf Club. Archaeological Metal Detector Survey*, Unpublished client report

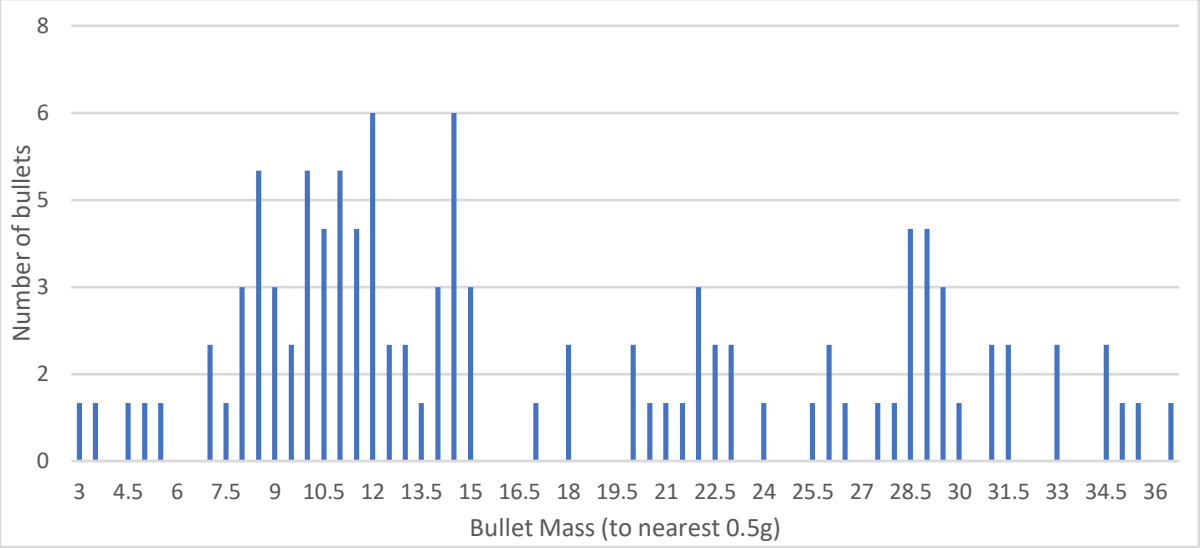

Figure 4. Recovered lead bullet assemblage

Insert Figure 5. Distribution plot of all lead bullets

Analysing the bullets in this way draws out two notable points of discussion. The lower half of the graph (from smaller calibre weapons) can be clearly argued to be a fairly typical assemblage of background shooting/sporting activity from the early modern period. Clear correlations are present with the background assemblage of bullets from the Bosworth survey and from B King's collecting in Northamptonshire on non-battlefield sites. However, the Barnet assemblage clearly differs at the upper end of the graph. Whereas the bullets in the Bosworth and Northamptonshire assemblages tail off towards the larger weights, the Barnet assemblage does not, and indeed there is a peak in the graph at 29g, a bullet weight indicative of a smaller calibre musket. The maximum weight is recorded as 36.5g which places the bullet firmly in 12 bore musket territory. These larger bullets are clearly unsuitable for shooting all but the largest game, and suggest a military presence to some degree across the landscape of the survey (Figure 6).

Insert Figure 6. Distribution plot of bullets 27g and greater, including powder box cap, slugs and Napoleonic button

Further indications of this early modern military presence can be seen through a small number of other finds. In Field 1 a military uniform button of the 49th Regiment of Foot (dated 1782-1816) was recovered and clearly indicative of some level of Napoleonic period military activity. Furthermore a powder box cap of 17th century military origin was found in Field 6, a field which also yielded a number of fragments of copper alloy vessel of probable early modern date. The proximity of this field to the St Albans road, perhaps makes it a good candidate for a site that Monck's troops were bivouacked on their march south in 1651. A slug found in field 17 further suggests a 17th century military presence in this general vicinity.

Modern military presence was also notable across the survey area. Shrapnel, mostly driving band and fuse fragments, was recovered abundantly and it seems likely that this can be attributed to anti-aircraft

fire defending London during the blitz. A dummy airfield is known from the vicinity of the site and a pillbox still survives hidden in undergrowth on the northern boundary of the Old Fold Golf course.

5. Discussion

While wide-reaching in its coverage of landscape, the survey failed to find definitive evidence of the 1471 battle. A number of medieval objects of appropriate type and date were recovered (Figure 3) These included mounts, spurs, buckles, coins and a purse bar. However, with the absence of any supporting material of obviously military origin (such as artillery rounds), this cannot be definitively regarded as having originated from participants in the battle. The landscape around Barnet saw intense activity throughout the medieval period and it is therefore not surprising that occasional objects of this period might be found during metal detecting.

It is thought that handgunners were also deployed in the battle which would have fired lead bullets indistinguishable from early modern lead bullets. As discussed above, an assemblage of bullets was recovered from across the survey area, although these still cannot be tied into the battle, due to the lack of finds that can be confidently dated to 1471. The apparent presence of other early modern military activity within the same landscape, further confuses matters.

Of considerable confusion is the apparent lack of any other round shot given that three are known from the survey area. Metal detecting was undertaken in close proximity to the apparent find spot of two and yet still failed to turn up any more. A fourth possible roundshot was brought to light during the course of the fieldwork, by the local Portable Antiquities Finds Liaison Officer who believed that an artefact might have been incorrectly identified as a weight when it was in fact a roundshot[3] . The recorded find spot places the artefact just north of Old Fold Golf Course frustratingly in an area that was off limits to the survey. Attempts to track down the artefact for additional identification and analysis were unsuccessful so it must remain only as a 'possible' roundshot.

This throws up multiple questions as to the validity of the reported find locations or the number of artillery rounds that might be expected at Barnet in the first place. At the outset of the project, the presence of multiple known artillery rounds set Barnet apart from many other Wars of the Roses battlefields, however the task of identifying the battlefield has proven more difficult than suggested by the presence of these finds.

Crucially, a number of significant land use issues encountered during the survey must be taken into account when considering the relative success or failures of the survey. The first overriding issue that was encountered at Barnet was the inability to access a large swathe of land determined to be a key area of investigation, a series of large arable fields to the north of Old Fold Golf Club. Whilst the landowner had given permission to access this area, the tenant farmer had unfortunately refused, meaning that a hugely significant area was off limits to the project. Frustratingly, in the summer of 2016, this whole area lay under almost perfect detecting conditions for a number of weeks, when by comparison, much of the surrounding area had been under generally poor detecting conditions.

For approximately ten months of this initial twelve-month survey, detecting was limited exclusively to areas of pasture both within and without Wrotham Park. This was largely a result of the intensive agricultural regime denying any opportunity to work on land under arable cultivation for a significant part of the year. The positive side of this limitation is that it enabled extensive detecting in fields some distance away from the core area of focus, resulting in the testing of possible alternative theories and

[3] Portable Antiquities Scheme reference BH-E807D2, https://finds.org.uk/database/artefacts/record/id/389965, accessed 26/11/2018

broadly gauging the level of 'background noise' in areas across the wider landscape. However, systematic detecting on long-standing pasture comes with a set of issues that must be considered in order to understand the limitations of a survey being conducted on such a landscape. Along with possible downward movement of artefacts through the soil due to worm action and other processes, the length of the grass and thickness of the grass and root system are a key consideration. The depth of artefacts, length and thickness of the grass will impact on how close the head of the detector can be brought to the surface and thus the efficiency of the survey. It is possible that in such conditions some artefacts may be missed. A number of pasture fields contained relatively long grass and were rarely grazed by animals, meaning that they had to be surveyed in winter when growth was least abundant.

Under many circumstances, the use of a standard VLF (Very Low Frequency) detector will prove sufficient for the recovery of most artefacts and was utilised by the whole detecting team working at Barnet. However under certain circumstances the employment of a PI (Pulse Induction) or ZVT (Zero Voltage Technology) detector may be necessary as a way of penetrating further into the soil, neutralising the negative effects of long grass, the grass matte or lack of ploughing bringing artefacts closer to the surface. Experiments in the use of PI and ZVT detectors in America have proven highly successful under certain circumstances[4]. Brief experiments with a PI detector during the Barnet survey in an attempt to address the issue of large areas of pasture however exposed the current limitations of such technology. Initially designed for gold prospecting, PI and ZVT detectors can often penetrate the soil to over one metre in depth and do so in a non-discriminating fashion, identifying even the smallest ferrous fragments. In an area that has seen a high level of human activity and rubbish deposition like Barnet, the huge addition in time required to dig each signal, and the decreased forward detecting rate required by the machine, added an unmanageable time penalty. As a result, the use of the PI detector was not pursued further, but additional experiments are required to determine the effectiveness of the technology on British battlefields, which often exist under different landscape conditions to many US sites where large swathes of land have not seen intensive agricultural activity.

When the agricultural regime allowed, detecting at Barnet was undertaken in a number of arable fields, the majority of which were located outside Wrotham Park. However, due to the limited turnaround time between crops, there was little choice but to detect some areas under far from ideal conditions. These had been roughly ploughed, creating difficult terrain in which the detectors would not have been operating in an optimum manner. The rough clay boulders of the ploughed soil greatly limited how close the detector could be brought to the surface. The volume of modern non-ferrous rubbish also potentially hampered the recovery of archaeological objects. In Fields 14 and 15 the ploughed surface was covered in abundant amounts of post-medieval/modern pottery to the extent that it seemed certain that waste must have been dumped there in the past. Satellite imagery shows numerous large sub-circular pit-like features within Field 14 which may potentially be where the material was originally dumped and has subsequently been scattered by ploughing.

The limited time between crops also meant that it was not possible to detect some fields before access was once again denied. As previously discussed, a substantial parcel of arable land was also off limits as access had not been given by the tenant farmer. The area accessed under the most optimum conditions were fields 5 and 16 which were detected whilst containing short cereal crop stubble. The field still contained vast quantities of modern rubbish, but it can be argued to be no great coincidence that this area also provided the largest number of interesting finds. The limited window of opportunity in these areas, also made further experimentation with the PI detector impractical as simply not

[4] C. Adams, C. Haecker, D. Scott and P. Severts, 2016, 'The Methodological Implications for Battlefield Metal Detecting Survey of the Pulse Induction and Zero Voltage Technologies'. Paper given at the Ninth International Fields of Conflict Conference 2016, Dublin.

enough land would have been covered in the available time. Should time allow in the future, a contrasting data set comparing the use of VLF and PI detectors in this area, would provide useful information as to the effectiveness of PI detectors in a British agricultural landscape.

Furthermore, a key area of survey to the east of Wrotham Park (Field 18) was quickly determined to have had green waste spread over it, making the field practically undetectable. Green waste, unlike the name suggests, contains metal fragments in addition to organic matter with landowners often incentivised to spread such material on their land. This introduces a huge amount of contamination into the ground making detecting virtually impossible. Archaeological geophysicists have reported similar interference of their instruments caused by green waste[5]. The spreading of green waste clearly has wider implications than Barnet and may continue to have a hugely damaging effect on battlefields and other types of archaeological site if not controlled. In the case of Barnet, it has denied a key survey area from being investigated.

6. Conclusions and further questions

As discussed above, the survey techniques employed at Barnet followed the model refined during the Bosworth investigation, which clearly allowed for the identification of a 15th century artillery round scatter, indicating the true site of the battle. However, a key question to understand is why the results from the Barnet survey were so different. After all, the documentary and cartographic evidence all seemed to be pointing to the same general battlefield location, which formed the focus of the survey, so why was it not possible to find similar evidence?

It is difficult to imagine any further way in which the archaeological detecting technique might be further refined at this stage, beyond simply detecting at an even greater intensity. Given more time and the right opportunity, re-detecting fields that were encountered under poor conditions is key as crucial evidence may have been missed initially. It is perhaps in modern limitations imposed by access issues and the agricultural cycle in combination with a relatively short project that at least part of the answer may be found.

One key issue has to be that a large number of the Barnet fields were surveyed under inferior conditions, an unfortunate result of the modern agricultural scheme. It may be that if artefacts from the battle were present in these fields then they may simply have been missed. Unlike more traditional archaeological techniques of trenching and test pitting, the success of metal detecting is at the mercy of the field conditions. Poor conditions, such as rough ploughing or long grass can prove extremely detrimental to the success of a survey, mostly because it limits the effectiveness of the detector and how close it can be brought to the ground surface.

Ideally, such areas would need re-detecting under better conditions to be more certain they contained no relevant artefacts, although given the intensity of the present agricultural cycle it seems unlikely this will be possible in the foreseeable future. This leave the tantalising possibility that some detecting of the battlefield has been done, but without successfully locating any relevant objects.

While a lot of land was available for survey, a key consideration is the land that was inaccessible. This large swathe to the east of Wrotham Park and Kitts End lay within the low area of ground that may be that described by Von Wezel as a ‘hollow and a marsh’ and was an obvious and important area of consideration. Fields to the north of this area (7, 8, 9, 14, 15) were surveyed, however they saw the worst of both the arable and pasture conditions and it is clear that objects here may have been

[5] Gerrard, J., Caldwell, L. and Kennedy, A. 2015. ‘Green Waste and Archaeological Geophysics’ in *Archaeological Prospection*, 22:2, pp. 139-42

missed. Survey of Fields 14 and 15 was also not completed due to the very limited window between crop rotations where access was permitted. Therefore, it can be considered that the majority of the key valley in the investigation was unable to be surveyed at all or at best, in anything resembling favourable conditions. Fields 2, 5 and 16 form the only part of the valley defined by Dancer's Hill, Kitts End Road, the modern St Albans Road and Old Fold Golf Club that was surveyed under favourable detecting conditions. That being so, the artefact assemblage from them can be considered to be a reasonable reflection of the scatter of artefacts they contained. It is perhaps no coincidence that a reasonable number of medieval finds came from these fields, which make the inability to properly survey adjacent fields all the more frustrating. The total number of finds of medieval or possible medieval date from these three fields represented 33% of the total number of artefacts identified as of medieval or possible medieval date.

The final major archaeological issue is that of contamination. As discussed above, a number of fields appeared to have had material deposited onto them, or buried beneath them in the post-medieval and modern periods that is far in excess of what might be expected through normal manuring practices and was readily visually apparent on the surface.

Clearly this phenomena continues to the present day, with the introduction of green waste into another key area of investigation (Field 18) which sought to examine one of the proposed alternative sites. Such effort has been rendered impossible by the contamination now found within that area and highlights a serious wider issue of contamination on battlefields and problems of their future investigation and management, should this activity be allowed to continue.

One of the other overriding considerations in examining the differing result between the Bosworth and Barnet investigations is what might be expected of the battlefield assemblage in the first place. Bosworth and Towton demonstrated that artefact assemblages from battlefields of more or less the same period can vary greatly. It is still uncertain if there is a 'normal' form of assemblage that could be expected from Wars of the Roses sites, although the significantly larger number of high status individuals fighting and killed at Towton might perhaps suggest that the Towton assemblage is anomalous of what might be encountered on other sites.

At first glance, the use of artillery at Barnet seems dominant – a fact corroborated by multiple contemporary accounts, most notably Von Wesel's account and The Arrivall. These both include specific details such as Warwick's night bombardment, which it is therefore reasonable to consider did occur. The presence of up to four round shot from the general battlefield area was also considered to be a reasonable indicator that a round shot scatter existed, similar to that of Bosworth.. Detecting within the field where apparently two of the round shot were located (Field 17), revealed no more however, and indeed no objects of the right date at all. Both Field 17 and Field 5 which bordered the supposed locations of the two roundshot were detected by teams that were at least in part, formed of detectorists that had considerable experience of surveying at Bosworth. It is therefore highly unlikely that at least one additional round shot could have been present in that entire zone without being successfully located, particularly as both fields were surveyed under highly favourable metal detecting conditions. Additionally, smaller lead bullets were recovered in relatively large numbers so it seems implausible that all larger roundshot would have been missed. The logical conclusion therefore is that the reported location of the two finds is incorrect.

However, it is also important to consider that the apparent use of artillery may have taken on greater significance because it is mentioned in the accounts numerous times, and that in reality it played a lesser role than it seems. Real world practicalities of the battle must be considered here, in seeking an answer, one of course it is never possible to know for certain, but in the absence of any further data must at least be hypothesised. There are two main episodes of artillery use detailed in the accounts, the night bombardment and opening bombardment of the battle.

A night bombardment is an unusual tactic during the Wars of the Roses, although not unheard of. A similar bombardment happened at Ludford Bridge in 1459, for example. The main reason being that the artillery required line of sight to see the target and the intervening terrain in order to be accurately aimed. Until the invention of exploding shells, artillery rounds had to physically hit their target in order to cause any damage, making blind firing a fairly ineffective activity. It is possible that Warwick knew the general but not precise location of the enemy, perhaps indicated by their campfires or fleeting glimpses as they approached the field at dusk, but this is still unlikely to be sufficient to accurately site guns in a relatively unfamiliar landscape. It is of course possible that by firing artillery during the night Warwick wanted to simply deny his enemy sleep and rest although clearly the noise at least would have had a similar effect on his own troops, so that too seems unlikely. The question of exactly what constitutes a night bombardment is also key. Were Warwick's guns firing rapidly all night or was it just an occasional shot from a single artillery piece? This has a profound impact on the number of artillery rounds that might be deposited within the ground.

A similar issue exists with the artillery bombardment which opens the battle. It is clear that the fog played a crucial role in the outcome of the battle and was sufficiently thick to hide formations from one another and cause confusion. The fog would play a similar role to the darkness in that it would mask the position of enemy troops and the lie of the land between them and the artillery. As the armies moved to engage, any firing would have to cease for fear of hitting friendly troops. Von Wesel records that the armies made one another out at dawn before the fog descended, and this is perhaps a key statement in understanding the bombardment. It gives the impression that there was a limited time that the armies could see one another and that the appearance of the fog was in effect the impetus for the armies closing on one another, at least to within arrow range. Von Wezel describes the thousands of arrows remaining on the battlefield a few days later and John Paston was wounded by an arrow to the arm, so we can be certain there was some form of arrow exchange, indicating that the armies could more or less see one another up to a maximum distance of around 200 yards. However, this is far too limited for an artillery bombardment. The possibility therefore remains that the bombardment did take place, but was a somewhat limited affair during the time that the armies could see one another prior to the fog descending. Again, this raises the possibility that there were fewer artillery rounds deposited in the ground than the accounts might suggest at first glance. All of which has an impact on the rounds which might be found through metal detecting.

7. Kicks End Investigations

Two phases of archaeological test pitting were undertaken during the battlefield investigation, each seeking to answer different questions of the historic landscape.

Phase One was undertaken in 2016 and focused on archaeologically locating the former site of Kick's End and determining if it had been occupied in the medieval period (Figure 7) No above ground remains exist on the site which is now occupied by a pinetum, part of the Wrotham Park estate. Due to the restricting undergrowth within the woodland, only a limited area was available for investigation and a methodology of shovel test pits was adopted. This involved excavating a linear transect of eight evenly spaced 0.5x0.5m test pits with a 5m gap between each pit, sieving the contents to recover dateable artefacts and recording the stratigraphy contained therein. This was undertaken in the only open area within the pinetum which allowed for a single transect of pits to be dug. The area that these pits were excavated appears to be broadly contained within an area of gardens illustrated on Rocque's 1757 map and centrally located within the projected extent of Kick's End.

Insert Figure 7. Area of Shovel Test Pitting

The test pits were excavated to an average depth of 0.6m, reaching natural geology in all cases. Test pit 1 contained a possible ditch or pit, although it was not possible to determine its extent within the test pit. The fill within did not contain any dateable material. The test pits revealed subsoil layers overlying the natural geology including probable historic topsoil layers which contained pottery of medieval date, spanning the 11th to 15th centuries (Mepham, pers. comm.). There was no particular concentration of pottery noted within the limited spread of test pits, but the presence of a reasonable number of pottery sherds from a broad chronology is strong evidence of sustained occupation in the vicinity of Kick's End throughout the medieval period. A whetstone was also recovered, further indicative of occupation although narrow dating of such an object is not possible and it is not certain that it is of medieval date. These layers were typically overlain with deposits containing quantities of post-medieval ceramic building material, assumed to relate the final demolition of the surviving buildings within Kick's End when the settlement was subsumed into Wrotham Park land in the 19th century. Alternatively this material may be associated with the later construction of Home Farm to the east of the pinetum, now in use as a business park. Nothing particularly diagnostic was recovered from the post-medieval assemblage, which instead is simply indicative of general construction or demolition related activity.

The shovel test pits produced limited results, although achieved the aim of determining whether there had been medieval occupation on the site or nearby. Due to the very restricted area in which they were dug, the spread and number of test pits was not sufficient to extract detailed information on varying artefact densities, which would have proved useful to indicate 'hot spots' of occupation. However, given the nature of the terrain and confined space between the trees, it is difficult to see any alternative approach which may have been possible without causing damage. Further intrusive works may only be possible when additional space becomes available after natural or deliberate tree felling, at which point the excavation of a larger area or greater spread of test pits would shed more light on the extent of medieval occupation of the settlement.

Despite the limited results of the first phase of test pit investigation, the archaeological confirmation that Kick's End was occupied in some form during the medieval period adds to our understanding of the historic landscape. While map and documentary evidence clearly shows the development and decline of the settlement through the post-medieval period, there is little firm information relating to it in the medieval period. It also receives no mention within any accounts of the battle. Clearly it is likely that Kick's End had its origins in the medieval period, but the presence of appropriately dated pottery from below-ground deposits confirms this. This therefore means that the settlement must have been an extant landscape feature during the battle, which may have had an impact on armies moving, and deploying within the general landscape. Had it played a significant role in the battle, it seems likely that it may have been mentioned in accounts of the battle, either specifically named or in more general terms as a settlement. It does not appear that it did, but knowing of its presence assists in fixing another element of the historic landscape firmly within its wider setting.

8. Chantry chapel

The possible chapel site is currently under permanent pasture, forming part of the well-maintained entrance way into the Wrotham Estate business park. It has however been subject to historic arable cultivation and the last time it was ploughed, was subject to a fieldwalking exercise under taken by Brian Warren (Warren pers. comm.). The investigation recovered an assemblage of post-medieval material, mostly ceramic building material and pottery but nothing directly indicative of the presence of a chapel, medieval or otherwise. The artefacts from the fieldwalking are currently held at Barnet Museum.

Archaeological investigation of the site initially comprised a magnetometry survey undertaken by Southampton University, which was then followed up by a Ground Penetrating Radar survey. The magnetometry results in the supposed vicinity of the chapel site were inconclusive in that no clear east-west orientated structure was revealed, although it did identify the surrounding moat and a number of other possible features and structures, as well as the 'Gannick Bank' along the boundary of Enfield Chase[6].

Phase Two of test pitting was undertaken in 2017 and concentrated on the hypothesised site of the chantry chapel. It sought to identify any below ground remains associated with the chantry chapel or its later iterations and any other unrecorded archaeological remains. The test pits were initially targeted on a number of uncertain anomalies noted from the preliminary magnetometry survey undertaken in 2016[7] by the University of Southampton which was later expanded in 2018. A total of sixteen 1x1m test pits were excavated, encountering natural geology at widely varying depths. Substantial demolition related deposits were identified, containing large quantities of post-medieval brick and tile, along with a possible flagstone, a single fragment of architectural limestone and a number of large flint cobbles. It was hypothesised that the stone and flint may have come from the chantry chapel and the brick and tile possibly from its later phases, or indeed from other post-medieval construction associated with the Estate.

No in situ structural remains were identified however, with the exception of a brick culvert of probable 18th century date. A small number of cut features were identified (Test Pits 6, 9 and 15) including a very substantial pit or ditch within Test Pits 6 and 15, the upper fills of which contained post-medieval material. Unfortunately within the confines of the test pits, it was not possible to determine the full nature or extent of these features.[8] Undoubtedly further intrusive works are required here to further investigate the date and nature of multiple features. Whilst a useful technique for prospecting over a large area with limited resources and volunteer diggers, test pitting has a number of drawbacks. Chief among these is its ability to generate more questions than it answers. While the archaeological story of the possible chantry chapel site has been advanced to a certain degree, a significant number of new questions have been thrown up relating to previously unknown features. Within the confines of the test pits, determining their true nature and date can be problematic. In a world where cost was not an issue, stripping the whole area would rapidly answer the question once and for all.

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[6] Barker, D. Strutt, K. and Wilson. S. 2019. *Report on the Geophysical Survey at Wrotham Park, Potter's Bar, Barnet, Hertfordshire August-September 2018,* Report No. SREP 2/2019

[7] Barker, D. and Wilson, S. 2017. *Battle of Barnet, Wrotham Park, Archaeological Geophysical Survey*, Unpublished report

[8] Cotswold Archaeology, 2017. *Battle of Barnet Survey, Wrotham Park, Barnet, Hertfordshire. Archaeological Test Pitting*, unpublished report no. 17672

Appendix 1

LEAD BULLETS FROM HADLEY WOOD, BARNET

A total of 85 lead artefacts plus a number of other miscellaneous finds were provided for analysis by the Barnet Battlefield Group of the Battlefields Trust. These finds are reported as having been collected at some time before 1988-9 in (?)Hadley Wood by a metal detectorist and brought to 'the museum', presumed to be Barnet Museum, by Jennie Cobham.

Analysis has been undertaken on all the bullets and possible bullets. The miscellaneous artefacts, most of which were not of lead, and the two lead spheres with large holes right through, which are lead 'beads' of uncertain function, have not been studied. Analysis was conducted on the remaining 83 items, which are or might be bullets, following the methodology and classification for analysis of 17th century bullets defined by Foard (Foard, in preparation).

Many of these bullets are in relatively poor condition, having been stored in groups in bags, rather than individually bagged. This has resulted in abrasion between bullets which has damaged the bullet surfaces and generated significant quantities of lead oxide dust. This dust poses a significant health risk and so the present analysis was undertaken wearing a safety mask and protective gloves, with all surfaces and equipment being wiped down after work on the assemblage. In the future these bullets should be handled with care and action taken to minimise further abrasion which would cause more damage and generate more lead oxide dust. Draft guidance on health and safety issues relating to the handling and storage of lead bullets, prepared for the Portable Antiquities Scheme (Foard, forthcoming), are attached as an appendix to this report.

The Assemblage

The assemblage is rather small for a meaningful analysis, especially as there is no information on exact location, thus significant information that might be expected to come from spatial patterning is not available. Most of the bullets have a thick surface corrosion of lead oxide, which has been badly eroded in some cases, but two groups of bullets lack such oxidisation and these are likely to be more recent.

- 58 lead balls
    - 27 (46%) of the total are impacted
    - 17 (29%) are banded and 11 (19%) of these heavily banded.

Figure 1: banded bullets (sample of finds 58-74)

Figure 2: impacted banded bullets (sample of finds 58-74)

- 1 of the 58 is burred, and one other is possibly burred, but in both cases the burring comprises far smaller gouges than has been observed in bullets from other collections.

- 8 have a distinct raised flash and are of dark grey metal with no surface corrosion. This is an unusual form, not seen in any 17th century collections previously examined and, given the lack of oxidisation, it seems likely that these are of more recent origin. However they show the same manufacturing marks as other bullets and there is evidence of impact damage on at least one, suggesting that they are bullets. These bullets account for almost all the artefacts in the 18-22g range.

Figure 3: bullets with high intact flash ridge and very limited surface corrosion. Probably more recent bullets. The left bullet shows incomplete fill of mould adjacent to sprue snip.

- 1 double ball, probably resulting from the fusing when two bullets were fired as a single load. This bullet has possible impact damage. However it might prove to be a double ball connected by a sprue bar that have been compacted (cf. Easton Maudit 34-37).

Figure 4: two probably originally spherical lead bullets apparently fused and compressed by being fired as a double load (find 8)

- 1 large lead ball, possibly roundshot from small calibre ordnance. It has a very irregular surface making exact diameter measurement difficult, but it is approximately 1.6 inches. In terms of 17th century ordnance this lies between a Robinet (1.375 in) and Falconet (2.125 in). (This find is clearly the lead roundshot recovered by Heathfield from Shire Golf Course that was accidentally mixed up with the Hadley Common bullets when provided for analysis in 2006. GF29/07/2020)

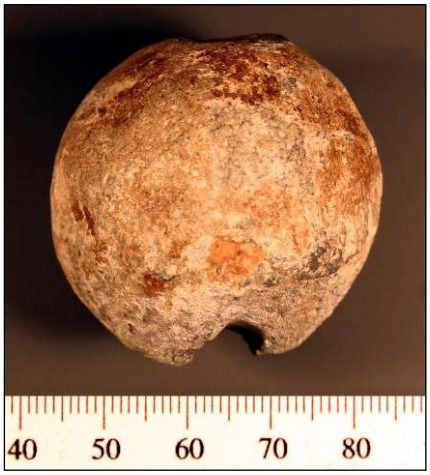


Figure 5: Lead sphere with linear impact damage, possibly a roundshot for artillery (find 75).

- 12 drums of lead, dark grey in colour with little oxidisation of the surface. These lack the attributes seen in slugs and related bullets seen in other collections, with the one exception of Easton Maudit. It is possible that they are not bullets but rather are gaming pieces, weights or had some other function unrelated to firearms. They appear to have been manufactured by cutting a long circular section bar of lead into a short drum shaped pieces.

Figure 6: drum with star shape scoring on one end (find 15)

- 8 slugs or probable slugs. These comprise 12% of the whole assemblage of bullets (excluding later and probable non bullets). This is a far higher percentage than seen on other sites, with for example at Edgehill the slugs comprising 4% of the assemblage.

Figure 7: probable slug of regular box form, apparently created by hammering of lead ball, with one end also flattened. The other end (shown here) appears to have embedded ferrous material (find 4)

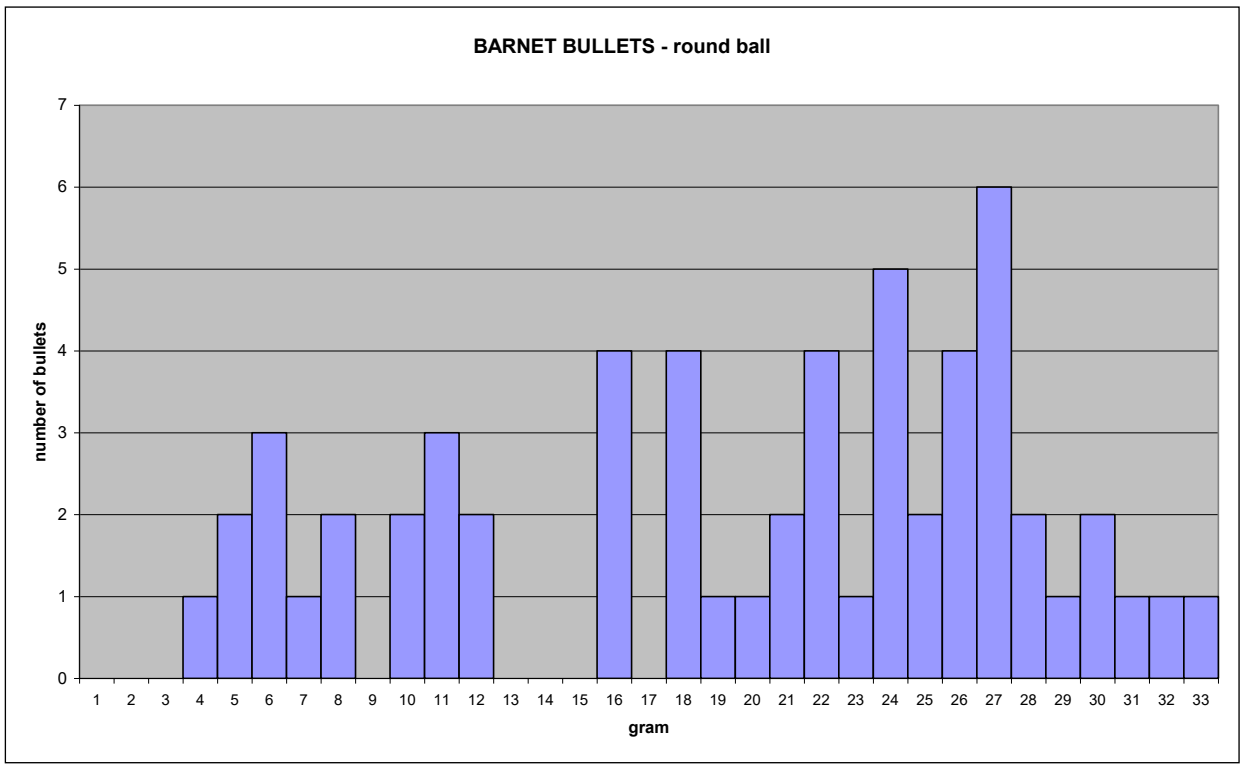
Figure 8: probable slug of irregular form (find 2)

Two other bullets have small holes not passing wholly through (40 & 41), and one other with a small hole right through (39). These are probably not bullets, but it is conceivable that they might represent wired shot, though these are only securely identified in 17th and 18th century naval contexts and may not have been used on land.

Assessment

The presence of one possible artillery roundshot might suggest that the bullets are in part related to military action but the absence of the powder box caps seen at the Easton Maudit site, which would tend to indicated a mid 17th century or earlier date, are absent from Barnet, though this could simply be because of the small size of the assemblage. However in other

respects the assemblage is quite unlike any 17th century military assemblage that has been studied so far. The graph of calibre from the round ball bullets, when the 8 probable recent bullets are excluded, is seen to concentrate on 17 bore. A concentration on 12 bore or 14 bore should be expected from a military assemblage involving infantry action in the 17th century. Neither however does the assemblage focus on carbine or pistol calibres that one might expect from cavalry action of that period.



The assemblage is also unusual in that almost all the bullets of 26 gram and above are banded, indicating tight fit in the barrel. If this was to indicate a rifled barrel then this would again be exceptional for a 17th century or earlier military context, while if fired tightly fitting in a smooth bore barrel then it would be surprising not to find some bullets fired before fouling of the barrel caused such a tight fit.

The nearest comparison is to part of the assemblage of the Grafton Regis siege site, which is an assemblage which itself seems atypical. Interestingly Grafton is not just a siege site but also partly within a deer park, and the Barnet bullets are from within or adjacent to Enfield Chase. Thus the possibility that the bullets are hunting related should be considered. Unfortunately at present there is no comparative data available from an assemblage securely identified to hunting. What may be significant is that the 17 bore, the focus of the Barnet collection is exactly the bore of the arquebus, though this does not explain the banding of the bullets.

Glenn Foard
26-06-2006

TABULATION OF BULLET DATA

FIND	FIND MATERIAL	FIND TYPE	FIND SUB	CERTAINTY	BULLET WEIGHT	WIDTH	DEPTH	BAND	BAND MATERIAL	IMPACTED	SURFACE CORR	COMMENTS

No.			TYPE		GHT Gram	MAX Mm	MIN Mm	X DIAM mm		OSION	
1	lead	slug	drum		15.21	19.84	13.50	0.0 0			
2	lead	slug		possible	22.70	22.29	10.09	0.0 0			min dimension 13.02; folded once and cut to length and hammered?
3	lead	slug		possible	21.21	23.00	10.25	0.0 0			min dimension 13.62; folded hammered and cut? or a cut strip folded;
4	lead	slug			26.76	19.03	9.14	0.0 0			min dimension 9.81; possible small embedded ferrous piece in one end; box with one flattened end; 4 facets hammered?
5	lead	uncertain			17.37	0.0 0	0.0 0	0.0 0			
6	lead	uncertain			23.02	13.85	14.22	0.0 0			pos raised sprue on one end; drum
7	lead	slug		possible	0.00	17.39	15.79	0.0 0			13.93; folded lead piece hammered to cube; possible slug;
8	lead	double ball			33.12	21.26	15.89	0.0 0			impacted in gun barrel and welded? one end flattened with banded effect in that ball and possible impact on other;
9	lead	slug		possible	16.57	14.12	13.46	0.0 0			snipped sprue on one end central;
10	lead	slug		possible	31.84	22.73	13.69	0.0 0			min dimension 18.26
11	lead	slug		possible	26.21	16.12	16.08	0.0 0			eroded
12	lead	slug	drum	possible	11.01	9.35	15.39	0.0 0			
13	lead	ball		possible	16.32	0.0 0	0.0 0	0.0 0	y		
14	lead	ball		possible	27.42	0.0 0	0.0 0	0.0 0	y		
15	lead	drum			14.60	11.51	12.85	0.0 0			star scored end; not a bullet?
16	lead	drum			14.25	12.39	12.10	0.0 0			scored end; not a bullet?
17	lead	ball	burred multiple charge	possible	20.92	0.0 0	0.0 0	0.0 0			
18	lead	ball			7.35	0.0 0	0.0 0	0.0 0			4 facets? but is eroded
19	lead	ball			26.10	0.0 0	0.0 0	0.0 0			
20	lead	drum			14.98	12.50	11.95	0.0 0			not a bullet?
21	lead	drum			15.85	12.86	12.13	0.0 0			not a bullet?
22	lead	drum			15.73	12.59	12.17	0.0 0			not a bullet?
23	lead	drum			15.20	12.70	11.58	0.0 0			not a bullet?
24	lead	drum			15.54	12.79	11.97	0.0 0			not a bullet?
25	lead	drum			14.52	12.49	11.76	0.0 0			not a bullet?
26	lead	drum			15.76	12.83	12.14	0.0 0			not a bullet?
27	lead	drum			16.34	13.01	12.38	0.0 0			not a bullet?
28	lead	drum			8.96	10.10	10.94	0.0 0			not a bullet?
29	lead	ball			24.10	0.0 0	0.0 0	0.0 0			impacted slight deformed
30	lead	ball			23.74	0.0 0	0.0 0	0.0 0	y		
31	lead	ball			24.26	0.0 0	0.0 0	0.0 0	y		odd other deformation

					21.2	0.0	0.0		0.0				
32	lead	ball			9	0	0		0	y			
					22.1	0.0	0.0		0.0				
33	lead	ball			0	0	0		0	y			
					16.2	0.0	0.0		0.0				
34	lead	ball			8	0	0		0	maj			
					11.1	0.0	0.0		0.0				
35	lead	ball			9	0	0		0	maj			
					25.7	0.0	0.0		0.0				
36	lead	ball			0	0	0		0	maj			
					24.9	0.0	0.0		0.0				
37	lead	ball			7	0	0		0	maj			
						0.0	0.0		0.0				
38	lead	ball			8.34	0	0		0	y			
			sma ll hole thro										
			ugh		22.6	0.0	0.0		0.0		dark		
39	lead	ball	small hole		3	0	0		0		grey	Probably not a bullet.	
			not through		16.6	0.0	0.0		0.0		dark	Probably not a bullet, but might	
40	lead	ball	small hole		1	0	0		0		grey	be wired shot.	
			not through			0.0	0.0		0.0		dark	Probably not a bullet, but might	
41	lead	ball			5.33	0	0		0		grey	be wired shot.	
					10.3	0.0	0.0		0.0				
42	lead	ball			9	0	0		0		black		
					11.1	0.0	0.0		0.0				
43	lead	ball			3	0	0		0		black		
					12.5	0.0	0.0		0.0				
44	lead	ball			5	0	0		0		black		
					10.3	0.0	0.0		0.0		black		
45	lead	ball			3	0	0		0		metal		
				possi	25.7	0.0	0.0		0.0				
46	lead	ball		ble	9	0	0		0	y			
					12.6	0.0	0.0		0.0				
47	lead	ball			8	0	0		0			snip or cut down? with small hole	
					24.9	0.0	0.0		0.0				
48	lead	ball			4	0	0		0				
					21.5	0.0	0.0		0.0				
49	lead	ball			6	0	0		0				
						0.0	0.0		0.0				
50	lead	ball			4.59	0	0		0				
						0.0	0.0		0.0				
51	lead	ball			6.86	0	0		0				
						0.0	0.0		0.0				
52	lead	ball			5.55	0	0		0				
						0.0	0.0		0.0				
53	lead	ball			6.51	0	0		0				
						0.0	0.0		0.0				
54	lead	bal			7.48	0	0		0				
						0.0	0.0		0.0				
55	lead	ball			8.69	0	0		0				
						0.0	0.0		0.0				
56	lead	ball			6.45	0	0		0			very eroded	
					16.2	0.0	0.0		0.0				
57	lead	ball			8	0	0		0				
					27.6	0.0	0.0	po	0.0				
58	lead	ball			0	0	0	s	0			possible faintly banded	
					24.7	0.0	0.0	mi	16.				
59	lead	ball			1	0	0	n	02				
			burr		27.7	0.0	0.0	mi	16.				
60	lead	ball	ed?		2	0	0	n	75				
					26.2	0.0	0.0	mi	0.0			damage means band not	
61	lead	ball			8	0	0	n	0	y		measurable	
					30.2	0.0	0.0	ma	0.0			damage means band not	
62	lead	ball			4	0	0	j	0	maj		measurable	
					31.1	0.0	0.0	ma	0.0			damage means band not	
63	lead	ball			7	0	0	j	0	maj		measurable	
					29.1	0.0	0.0	ma	0.0			damage means band not	
64	lead	ball			5	0	0	j	0	maj		measurable	
					32.5	0.0	0.0	ma	0.0			damage means band not	
65	lead	ball			3	0	0	j	0	maj		measurable	
					30.4	0.0	0.0	ma	17.				
66	lead	ball			4	0	0	j	30	pos			
					26.9	0.0	0.0	ma	13.				
67	lead	ball			0	0	0	j	18	y			

68	lead	ball		33.96	0.0	0.0	poss	33.96	maj			damage means band not measurable
69	lead	ball		27.22	0.0	0.0	majj	16.10	min			
70	lead	ball		26.51	0.0	0.0	majj	0.0	maj			damage means band not measurable
71	lead	ball		27.87	0.0	0.0	majj	16.91				
72	lead	ball		28.07	0.0	0.0	majj	16.35				
73	lead	ball		28.55	0.0	0.0	majj	17.03				
74	lead	ball		27.78	0.0	0.0	poss	0.0				damage means band not measurable
75	lead	ball	artillery	0.00	40.67	0.0		0.0				possible artillery rounshot; impacted deep gouge stria
76	lead	ball		18.63	15.87	15.93		0.0		unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue;
77	lead	ball		19.40	0.0	0.0		0.0	y	unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue;
78	lead	ball		18.42	15.83	15.79		0.0		unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue;
79	lead	ball		22.49	15.79	15.87		0.0		unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue;
80	lead	ball		18.13	15.75	15.97		0.0		unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue; incomplete fill of mould
81	lead	ball		22.98	15.54	15.83		0.0		unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue;
82	lead	ball		18.66	15.67	15.74		0.0		unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue; slight incomplete fill of mould
83	lead	ball		11.92	15.62	15.76		0.0		unoxidised metal - recent ?		high & wide consistent intact flash ridge of min 1mm high; snipped sprue;

Appendix 2

List of weights in grams of each of the lead bullets collected by Adkin from the Wrotham Park estate and provided for analysis by Sam Wilson.

7.4
10.3
11.2
11.3
11.9

12.6
15.7
15.8
16.8
17.2
17.3
17.9
17.9
18
18.1
18.2
18.9
20.2
20.7
20.9
21.5
22.5
22.5
23
24.3
24.5
25.1
25.1
25.1
25.6
25.9
26
26
27.2
27.5
27.8
28
28.2
28.6
28.7
28.9
29.2
29.2
29.4
29.6
29.6
30.1
30.5
30.5
30.6
30.7
30.8
30.8

31.2
32
32.4
32.7
33.1
33.1
33.1
34.7
35.5
36.1