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FULL ANALYSIS OF HUMAN REMAINS FROM FIELDS 207-211 OF THE A1 WIDENING SCHEME

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Introduction

During excavations in 2014, a total of five inhumation burials (Appendix, Table 1), six cremation burial deposits (Appendix, Table 2), and two disarticulated contexts of human bone (Appendix, Table 3, Table 8) were identified during excavations by Northern Archaeological Associates in Fields 207-211 of the Carillion/Morgan Sindall A1 Leeming to Barton Joint Venture for widening of the A1.

Field 209 contained three inhumation burials and a disarticulated human recovered from a deposit within a corn dryer. Field 210 contained two cremation burials, two inhumation burials, and disarticulated human bone recovered from an east to west enclosure ditch. Lastly, Field 211 contained four cremation deposits, relating to two cremation burials. This document presents the objectives, methods and results of the analysis of these remains.

Objectives

The skeletal assessment aimed to determine age and sex, as well as any manifestations of disease from which the individuals may have suffered. Additionally, information was sought regarding the cremation techniques where appropriate.

Methodology

The skeletons were analysed in detail, assessing the preservation and completeness, as well as determining the age, sex and stature of the individual. All pathological lesions were recorded and described. A summary of the osteological and palaeopathological data for the inhumation burials is given in the Appendix in Table 4.

The cremated bone was sieved through a stack of sieves; with 10mm, 5mm and 2mm mesh sizes. The bone recovered from each sieve was weighed and sorted into identifiable and non-identifiable bone. The identifiable bone was divided into five categories: skull, axial (excluding the skull), upper limb, lower limb and long bone (unidentifiable as to the limb). All identifiable groups of bone were weighed and described in detail. A summary of the data for the cremated bone assemblages is given in the Appendix, in Table 5.

Osteological Analysis

Skeletal preservation depends upon a number of factors, including the age and sex of the individual as well as the size, shape and robusticity of the bone. Burial environment, post-depositional disturbance and treatment following excavation can also have a considerable impact on bone condition. Preservation of human remains is assessed subjectively, depending on the severity of bone surface erosion and post-mortem breaks, but disregarding completeness.

Preservation was assessed using a grading system of five categories: very poor, poor, moderate, good and excellent. Excellent preservation implied no bone erosion and very few or no post-depositional breaks, whereas very poor preservation indicated complete or almost complete loss of the bone surface due to erosion and severe fragmentation.

The inhumation burials from Fields 209 and 210 were all severely fragmented, and had poor to very poor surface preservation. Poor preservation of the skeletons meant that for all five individuals, very few skeletal elements remained, with the highest completeness being 35% (Skeleton 10869). Often, elements were only identified as being present by their position within the grave cut.

The cremated bone assemblages from Field 210 (Burials 7831 and 7860) were in a good state of preservation, with retention of surface detail and minimal post-mortem breakage. However, those from Field 211 (Burials 7672, 7673, 7684, and 7685) were in a comparatively poor state of preservation, with loss of surface detail and more evidence of post-depositional disturbance in the form of fresh breaks.

A count of the 'minimum number of individuals' (MNI) recovered from a cemetery is carried out as standard procedure during osteological assessments of inhumations in order to establish how many individuals were represented by the articulated and disarticulated human bones (without taking the archaeologically defined graves into account). The MNI is calculated by counting all long bone ends, as well as other larger skeletal elements, such as the hip joints and cranial elements.

It is difficult to calculate the MNI for cremation burials, because only a token selection of bone from the pyre tends to be buried. Double burials can be identified only if skeletal elements are duplicated, or if skeletons of different ages are represented in one burial. There were no double burials identified amongst any of the cremated assemblage, therefore assuming a minimum number of one individual per cremation burial gives a total of four individuals.

Due to the extremely poor preservation of the inhumation burials, there were very few identifiable skeletal elements present to determine duplicates. A number of duplicates were seen in the dentition, for example two lower left third molars were present, suggesting at least

two adult individuals were present within the articulated sample. One older juvenile was also identified within the disarticulated sample (see below). This is obviously a much lower number than that suggested by the five grave cuts.

Age was determined using standard ageing techniques, as specified in Scheuer and Black (2000a; 2000b) and Cox (2000). Age estimation relies on the presence of the pelvis and uses different stages of bone development and degeneration in order to calculate the age of an individual (Lovejoy et al 1985; Meindl and Lovejoy 1989). Age is split into a number of categories, from foetus (up to 40 weeks in *utero*), neonate (around the time of birth), infant (newborn to one year), juvenile (1-12 years), adolescent (13-17 years), young adult (*ya*; 18-25 years), young middle adult (*yma*; 26-35 years), old middle adult (*oma*; 36-45 years), mature adult (*ma*; 46+) to adult (an individual whose age could not be determined more accurately as over the age of seventeen).

In all but one of the cremation burials the criteria normally used for age determination were absent, as such; age determination was based on less reliable criteria. The bone robusticity suggested that all but one of the individuals containing identifiable human were at least sixteen years old but may have been considerably older. Burial 7860 appeared to contain the remains of an older juvenile, based on the crown development of an unerupted lower second molar.

Out of the five inhumation burials from Fields 209 and 210, age estimations could only be made for two individuals. Due to poor preservation of skeletal elements these estimates were also based on dental wear alone, which is not a reliable indicator of age when used in isolation as wear can be influenced by a myriad of factors. Skeleton 11815 was possibly a young adult (18-25 years) based on minimal wear of the dentition, and Skeleton 11819 possibly a younger middle adult (26-35 years). However, it may be more prudent to class these individuals simply as 'adults' (18+ years). Skeleton 10869 was also likely an adult individual. Due to the extreme fragmentation seen in Skeletons 11810 and 10869 it could not be determined whether they were adult or non-adult, and without the context of the grave cut it would even be difficult to confirm the bone fragments were human. It was suggested by the excavators that the size of the grave cut of Skeleton 10841 indicated that they may have been a child, but no skeletal elements survived to confirm this.

One adult right femur, and multiple teeth from an older juvenile (6 -8 years) were identified within the disarticulated sample.

Sex determination is usually carried out using standard osteological techniques, such as those described by Mays and Cox (2000). Assessment of sex in both males and females relies on the preservation of the skull and the pelvis and can only be carried out once sexual characteristics have developed, during late puberty and early adulthood. None of the cremation or inhumation burials contained any diagnostic skeletal elements to allow for the estimation of sex.

Stature depends on two main factors, heredity and environment; it can also fluctuate between chronological periods. Stature can only be established in skeletons if at least one complete and fully fused long bone is present, but preferably using the combined femur and tibia. Knowing the sex of the individual is also necessary, which is an issue with disarticulated long bones where sex cannot be determined. The bone is measured on an osteometric board, and stature is then calculated using a regression formula developed upon individuals of known stature (Trotter 1970). Where possible, bones from the legs were used in preference to those of the upper limb as these carry the lowest error margin (*ibid*).

Cremated bone shrinks at an inconsistent rate (up to 15%) during the cremation process and it was therefore not possible to measure any of the bones from these burials. In addition, due to severe to extreme fragmentation, stature could also not be estimated for any of the inhumation burials.

Non-metric traits are additional sutures, facets, bony processes, canals and foramina, which occur in a minority of skeletons and are believed to suggest hereditary affiliation between skeletons (Saunders 1989). The origins of non-metric traits have been extensively discussed in the osteological literature and it is now thought that while most non-metric traits have genetic origins, some can be produced by factors such as mechanical stress (Kennedy 1989) or environment (Trinkhaus 1978). Non-metric traits were not observed in any of the individuals.

Cremated Bone Pyre Technology

The amount of bone retrieved from all of the burials weighed significantly less than the average bone weight produced by modern crematoria (Appendix, Table 5), which tends to range from 1,000.5g to 2,422.5g with a mean of 1,625.9g (McKinley 1993). Wahl (1982, 25) found that archaeologically recovered remains of cremated adults tend to weigh less (between 250g and 2,500g) as a result of the commonly practised custom of selecting only some of the cremated bone from the pyre for inclusion in the burial, thereby representing a symbolic, or token, interment. However, post-depositional disturbance of the burials may also have led to the loss of bone.

The cremated bone assemblages varied in terms of colour (Appendix, Table 5). The two cremation burials from Field 210 were generally well burnt, causing the complete loss of the organic portion of the bone and producing a white colour (although some patches of light grey were also evident). However, the two cremation burials from Field 211 were incompletely calcined, having a more mottled appearance of white, grey, and black. The colour of cremated bone is connected to the temperature of the pyre, amount of oxygen available during burning, and the duration of the cremation. High temperatures (c. 600°C and over) and plentiful oxygen will result in fully oxidised white bone given adequate time, whereas temperatures between c.300-600°C and/or lack of oxygen will result in partially oxidised bone ranging in colour from

dark to pale grey (McKinley 2004b). Temperatures below c. 300°C and absence of oxygen will lead to charring of the bone, expressed as brown and black colours (*ibid*). According to McKinley (1989), the body requires a minimum temperature of 500° Celsius over seven to eight hours to achieve complete calcination of the bone. This suggests that in some of the burials the bone had either not reached sufficient temperatures, or been allowed to burn for long enough. Alternatively, the pyre may not have been well constructed and prevented adequate air flow for optimal burning.

Moderate warping and bone cracking, which occurs commonly during the cremation process, was evident in many of the cremated bone assemblages.

The fragment size of cremated bone is frequently attributed to post-cremation processes. This is because skeletal elements retrieved from modern crematoria tend to be comparatively large before being ground down for scattering or deposition in the urn. Bone is also prone to fragmentation if it is moved while still hot (McKinley 1994, 340). In the majority of burials the greatest proportion of the bone was derived from the 5mm and 2mm sieves (Appendix, Table 6). This suggests that the bone from these burials was subject to disturbance while they were still hot.

The majority of identifiable bones were derived from unidentified long bone shaft fragments and cranial vault fragments (Appendix, Table 7). As the cranial vault is very distinctive and easily recognisable, even when severely fragmented, it often forms a large proportion of identified bone fragments in cremated remains (McKinley 1994). Rib fragments and vertebral fragments were also identified in all cremation burials.

Pathological Analysis

The analysis of skeletal and dental manifestations of disease can provide a vital insight into the health and diet of past populations, as well as their living conditions and occupations. In this case, manifestations of disease were not observed amongst any of the cremated remains.

Due to the poor skeletal preservation and comparatively good preservation of the teeth in the majority of the inhumation burials, only dental pathology could be assessed for the articulated sample.

Three individuals had teeth present for analysis, but no tooth positions survived. Skeleton 10869 (adult) had two teeth preserved, Skeleton 11815 (young adult) had 23 teeth preserved, and Skeleton 11819 (younger middle adult) had eight teeth preserved.

If plaque is not removed from the teeth effectively (or on a regular basis) then it can mineralise and form concretions of calculus on the tooth crowns or roots (if these are exposed), along the line of the gums (Hillson 1996, 255-257). Mineralisation of plaque can also be common when

the diet is high in protein (Roberts and Manchester 2005, 71). Calculus is commonly observed in archaeological populations of all periods, although poor preservation or damage caused during cleaning can result in the loss of these deposits from the teeth (*ibid*, 64). Calculus deposits were seen on one tooth from Skeleton 10869 (adult), four teeth from Skeleton 11815 (young adult), and four teeth from Skeleton 11819 (younger middle adult).

Dental caries (tooth decay) forms when bacteria in the plaque metabolise sugars in the diet and produce acid, which then causes the loss of minerals from the teeth and eventually leads to the formation of a cavity (Zero 1999). Simple sugars can be found naturally in fruits, vegetables, dried fruits and honey, as well as processed, refined sugar; since the latter three contain the most sucrose they are most cariogenic. Complex sugars are usually less cariogenic and are found in carbohydrates, such as cereals. However, processing carbohydrates, including grinding grains into fine powders or cooking them, will usually increase their cariogenicity (Moynihan 2003). One very small carious lesion was seen on a tooth from Skeleton 11819 (younger middle adult).

Dental enamel hypoplasia (DEH) is the presence of lines, grooves or pits on the surface of the tooth crown, and occurs as a result of defective formation of tooth enamel during growth (Hillson 1996). Essentially, they represent a period when the crown formation is halted, and they are caused by periods of severe stress, such as episodes of malnutrition or disease, during the first seven years of childhood. Involvement of the deciduous (milk) teeth can indicate pre-natal stress (Lewis 2007). Trauma can also cause DEH formation, usually in single teeth, therefore only individuals with three or more teeth with DEH defects were included in the analysis below. Dental enamel hypoplasia was seen on eight teeth from Skeleton 11815 (young adult). It also affected five out of the sixteen teeth from an older juvenile (6-8 years) recovered from one of the disarticulated deposits.

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Appendix

Table 1 List of articulated skeletons

Field	Sk No	Position	Orientation	Additional finds with Sk	Notes
209	11810	-	N-S??	-	One of three grouped inhumations, located between Skeletons 11815 and 11819, and slightly to the south. Extremely poorly preserved skeleton, not visible within grave cut, but fragments of bone recovered from the fill during post-excavation processing
209	11815	Supine, extended	N-S	Copper alloy ankle bracelet (left leg); copper alloy brooch pin; pottery (AD200+); animal tooth	One of three grouped inhumations, to the west of Skeletons 11810 and 11819. Skull truncated by modern drain
209	11819	Supine	N-S	-	One of three grouped inhumations, to the east of Skeletons 11810 and 11815. Lower half of the body truncated by modern drain
210	10841	-	-	Necklace comprising 101 jet, bone, and glass beads	Extremely poorly preserved skeleton, with few fragments of bone preserved. Excavators felt the grave cut size was indicative of child burial, but no skeletal elements survived that could confirm this. To the south of Skeleton 10869
210	10869	Supine, extended	N-S	33 iron nails; pottery (AD240-300)	Coffin burial (determined by presence of <i>in situ</i> iron nails and timber stains). To the north of Skeleton 10841

Table 2 List of cremation burials

Field	Sk No	Feature type	Artefacts and inclusions	Notes
210	7831	Bowl-shaped pit [7830]	Pottery (AD120-200); animal bone	Four stakeholes set around the outer edge. To the south of Burial 7860
210	7860	Bowl-shaped pit [7859]	Pottery (AD200+)	Five burnt stakes set within the feature, four additional stakeholes set around the outer edge. To the north of Burial 7831
211	7672	Upper fill within a bowl-shaped pit [7671]	Sherds of a Crambeck ware beaker (AD270-370); charcoal; animal bone	Surrounded by a sub-rectangular arrangement of four stakeholes. Burials 7672 and 7673 form one deposit from the same burial event. To the south of cremation pit [7683]
211	7673	Lower fill within a bowl-shaped pit [7671]	Charcoal; animal bone	Surrounded by a sub-rectangular arrangement of four stakeholes. Burials 7672 and 7673 form one deposit from the same burial event. To the south of cremation pit [7683]
211	7684	Upper fill within a bowl-shaped pit [7683]	Pottery (late 2 nd /early 3 rd centuries AD); animal bone	Surrounded by a sub-rectangular arrangement of four stakeholes. Burials 7684 and 7685 form one deposit from the same burial event. To the north of cremation pit [7671]
211	7685	Lower fill within a bowl-shaped pit [7683]	Animal bone; possible iron hobnail; charcoal	Surrounded by a sub-rectangular arrangement of four stakeholes. Burials 7684 and 7685 form one deposit from the same burial event. To the north of cremation pit [7671]

Table 3 List of contexts containing disarticulated human bone

Field	Context No.	Location on site	No. fragments	Notes
209	10713/ 10715	Deposit within corn dryer 10712	45	Juvenile teeth (approximately 6 to 8 years of age) likely from one individual, and a small number of cranial and long bone fragments. Deposit also included pottery, coarseware, mortar and flint
210	7960	Fill of E-W enclosure ditch 7959	13	Fragments of an adult right femur. Fill also included pottery, coarseware, and an iron object

Table 4 Summary of osteological and palaeopathological results

Field	Sk No	Fragmentation	SP	Completeness (%)	Age	Age Group	Sex	Dental Pathology	Skeletal Pathology
209	11810	Extreme	4	<5	-	-	-	-	-
209	11815	Severe	4	25	18-25 years	YA	-	Calculus, DEH	-
209	11819	Extreme	5+	<5	26-35 years	YMA	-	Calculus, caries	-
210	10841	Extreme	5+	<5	-	-	-	-	-
210	10869	Severe	4	35	18+ years	Adult	-	Calculus	Degenerative disc disease and DJC in the spine

Key: SP = Surface preservation: grades 0 (excellent), 1 (very good), 2 (good), 3 (moderate), 4 (poor), 5 (very poor), 5+ (extremely poor) after McKinley (2004a); C = Completeness; F = Fragmentation: min (minimal), sli (slight), mod (moderate), sev (severe), ext (extreme)

Non-adult age categories: f (foetus, <38 weeks *in utero*), p (perinate, c. birth), n (neonate, 0-1m), i (infant, 1-12m), j (juvenile, 1-12y), ad (adolescent 13-17y)

Adult age categories: ya (young adult, 18-25y), yma (young middle adult, 26-35y), oma (old middle adult, 36-45y), ma (mature adult, 46+y), a (adult, 18+y)

R - right; L - left; OA = Osteoarthritis; DJC = Degenerative Joint Changes; DEH - dental enamel hypoplasia

Table 5 Summary of cremated bone assemblages

Field	Fill No	Urn?	Bone Colour	Preservation	MNI	Age	Sex	Max frag. (mm)	Weight (g)	Percentage of Expected Quantity of Bone
210	7831	Y?	White/grey/black	Good	1	A?	-	25.8	72.4	4.5
210	7860	N?	White/grey/black	Good	1	J	-	29.3	92.3	-
211	7672	?	White/light grey	Poor	1	-	-	19.83	73.1	4.5
211	7673	?	White/light grey	Poor	1	A?	-	46.77	70.0	4.3
211	7684	?	White/light grey	Poor	1	-	-	22.71	57.9	3.6
211	7685	?	White/grey	Moderate	1	A?	-	26.61	62.0	3.8

Key: Age: A - adult, C - child, N - neonate, J - juvenile, Ad - adolescent, - - unknown; Sex: M - male, F - female, - - unknown; MNI - minimum number of individuals; Date: BA - Bronze Age

* Weight of bone >2mm expressed as a percentage of average weight of bone >2mm recovered from modern cremation burials (1625.9g, McKinley 1993)

Table 6 Summary of cremated bone fragment size

Burial No	10mm (g)	10mm (%)	5mm (g)	5mm (%)	2mm (g)	2mm (%)	Residue	Weight (g)
7831	4.1	5.7	29.9	41.3	34.2	47.2	4.2	72.4
7860	6.7	7.3	40.4	43.8	42.4	45.9	2.8	92.3
7672	3.4	4.7	28.7	39.3	37.6	51.4	3.4	73.1
7673	10.1	14.4	25.0	35.7	28.5	40.7	6.4	70.0
7684	0.6	1.0	21.3	36.8	29.1	50.3	6.9	57.9
7685	8.4	13.5	27.5	44.4	24.7	39.8	1.4	62.0

Table 7 Summary of identifiable elements in the cremation burials

Burial No	Skull (g)	Skull (%)	Axial (g)	Axial (%)	UL (g)	UL (%)	LL (g)	LL (%)	UIL (g)	UIL (%)	Total ID (g)	Total ID (%)	Total UID (g)	Total UID (%)
7831	22.2	30.7	7.5	10.4	3.0	4.1	-	-	14.1	19.5	46.8	64.6	25.6	35.4
7860	14.3	15.5	6.1	6.6	6.8	7.4	6.9	7.5	20.8	22.5	54.9	59.5	37.4	40.5
7672	7.8	10.7	3.5	4.8	4.5	6.2	1.5	2.1	27.6	37.8	44.9	61.4	28.2	38.6
7673	2.5	3.6	1.8	2.6	5.9	8.4	6.1	8.7	21.4	30.6	37.7	53.9	32.3	46.1
7684	5.9	10.2	0.7	1.2	2.2	3.8	-	-	18.5	32.0	27.3	47.2	30.6	52.8
7685	10.6	17.1	1.8	2.9	7.7	12.4	4.7	7.6	17.0	27.4	41.8	67.4	20.2	32.6

Table 8 Disarticulated bone catalogue

ID	Field	Context	Bone Element	Detailed Description	Side	%	SP	No. Frags	Age	Sex	Other
1	209	10713	Upper 2 nd molar	Crown	R	100?	0	1	J	-	Developing tooth, but root possibly slightly broken, minimum Ri. ID1-13 likely same individual, approximately 6-8 years of age
2	209	10713	Upper 1 st molar	Crown	R	90?	0	1	J	-	Root broken PM so can't determine developmental stage, minimum Crc. DEH. ID1-13 likely same individual, approximately 6-8 years of age
3	209	10713	Upper 1 st premolar	Crown and part of root	R	90?	0	1	J	-	Root broken PM, minimum R¼. ID1-13 likely same individual, approximately 6-8 years of age
4	209	10713	Upper central incisor	Crown and half of root	R	90?	0	1	J	-	Root slightly broken, minimum R½. ID1-13 likely same individual, approximately 6-8 years of age
5	209	10713	Upper central incisor	Crown and half of root	L	90?	0	1	J	-	Root slightly broken, minimum R½. ID1-13 likely same individual, approximately 6-8 years of age
6	209	10713	Upper lateral incisor	Crown and quarter of root	L	90?	0	1	J	-	Root broken, minimum R¼. DEH. ID1-13 likely same individual, approximately 6-8 years of age
7	209	10713	Lower 2 nd molar	Crown	R	100?	0	1	J	-	Root slightly broken, minimum Crc. ID1-13 likely same individual, approximately 6-8 years of age
8	209	10713	Lower 2 nd premolar	Crown	R	100?	0	1	J	-	Root slightly broken, minimum Crc. ID1-13 likely same individual, approximately 6-8 years of age
9	209	10713	Lower deciduous 2 nd molar	Whole	R	100	0	1	J	-	Wear=3. ID1-13 likely same individual, approximately 6-8 years of age
10	209	10713	Lower lateral incisor	Crown and half of root	R	100	0	1	J	-	R½, DEH. ID1-13 likely same individual, approximately 6-8 years of age
11	209	10713	Lower lateral incisor	Crown and half of root	L	100	0	1	J	-	R½-¾, DEH. ID1-13 likely same individual, approximately 6-8 years of age
12	209	10713	Lower 1 st premolar	Crown and part of root	L	100?	0	1	J	-	Minimum Ri. ID1-13 likely same individual, approximately 6-8 years of age
13	209	10713	Lower 2 nd premolar	Crown	L	90?	0	1	J	-	Minimum Ri. ID1-13 likely same individual, approximately 6-8 years of age
14	209	10713	Cranium	Vault fragments	-	-	-	10	J	-	-
15	209	10713	Long bone	Shaft fragments	-	-	-	3	?	-	-
16	209	10713	Fragments	Unidentified	-	-	-	16	-	-	-
17	209	10715	Upper 2 nd molar	Crown	L	80?	0	1	J	-	Damaged crown, DEH. Likely same individual as ID1-13

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18	209	10715	Lower 1 st premolar	Crown	R	80?	0	1	J	-	Damaged crown. Likely same individual as ID1-13
19	209	10715	Lower 1 st molar	Crown	L	80?	0	1	J	-	Damaged crown. Likely same individual as ID1-13
20	210	7960	Femur	Missing proximal and distal ends	R	60	3	6	A	-	Very sharp, smooth breaks on the fragments of the proximal end, difficult to tell if peri-mortem breaks or taphonomic damage
21	210	7960	Long bone	Shaft fragments	-	-	-	7	A	-	Likely belongs to femur ID20

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