Ancient Monuments Laboratory
Report 6/89

SOIL REPORT CONCERNING THE RAMPART AT LITTLECHESTER, DERBY.

Matthew Canti

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Summary

The rampart at the Roman fort of Derventio, Littlechester, Derby, has been examined with a view to explaining the construction methods and materials used. The sections exhibited marked lenses of dark clay in a lighter clay matrix, and were frequently crossed by horizontal-trending bands of sand and gravel up to 2m long. Iron concentrations were strongly associated with the banding but could also be found existing as independent mottles. Possible local sources for the clay are discussed and aspects of the lens/band morphologies are used to build up a likely construction scheme. Both blocks and clay rubble appear to have been used, with layers of sand to facilitate traffic over the surface. This produced the dark lenses by compression of blocks and the lighter matrix by sealing in of sand/clay-rubble mixtures. Subsequent iron redistribution is focussed on the abrupt textural variation brought about by this construction style.

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1. Introduction

The Roman fort of Derventio at Littlechester, Derby has been partially excavated at various times. Most recently, housing development on the East side has neccessitated rescue digs in the spring of 1987 and winter of 1988; these have been carried out by the Trent and Peak Archaeological Unit and directed by Christopher Drage.

Both the recent excavations have traced the path of the fort's South-Eastern rampart, which consisted of an early earth-bank and a later stone wall. This report deals with the questions that have arisen concerning the construction methods, and post-construction changes, of the earlier fortification.

2. Local Geology

The site is situated on the floodplain of the River Derwent, and is composed of alluvium overlying Keuper Marl at depth (Frost and Smart 1979). Other outcrops within a mile of the site include Permo-Triassic sandstones and Waterstones, Bunter pebble beds, Skerry bands, Millstone Grit and boulder clay.

3. The Rampart

The 1987 excavation revealed the rampart to be 0.9m high but of unspecified width. It was constructed mainly of grey silty clay with intercalations of yellowish sandy materials; towards the top and rear, these layers became increasingly pebbly.The 1988 excavation traced its course further South East. Here, the more extensive digging showed the width to be at least 7m. The construction and textural trends were found to be similar to the 1987 results.

The coarse layers are perhaps the most unusual aspect of this structure. They vary from small lenses to long bands traceable for over 2m. They are frequently picked out by iron staining which has developed into pans in some places. In the 1988 section (See Figure 3), the bands were notably absent from the central area, but could be found at the top (sand and pebbles) and bottom (pure sand) of the exposure.

4. Sampling

Figure 1 shows the sample locations from both excavations, and the relevant section drawings are reproduced in Figures 2 and 3. The 1987 samples (153 and 154) consist of two 26cm polythene monoliths sampled contiguously to provide a 52cm undisturbed sample, parallel to the axis of the rampart. The 1988 samples (SS1 to SS3) were taken at 90 degrees to the axis and comprise:-

- SS1 A 50cm monolith taken across the sand-poor central section, but including a pebble/sand layer in the top 15cm.
- SS2 A Kubiena box for thin section manufacture from an upper pebble/sand layer.
- SS3 A Kubiena box across a lower sand layer.

Spot samples were taken at 12, 22, 29 and 41cm from SS1 for pollen tests.

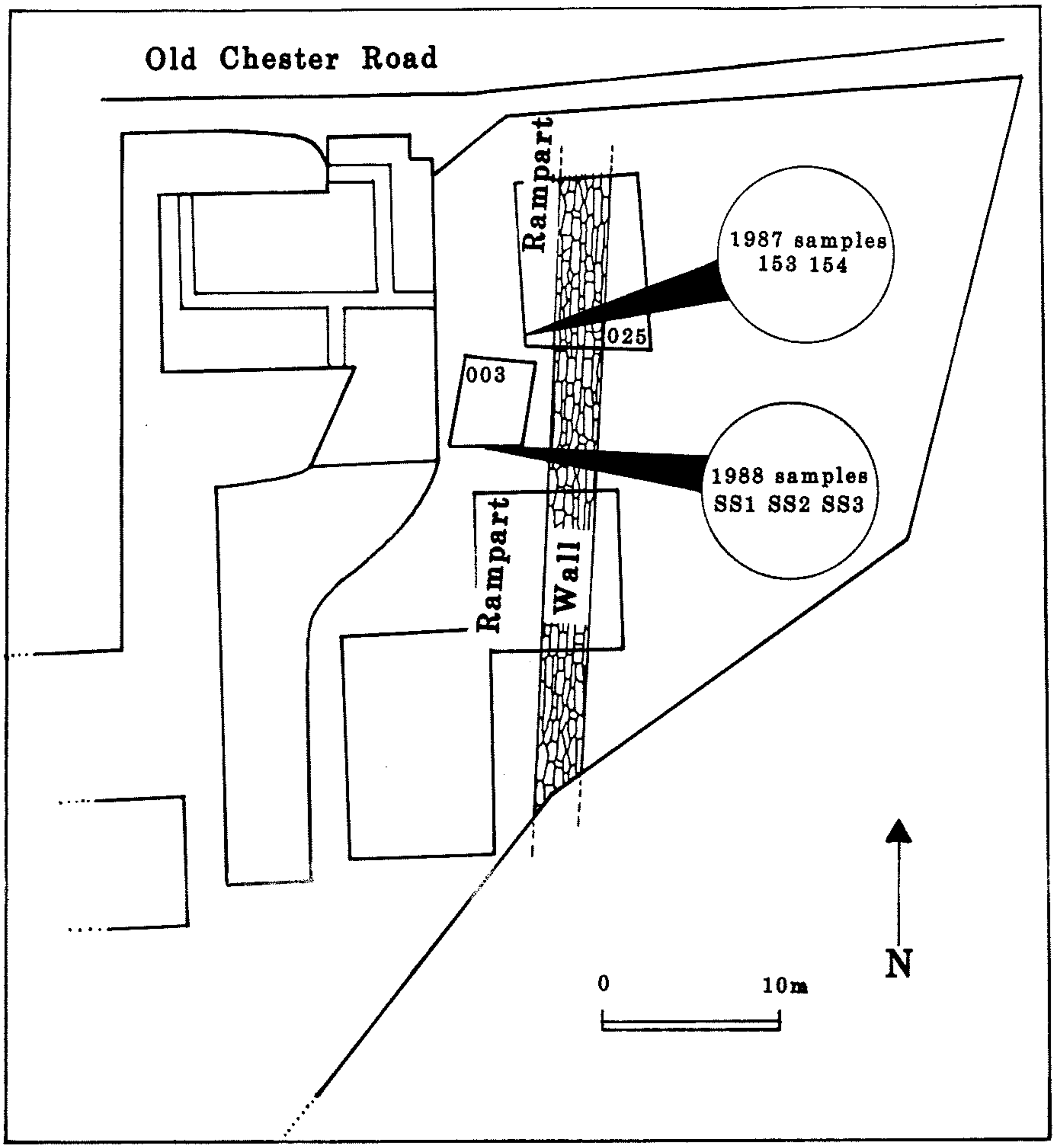


Figure 1
Location of 1987 and 1988 samples. See Figs. 2 and 3 for sections

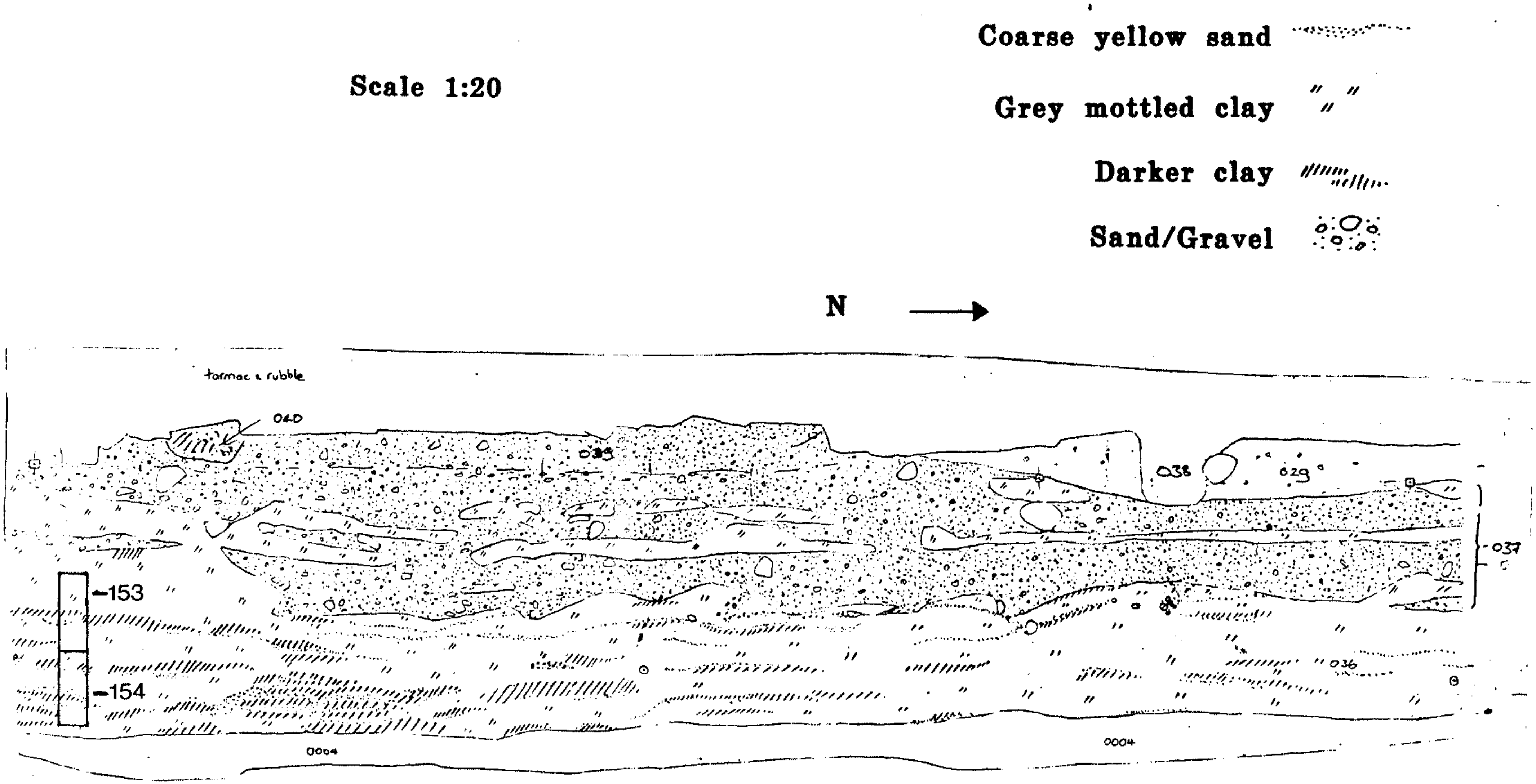


Figure 2. Part of west side of DLC 025

Scale 1:20

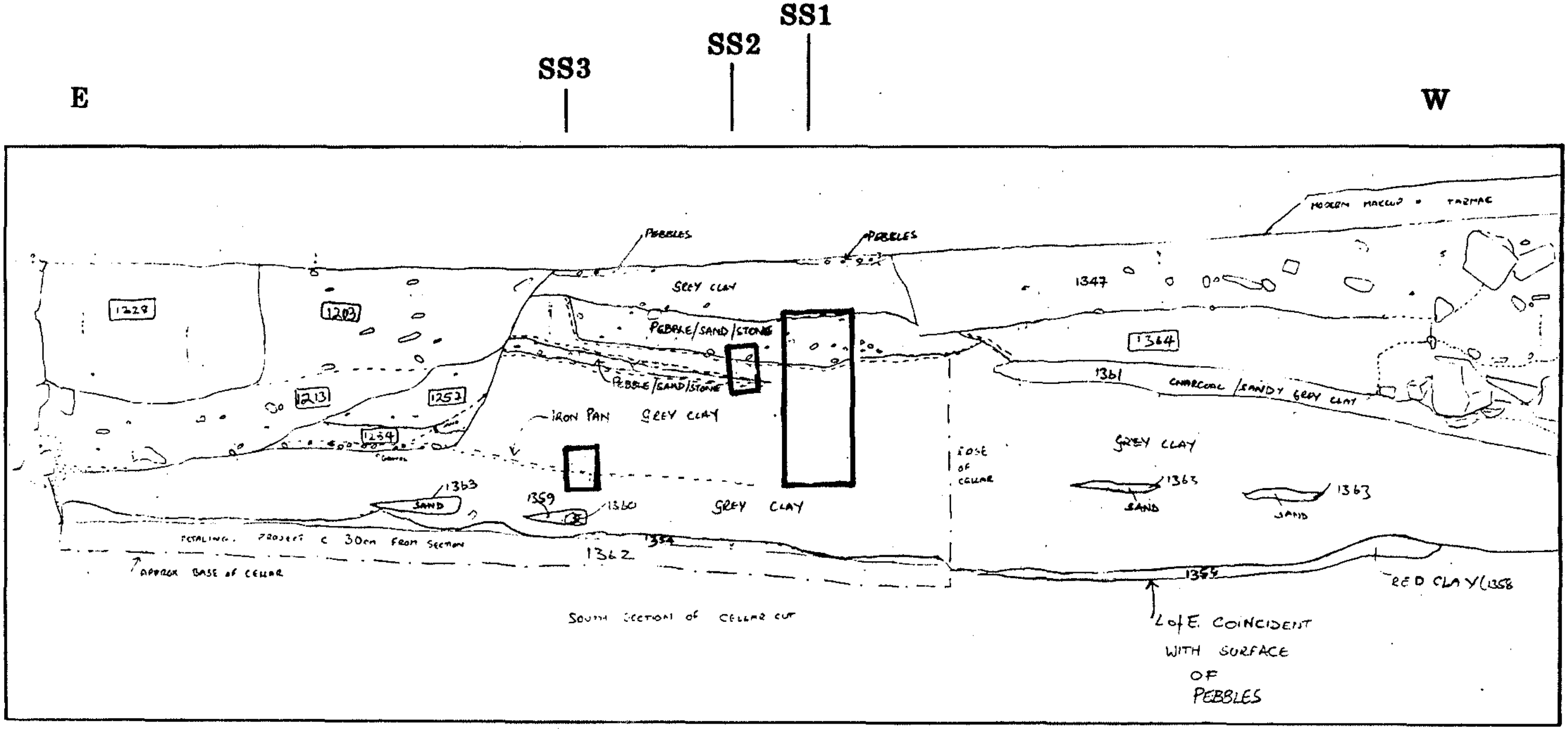
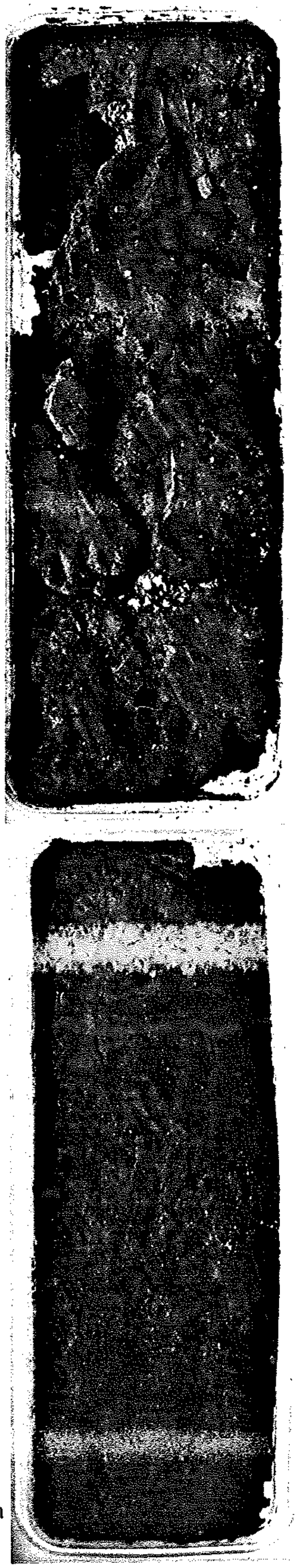


Figure 3. Part of south side of DLC 003

Plate 1 - MONOLITHS 153 and 154



20

45

55cm

\- 20cm Dark Greyish Brown (10yr 4/2) Silty Clay. 10-20% patches and streaks of coarser material. Frequent mottling ranging from 10yr 5/4 to 5yr 4/8, often associated with sandy materials. Structureless, massive, except for major pseudo-structural unit in lefthand quarter of monolith.

at 20cm Coarse inclusion of White (10yr 7/2) mortar, iron cemented at edges.

20 - 54cm Dark Greyish Brown (10yr 4/2) Silty Clay. 40-50% diffuse contamination by sand, associated with mottling as above, but with notably redder colours (2.5yr) and sharper patterns. Strong development including panning around 31-35 cm.

at 43-46cm Wedge-shaped inclusion of pure clay (10yr 4/1) enclosed in iron-stained sand mass.

Plate 2- MONOLITH SS1

0

25cm

50cm

-15/17 Dark Greyish Brown (10yr 4/2) Loamy Sand. Abundant small to large, subangular to rounded stones. Structureless. Abrupt smooth boundary to:-

15/17-50cm Dark Grey (10yr 4/1) Silty clay. Weakly developed, fine angular blocky structure. Iron stained in bands to Dark Reddish Brown (5yr 3/3) esp. at 20/22cm and 26/28cm. Less marked and more diffuse at 39/44cm. Stoneless.

At 29cm - Very Dark Grey (10yr 3/1) lens edge protruding into section.

Pollen samples taken at 12, 22, 29 and 41 cm.

5. Results

5.1 Macromorphology.

The two monolith samples shown in Plates 1 and 2 display slight differences within an overall morphological similarity. 153/154 has no upper stony layer as found in SS1, but it can be seen on Figure 2 that this is only a sampling difference. While moist, the clay matrix of 153 is similar to SS1 except for a notable increase of mottle frequency in the former. Both sections exhibit patchy iron - staining sometimes associated sand streaks. 154 is different mainly in the degree of sand contamination and its associated iron concentrations.

Individual features of the sections provide some evidence for the construction method. As a whole, the clay masses are weakly structured and do not part into discrete units (peds); the lefthand quarter of 153, however, is dominated by an irregular shaped unit (most of which fell away on cleaning). This is certainly not part of a natural structure and is likely to be the edge of a clay lump, possibly sand-contaminated, which has been preserved as a line of weakness. Additional evidence for this hypothesis is found in the mortar occurring at 20cm in 153; this irregular lens of coarse material is on the same line as the base of the structural unit and may well be contamination of the next block along. From this information, 153 could be seen as the intersection of three blocks at around 20cm. However, this view is not born out by the section drawing, which shows a band of dark clay cutting across the lower parts of the supposed blocks. On allowing the monolith to partially dry out, the dark clay became inreasingly obvious, and the "pseudo-structure" gave more the appearance of having been flattened over the dark layer.

In sample 154, two dark clay bands cross the monolith. The lower of these two features (at ca. 45cm) exhibits both the lensing nature of these bands, and the fact that the upper and/or the lower surfaces are frequently marked by sand layers. These layers have sharp edges against the dark clay intrusion and diffuse, almost crenulated interfaces with the clay mass above and below (see Plate 3). There is no evidence for a block stucture in this sample; indeed, the diffuse and irregular sand and mottle associations suggest dumping of mixed materials.

SS1, except for the upper stony layer, is relatively uniform. The central mass of clay is the same colour as the dark bands found in 153/154 and has a weakly developed fine angular blocky structure. Two iron-stained streaks cross the monolith, picking out a textural change. The lower of these has an associated fine lens of organic-rich clay. This probably represents old topsoil contamination and is considerably darker than any other sediments in the monoliths. More of such humic layers would be expected if the rampart had a turf construction. In addition, the sheer mass of dark clay present in the rampart argues strongly for the use of a naturally dark sediment. Further ideas on the clays and colour variation can be found in section 6.

Plate 3
Dark clay intrusion from 154. Note sand/clay interface types

5.2 Micromorphology

The rampart thin-sections show clearly that the mottling and staining by iron oxides occurs at 3 different types of site :-

1) As coats along voids e.g. old root channels (Plate 4).

2) As lines marking a change in soil texture (Plate 5).

3) As discrete lenticular mottles, growing concentrically without apparent cause (Plate 6).

Most mottling is caused by the reduction of iron from its insoluble (ferric) to its soluble (ferrous) form. This occurs mainly when a soil is waterlogged and microbial metabolism uses up all the oxygen. Once the iron is in the soluble form it is free to move with the general soil solution. On encountering aerobic conditions (such as a root channel or patch of coarse material where drainage is better), the soluble iron re-oxidises back to the ferric form. While this explains 1 and 2, a mechanism for 3 (the true mottles) is still required. Bloomfield (1951) showed that ferric oxide was, of itself, capable of fixing ferrous ions out of solution; thus, so long as there is a "seed" quantity of the ferric form present, it will act as a focus for continued growth by depletion of the ferrous-rich solution moving over it.

Evidence for blockwise construction of the rampart is sparse in the thin sections. Apart from the sand/clay interfaces, there is no significant fabric organization in either sample. A small area of oriented grains and micropans (long axes parallel to ground surface) was found in SS3, but the phenomenon is not widespread enough to be considered as a pre-construction alluvial feature. It could as well be caused by pressure or micro-erosion during the building of the rampart. Considerable quantities of charcoal are present in all the slides. Most of this is finely divided (maximum 250um) and uniformly spread , indicating that it is likely to be a constituent of the original silty clay.

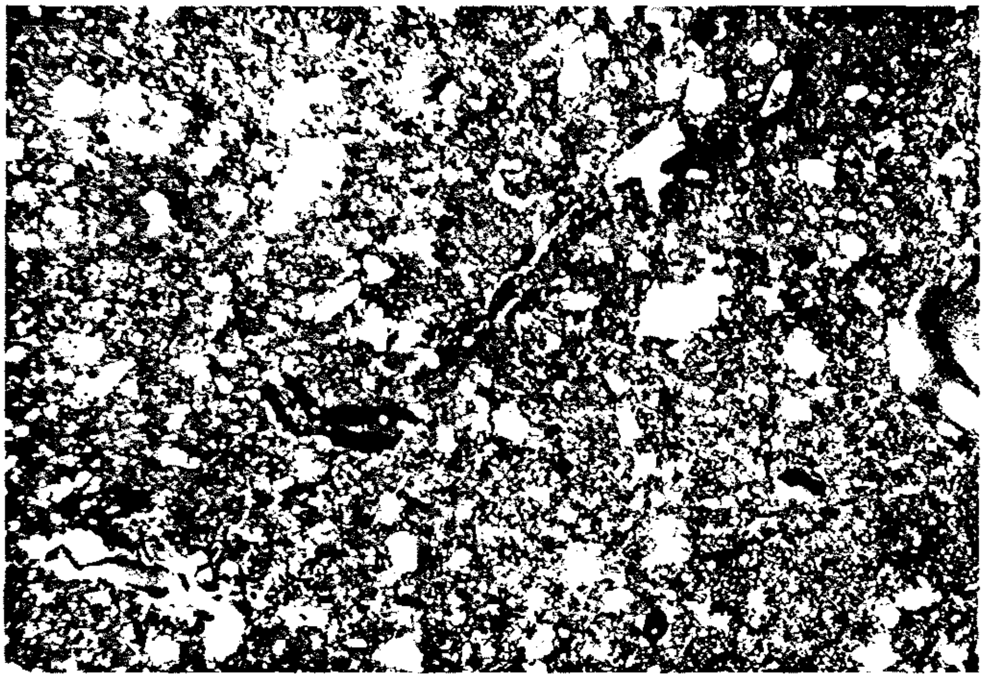
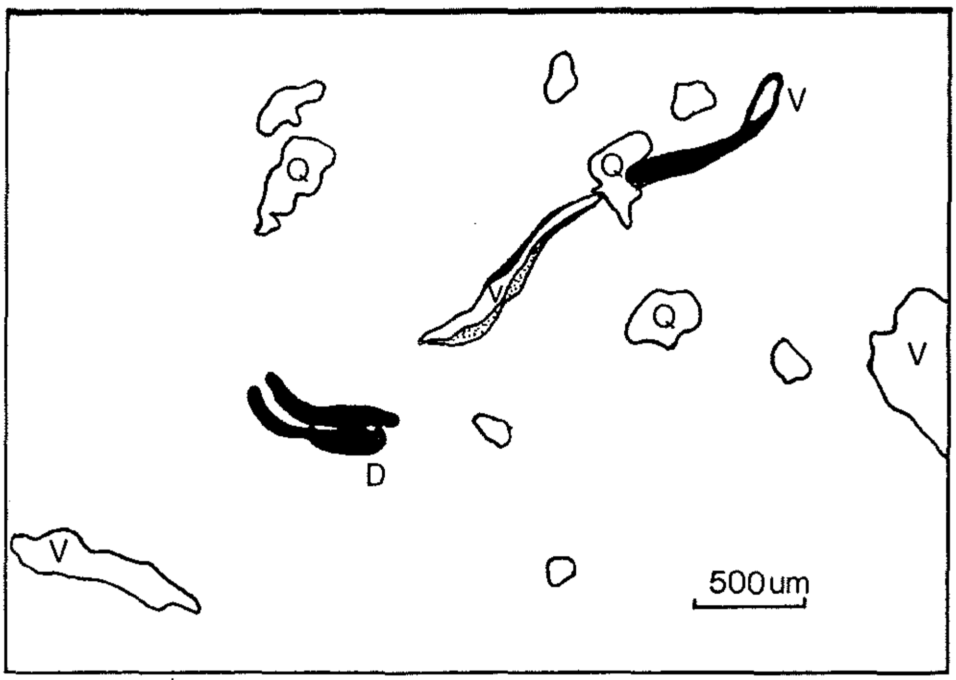
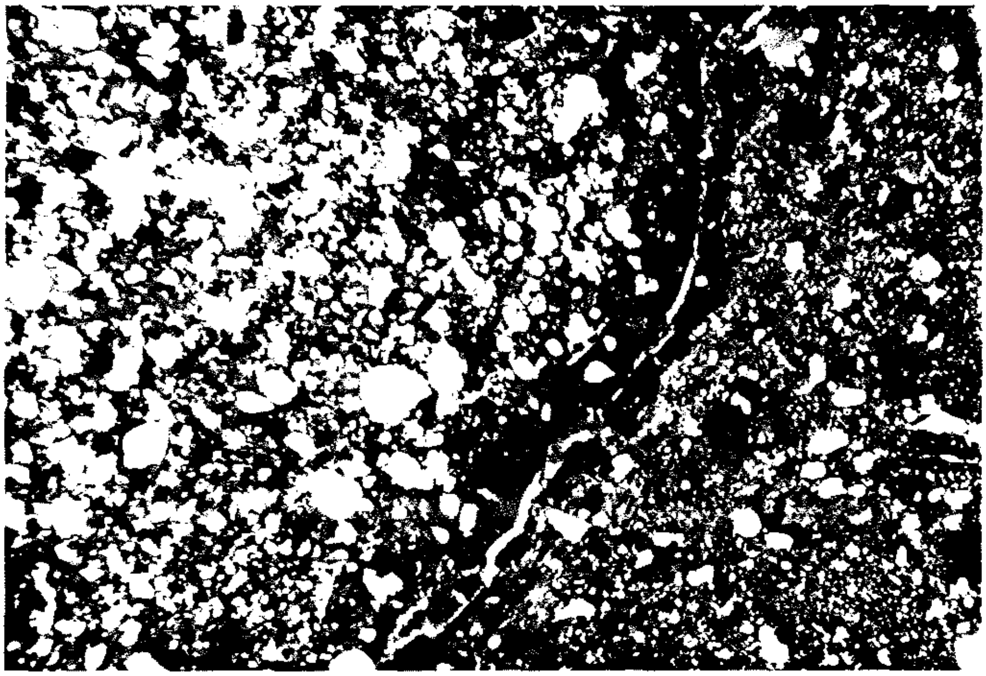
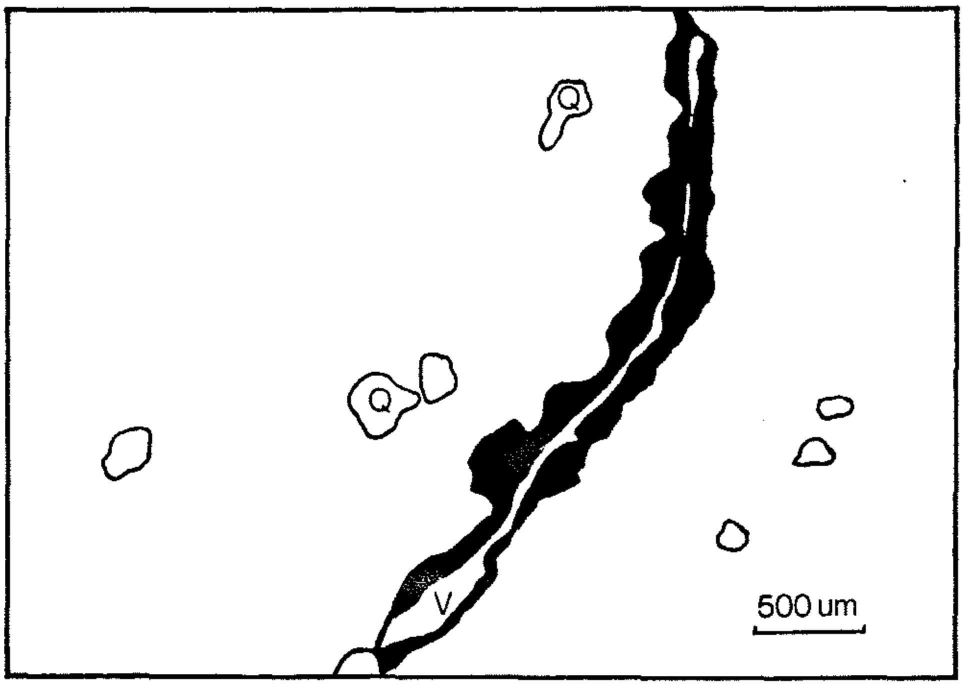


Plate 4
Iron enrichment (shaded) along a void (V). Note also displaced void coating (D). Q = quartz.





<u>Plate 5</u>
Iron coating developed at textural boundary between coarse silt/sand and silty clay. See Plate 4 for key.



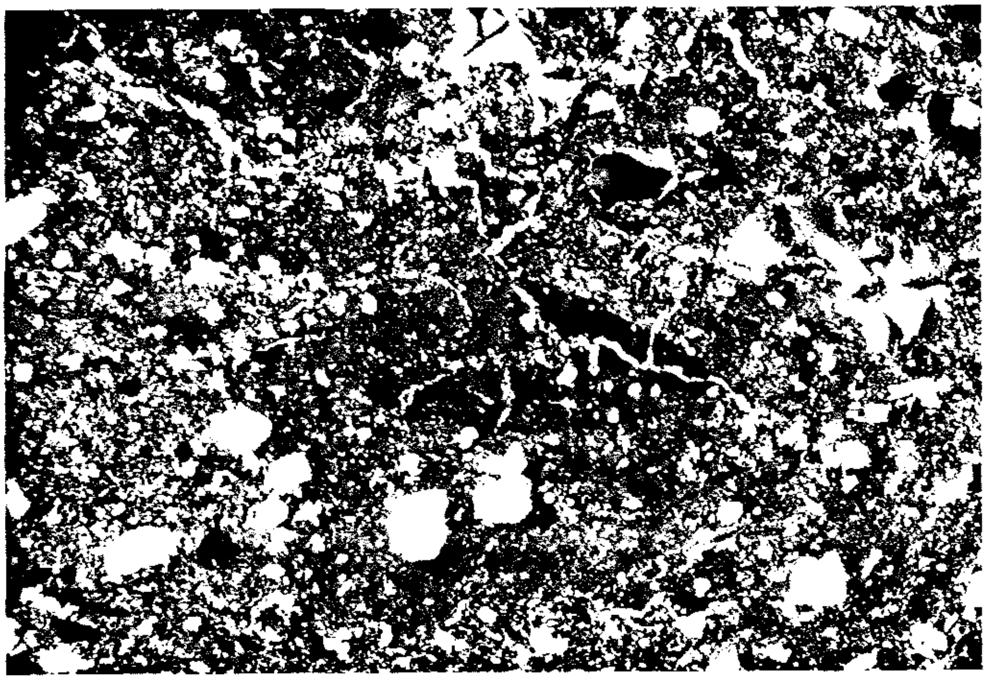
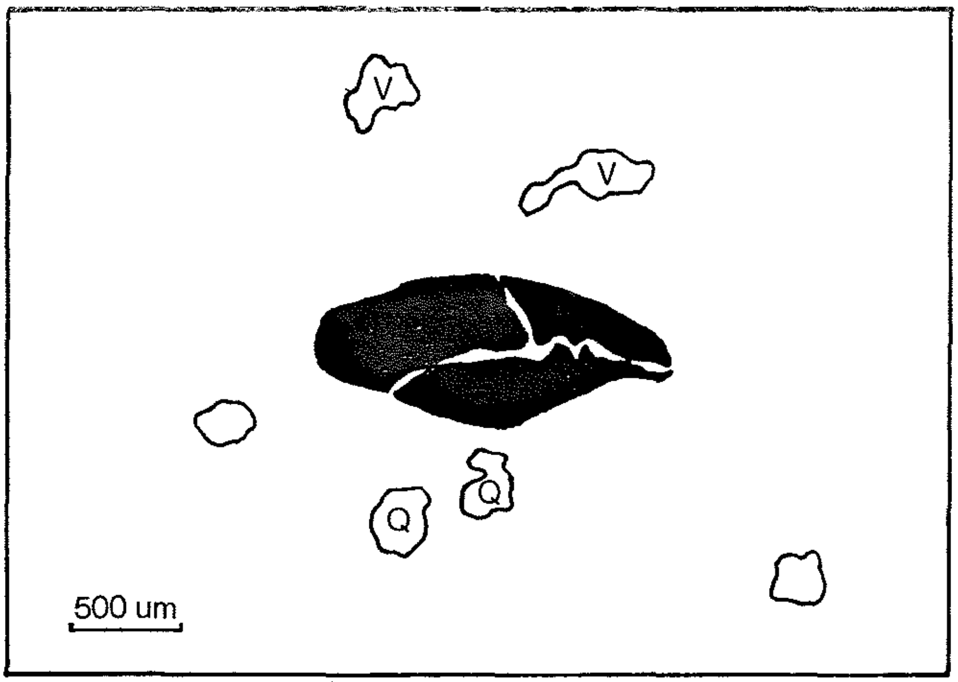


Plate 6
Lenticular mottle developed without apparent cause. See Plate 4 for key.



6. Discussion

To sum up, the following features need to be explained in a natural, constructional or post-constructional context:-

1) The source of the heavy silty clay.

2) The occurrence of darker silty clay bands in 153/154. (note that these are only dark relative to the the matrix of 153/154); they are the same colour as the central silty clay mass of SS1).

3) Bands, lenses and diffuse patches of sand, sometimes associated with the darker silty clay, sometimes not. Where interfacing with dark clay, exhibiting sharp boundaries; where interfacing with paler clay, boundaries sometimes diffuse.

4) Iron-staining associated with sand features and existing as independent mottles.

Typically, an alluvial valley, such as Derventio occupied, would offer mainly silts and sands for building materials; neither of these would remain particularly stable after the binding effect of roots had disappeared. Examination of the borehole records for the area shows, however, that thin patches of clay exist very locally viz:-

Aiton & Co (35873700) (ca. 750m S.E. of site)		Cable Works (35633783) (ca. 450m N.E. of site)	
3.07 m	Made Ground		
1.69 m	Blue Clay	1.07 m	Clay and Gravel
Over	Gravel	Over	Sand and Gravel

(adapted from Frost and Smart(1979); see also Crofts and James(1984))

If layers such as these were the source of the clay, then they could provide an explanation for at least some of the small sand lenses and diffuse contamination. The clay may have been dug spit-by-spit so that the earliest layers would be relatively pure; later, as the pit became exhausted, the final spits would have additional sand and gravel adhering from the underlying layers.

This explanation does not suffice for the more continuous sand bands. Even if the rampart was built strictly blockwise, there would surely have been vertical displacement and even vertical orientation for some of these contaminant layers. It is clear, then, that the bands must have been deliberately layed down, probably to facilitate trafficking of clay over the sticky surface.

The relationship between the sand and darker clay layers must fit into this pattern. On Figure 2, the lenticular shape apparent in sample 154 is constantly repeated at various different scales. The following construction method would appear to fit this, and most of the other noted features:-

a) The natural clay (which is dark-type) is dug and ?carted to the site. In this process large numbers of the spits break into smaller pieces or disintegrate entirely.

b) Sand is thrown (thick or thin depending on stickiness) onto the anticipated pathway over the existing structure.

c) Where still intact, blocks are layed. The remaining dross is shovelled out over and among the blocks.

d) More sand is layed, some of which falls among the dumped material and some onto the block surfaces.

e) The next load is brought over the new surface, squashing the blocks (to produce the lens shapes of dark clay), compressing the block/sand interface (sharp edges) and sealing a mixture of sand and "clay-rubble" into the surrounding areas (the lighter clay).

After construction was complete, the textural and density variations further increased the colour differential. The looser sand/clay infill tended to oxidise and reduce more quickly (greater mottling and iron loss to the sand bands); lost its organic content faster; and, on exposure in section, it dries faster, especially at the surface.

This scheme obviously relies on an unproven source of dark clay being present. From the borehole evidence this does not seem unlikely and the alternative would have to invoke the stripping of very large areas of turf; explain why the highly sensitive iron staining fails to mark the turf/turf boundaries; and justify the use of sand bands on a more-or-less non-sticky surface.

Haphazard factors within the scheme can explain those sections which do not completely conform. The central "sandwich" of nearly pure clay in 003 (represented by SS1), would have to be an area where dump or block construction was possible without recourse to traffic over the structure; perhaps the clay here was brought round to the building face. The increasing use of sand and pebbles (very evident in the 025 section) may reflect shortage of clay; or possibly a need to level up the inreasingly unmanageable surface of 036.

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