AML REPORT 44/83
VOL I

1745

HBMC1 AM ARCH(3SP)186

Soil Report on Hazleton Long Cairn, Glocestershire

R I Macphail 1985

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Summary

At Hazleton long cairn, Neolithic buried soils, non in situ "turves" from the cairn and the north quarry, and a local present day colluvial soil were investigated by soil micromorphology and other techniques. The pre-Neolithic soil history, the Neolithic soil, the effects of Neolithic occupation, cultivation and landuse are described and discussed in the specific light of a review of Dr Ian Cornwall's soil thin sections from eight other Neolithic sites, and current thinking. The early Holocene soil was completely disrupted by "Atlantic" tree throw, and probably also by later forest clearance. A high density of occupation materials were incorporated into one area of the site. Neolithic cultivation, which caused some erosion, shifted across the site allowing a vegetation cover to regenerate in places. The study is supported by fifty colour plates

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1. Introduction

The Cotswold/Severn Neolithic Long Cairn of Hazleton North was completely excavated (Director, Alan Saville) over the period 1979-1983 by the Western Archaeological Trust. This provided the first major opportunity since the long barrow of Ascott-Under-Wychwood was dug in the 1960's (Evans, 1971) for a full interdisciplinary study of a Neolithic environment. The potential of large areas of buried soil being preserved suggested that a soil investigation would play an important part in the understanding of the environmental history of the site - and Neolithic soils in general.

In 1980 a possible fallen turf (context 55) was collected from the North Quarry - in conjunction with molluscan studies (Bell, 1983a). In 1981 a small pit on the edge of the cairn was investigated, whereas during the 1982 season many sections of the buried soil and the local soils were examined from a variety of contexts. The local present day soil cover of clayey brown rendzinas and dry valley deposits (see Results) are discussed in Bell and Macphail (in prep). As the site presented such a rare opportunity to investigate a Neolithic landscape much thought and collaboration (Bell, Bullock, Catt, Courty, Federoff, Hollis, Keeley, Limbrey, Murphy, Romans, Saville and Scaife, pers. comm.) was given to its study.

Methods and Soils Sampled

The soils were described (Hodgson, 1974; Avery 1980) and analysed (Avery and Bascomb, 1974) for their organic status and grain size, while selected samples were studied for their nutrient chemistry (through Dr Loveland, Soil Survey, Rothamsted Experimental Station). Related magnetic susceptibility enhancement and iron studies were also carried out (Allen and Macphail, AMLR 4583 1985). Thirteen undisturbed samples were examined in thin section (Bullock, et al in press), including six mammoth thin sections specially made at the Institut National Agronomique, Paris-Grignon, France.

The soils sampled at Hazleton (Figs 1 and 2) are:
From the in situ buried soil;

No's 1-3 (Ha.1); thin sections of Profile 1; Plates 1-7,
No's 4-5 (Ha.3); thin sections of Profile 2; Plates 8-17,
No 6 (Ha.3); bulk analysis only of "marl" material (profile 2)
No's 7-9 (Ha.2); bulk analyses only of Profile 3, Plate 18,
No 15 (Ha.4); thin section of "midden area" (Context 561), Plates 19-20,
No 16 (Ha.5); thin section of "midden area" (Context 561), Plates 21-25,
No's 18-19; thin sections of soil beneath cairn slump, Plate 26,

From the mound;
No 17; thin section of "turf" in mound (Context 286).

From the North Quarry;
No 14; thin section of "turf" in Quarry (Context 55), Plates 27-29.

From the modern, recently arable, colluvial soil (Lower Barrow Ground Field), Profile 4, Plate 30;
No 10; thin section of Ap horizon Plate 31;
No 11; bulk analysis only of B1 horizon,
No 12; thin section of B(g)2 horizon Plates 32-33,
No 13; bulk analysis only of C2 "Marl" material.

Although this permitted a great deal of the buried and associated archaeological soils to be examined, in retrospect, it may have been better to also take samples in continuous soil sequences (Romans, pers. comm.) even through at the time there was no way to handle such large quantities of material.

Because of the lack of literature on Neolithic soil microfabrics, thin sections from eight of Dr Cornwall's Neolithic sites on comparable soils were reviewed. These are: Ascott-under-Wychwood, Oxfordshire (Plates 34 and 35); Fussels Lodge, Wiltshire (Plate 36); Kilham, N. Yorkshire (Plates 37, 38 and 39); Lanhill, Wiltshire (Plates 40,41, 42 and 43); Nutbane, Hampshire (Plates 44 and 45); Silbury Hill, Wiltshire (Plate 46); Willerby Wold, N. Yorkshire (Plates 47 and 48); and Windmill Hill, Wiltshire (Plates 49 and 50).

For convenience, Soil Profile and Micromorphological Descriptions and Interpretations and the fifty plates are in Volume 2 to allow constant reference.

RESULTS

Field

The soil cover The area carries a modern soil cover of mainly shallow (5-10 cms on upper slopes) to moderately deep (25-40 cms on gently sloping plateau areas) clayey brown rendzinas (Sherbourne Series, Courtney and Findlay, 1978), with deeper clayey brown calcareous earths, with limestone rubble (Didmarton Series) on colluvial slopes and dry valley fills (Bell and Macphail, in Prep) - for instance Profile 4 (Plate 30). These soils comprise the Sherbourne Association (Findlay, et at 1983). The Neolithic soils (Profiles 1-3) from beneath the cairn (Plates 1, 8, and 18) are argillic brown earths, both fitting the categories of the Tetbury series (fine loamy over clay over lithoskeletal limestone) and Ston Easton (fine silty over clay over lithoskeletal limestone) (Clayden and Hollis, 1984). It is worth noting that these argillic brown earths are now apparently absent from the adjacent area of Stow-on-the-Wold mapped in 1978 by Courtney and Findlay. The modern soil depth can be very shallow (eg 5cms) increasing to over a metre in colluvial sites. However, the Neolithic soils are not that much greater in depth (although of course unaffected by the last 4,000 years weathering) - varying from 10-20 cms over the oolitic limestone, with subsoil hollows giving a maximum depth of 46 cms (Plate 8).

3. Laboratory Results and Discussion

Basic chemistry and grain size data are presented in Table 1, whereas Table 2 gives the nutrient chemistry. In Appendix B the Neolithic and modern microfabrics are described and interpreted. Points of note from the examination of Dr I Cornwall's thin sections are discussed in Appendix C.

3A Parent material weathering and early soil fabrics. Microfabrics from the buried Bt horizons best seen at Profile 2 but also present at Profile 1 (Micro Samples 3, 4a, 4b and 5) contain fragments of bright reddish brown clay, which probably contribute towards the dark brown subsoil colours present across the site (Plates 8 and 18). Also, at Profile 3, the subsoil is more ferruginous than the topsoil, containing 4.22% dithionite extractable iron, as compared with 3.47% and 3.17% in the b A and bAg horizons, respectively (Allen and Macphail, AMLR 4583 1985). This may suggest this red clay which is mainly a subsoil feature, is actually more ferruginous, than the surrounding soil - an interpretation supported by the micromorphological evidence. The Cornbrash Beds (Jurassic) gave rise to similarly ferruginous fabrics at Lanhill (App. 6D ; Plates 40-43).

At Hazleton, the red clay which is best expressed in the subsoil hollow at Profile 2 (Plates 8, 14 and 15) is also found closely associated with the weathering oolitic (Hampen Marley Beds) limestone parent material (Plates 9 and

10). It is interpreted as Beta B horizon (Catt, 1979) clay derived from the weathering junction of the soil and the limestone parent material (Federoff, pers comm). Elsewhere, such red fabrics may also relate to long weathering, reddening (rubification) and may have palaeo-argillic (Avery, 1980; Kemp, 1985) origins (Bullock, pers comm).

At Hazleton, this red and probably ferruginous clay, although generally only present as soil fragments, is also associated with the upper weathering edge of the wedge of "Marl" and fragments of oolithic limestone seen at Profile 2 (Plate 8; Fig 2; Micro Sa 4b). The "Marl" here has a sandy clay loam grain size (Table 1, Sa 5) probably relating to the presence of unweathered sand size ooliths. From the overall grain size data (Table 1) and the microfabric analyses it can be shown that the Hampen Marley Beds parent material breakds down to a clay soil containing large quantities of silt size quartz, again probably originating from the oolitic material.

3B <u>Holocene soil development</u> The upper horizons of the buried soils have been strongly influenced by Neolithic activity (see Sections 3D, 3E) and post-burial pedogenic phenomena (see Section 39). The subsoils have been less affected, but nevertheless do not display a simple microfabric for interpretation, but a heterogeneous one instead.

The best evidence comes from Profile 2 as this is deeper than Profile 1, and therefore better preserved. Micromorphological sample 5 from the subsoil hollow (Fig 2) has a heterogeneous microfabric showing the mixing of different soil materials but also the mass-movement of soil, infilling much of the void space resulting from the poor organisation of juxtaposed soil fragments. The inclusion of red clay from the limestone junction (Plates 14 and 15) has already been noted in the soil. In sample 5 fragments of this red clay are set in larger areas of yellowish brown matrix soil and infills (Plates 16 and 17). Microfabric analysis further shows the latter material to contain more organic matter but probably less iron than the red clay. Variations within the yellow brown soil materials consist of little disturbed areas of argillic (including possible fragments of limpid clay coatings) Bt horizon (Avery, 1980) material, and more "leached" and organic "surface" (A1, Eb) horizon soil (Federoff, pers. comm).

Thus all the elements of an argillic brown soil (Avery, 1980) are present, namely; (Beta B), Bt, Eb and A horizons, which formed in early Holocene times prior to the Neolithic. Fortunately, although some mechanism, to be discussed later in this section, disturbed the soil, this pedogenic process of argillic brown soil (sol lessivé) formation can be described from Hazleton. Firstly, even whilst some surface horizons (Table 2, Sa 7, 8) have been affected by post-burial contamination by calcium ions washing into the buried soil from the overlying calcareous cairn, the better sealed A horizon at Profile 1 (Sa1) and the deep Bt horizon at Profile 3 (Sa9) show the pre-Neolithic soil to have been strongly decalcified and probably also acidified and leached. For comparison, see amounts of calcium and cation exchange capacity (CEC) for the present day Ap horizon (sa 10) of a local colluvial brown calcareous soil. Argillic brown earths are believed to have developed under a forest canopy, leaf leachate mobilising fine clay mainly in the Eb horizon, and soil water translocating it down profile into the Bt horizon (Duchaufour, 1982; Federoff, 1982) which is enriched in clay (Table 1, Sa2 and 3). Such argillic horizon development has been strongly associated in Temperate climates with the Atlantic period (Weir, et al 1971; Macphail, in press a), when according to pollen evidence broad-leaved forests reached their greatest development (Godwin, 1975), even on areas of limestone rocks (Scaife, 1982; Waton, 1982). Argillic Bt horizons on deeper soils than at Hazleton, such as at Selmeston, Sussex (Scaife and Macphail, 1983; Macphail in Rudling and Cartwright, 1985) and Balksbury Iron Age Camp, Hampshire (Macphail, AMLR 4621 1985) and in parts of France (Federoff, 1968; pers comm), for example, are characterised by structural units (peds) and voids with clay coatings which comprise a primary fine limped clay to microlaminated clay phase, succeeded by increasingly coarse, dusty clay phases. Such sequences are interpreted as the result of clay translocation under virgin forest being followed by "impure" clay translocation under increasingly unstable conditions through forest disturbance, forest clearance and cultivation practises (Federoff, 1968; pers com; Slager and van der Wetering, 1977; Courty and Federoff, 1982; Macphail, in press b; Macphail, et al in press). At the Neolithic soils at Hazleton, and also at Kilham (Plates, 37, 38 and 39) for example, these fabric types are absent, and as soon explained, may relate to, a) the shallow nature of the decalcified soil on limestone parent materials, and b) the affects on in situ soil fabrics of tree-throw and forest clearance, as mechanisms of soil disturbance, as described below.

In many ways, the subsoil feature at Profile 2 resembles subsoil hollows described elsewhere from buried soils on calcareous rocks (Evans, 1972; Limbrey, 1975) including the Oolitic Limestone at Ascott-under-Wychwood, Oxfordshire (Evans, 1971), which from molluscan data have been interpreted as tree-hollows from the Atlantic period. It is therefore probable that forest cover of Atlantic date was responsible for the subsoil feature at Profile 2 (Bell, 1984). Deeper areas of the Neolithic buried soil may have similar origins.

The subsoil feature at Profile 2 when viewed in the field (Plate 8) can be compaired with tree-throw features both reported in the literature (Lutz and Griswold, 1939; Limbrey, 1975), and noted after high winds at modern examples (eg Westonbirt Arboretum, Gloucestershire; Ashridge Forest, Buckinghamshire) of wind-throw. At Hazleton it is possible to envisage that in Plate 8, tree-throw was to the right (North), and that the "Marl" subsoil which clung to the root-plate was mainly deposited on the left hand (upthrow) side of the feature. The earlier formed "Atlantic" argillic brown earth was completely disrupted (Plates 9, 10, 14, 15, 16 and 17). Infills between coherent soil fragments were of all the soil horizons involved, which were more easily slaked by soil water once they were mechanically broken by tree-throw. This for instance accounts for the anomalously high amounts of organic matter noted in this "subsoil" microfabric, which is reflected in the chemistry (Table 1, 5A 5). Similar mixing may explain rather low accumulations of clay in the Btg horizon of Profile 3 (5a 7, 8 and 9) if illuvial soil was "diluted" by A and Eb horizon material.

There are however some problems in fully interpreting the infill of this feature at Profile 2. Firstly, such subsoil features according to molluscan evidence have often infilled gradually (Evans, 1972; pers comm), and an example of this was demonstrated from Balksbury Camp, Hampshire, where the micromorphological data clearly showed a primary infill phase to have high biological activity (Macphail, AMLR 4621 1985). However, at Hazleton, evidence for slow infilling with high biological activity is absent (Courty, Federoff, pers comm) and a mechanism for far more rapid infilling required. One suggestion is human activity. If so, it is unlikely to have been in Neolithic times because the buried soil is strongly decalcified, with relic "Marl" fragments being confined to the "upthrow" and the basal few centimetres of the hollow (Plate 8) which may suggest a moderately long weathering period before burial. The coincidental concentration of Mesolithic flints at the site may allow the speculation that tree-throw in the Atlantic forest encouraged Mesolithic man to the area, and he was responsible for the unusually rapid infilling of the subsoil hollow.

There is also evidence of some subsoil soil disruption at Profile 1 (Micro Sa 3). At Hazleton (see Micro Samples 14, 15, 16, 17, 18 and 19) no intact "Atlantic argillic" fabrics were noted in the review of Neolithic soils at Kilham, Lanhilll, Nutbane and possibly also Willerby Wold (Appendix 69). General periodic wind-throw that affects mature forests (Denny, 1956) may be envisaged, but the actual affects of forest clearances, if roots are disturbed, should also be considered. For example, relatively "fresh" mixed fabrics of sharply contrasting leached Eb horizon material and argillic soil, with heterogeneous infills, have been ascribed to known wartime deforestation (Macphail, in prep). The lack of recognition in the literature of the effects of Neolithic woodland clearance on the microfabric, other than to suggest that dusty clay coatings may relate to forest disturbance in general (Slager and Van Der Wetering, 1977; Courty and Federoff, 1982; Scaife and Macphail, 1983) may reflect a) the lack of survival of shallow "Neolithic" soils (Macphail, in press b), and b) the obscuring affect of later prehistoric, historic and modern landuse practices on deeper soils. The latter is especially true of the upper soil horizons most influenced by biological working.

3C <u>The Neolithic Soil</u> In order to interpret the nature of the Neolithic soil, the effects of long burial by a long cairn comprising limestone rocks with "Marl" and clay soil infills should be understood. These are discussed at greater length in section 3G, but in short include contamination by calcium ions (as noted in the previous section) and the effects of anaerobic burial on; a) soil organic matter and nitrogen; and b) soil hydromorphism (ie gleying), and the distribution of manganese and iron - the latter affecting magnetic susceptibility enhancement (MS) characteristics (Allen and Macphail, AMLR 4583, 1985).

The affects of clearance disruption on the decalcified and acidified argillic brown soil have been discussed in the last section. We now examine the nature of the buried soil and Neolithic man's affects on it. Firstly, the buried surface horizons contain rather low quantities of organic carbon (Table 1, Sa 1, 2, 4, 7, 8, 15, 16, 17, 18 and 19) compared with the modern Ap and B1 horizons (Sa 10 and 11) of the local colluvial soil. There are a number of reasons for this. Firstly, some Neolithic soil organic matter has been lost by oxidation; and the associated ferruginisation of it through post burial hydromorphism can be demonstrated (Plates 2, 3, 4, 5 and 13) for example at Profiles 1 and 2 (Micro Sa 1, 2, 4a and 4B) and in the field (Plate 1). Secondly, examination of the microfabric at high magnification (Micro, all Neolithic samples except 16) suggests that levels of organic matter were moderately low anyway, and this is supported by the contention that the surface horizons at Hazleton have few features typical of buried and unburied A1 horizons. For example, at Hazleton there is little evidence of the total excremental earthworm fabric of the Neolithic Mull A1 horizon at Nutbane(Plates 44 and 45), or of the highly biologically worked Neolithic humic A1 horizon at Fussels Lodge (Plate 36). In addition, low birefringement Neolithic fabrics, such as at Ascott-under-Wychwood (Plates 34 and 35) caused by the biological destruction of shrink and swell fabrics (Bullock, pers comm) are generally absent from the surface horizons at Hazleton. These, in contrast, have a mainly high birefringent groundmass (Plates 6, 7, 12, 24, 25, 28 and 29), for example as also present in the deep subsoil horizons in the local soil (Plates 25 and 26). Occasionally, probably relic (Romans, pers comm) earthworm channels (Plate 31) and other evidence of biological activity (Plates 24 and 25) occur, but these are not dominant. In addition, heterogeneous fabrics, presumed to relate to tree-throw disturbance, for example (Plates 9 and 10) have been unaffected by biological homogenisation, when only at 6-13cms depth. Also the presence of textural pedofeatures, such as dusty clay porosity coatings (Plates 6, 7, 22, 23, 24 and 25) in surface horizons of brown soils is totally anomalous at soil depths usually totally reworked by earthworms (Atkinsom, 1957; Duchaufour, 1982). However, a narrow herbaceous soil cover did occur on some parts of the site (Plates 1, 2, 3 and 4), but again not on a typically biologically worked A1 horizon (PLates 6 and 7).

The characteristics identified above may relate to a number of factors. The lack of typical A1 horizon soil (out of 7 known surface samples examined) and non-biologically worked fabrics at shallow depth at Profile 2, could suggest some erosion of the Neolithic soil prior to burial. If this is the case it was not a sudden truncation during cairn construction as there is clear evidence of a) the in situ surface organic cover at Profile 1 (Micro Sa 2) and b) the incorporation of occupation materials at samples 15 and 16 (Plate 21); but rather more likely to have been steady downslope surface soil loss through Neolithic agricultural practices (Section 3E). This may also in part account for the moderately low organic matter levels. For example, although there was some mixing of the Neolithic buried surface horizons of the argillic brown soil at Willerby Wold, it can still be described as humic (Appendix 69) and little eroded, in comparison.

The lack of earthworm worked fabrics at Hazleton may relate to low levels of soil organic matter as interpreted from the micromorphological and chemical data. Earthworms may have already been low in numbers prior to Neolithic activity, because of the moderately acid conditions developed under the early Flandrian forest cover. Nevertheless, Romans and Robertson (1983b and c) quoting Edwards and Lofty (1972; 1975) suggest that low levels of organic matter (measured at generally less than 1% at their Scottish sites, Macphail, et al, in press) caused by Neolithic subsistence agriculture led to the dissapearance of earthworms as their food supply was reduced. Amounts of Neolithic organic matter at Hazleton were not as low, and some biological activity persisted here, but nevertheless there may be a relationship between declining soil organic content and earthworm numbers.

The immediate preburial landsurface itself was mainly bare ground, characterised by "occupation" (Section 3D) and cultivation (Section 3E) at sample 16 (Fig 1); cultivation at sample 4 (Profile 2); some "occupation" at sample 15; a possible scrub cover at sample 7 (Profile 3); and an herbaceous cover at Profile 1. This indicates a mosaic of landuse at the site. In the latter two instances there is evidence of vegetation regeneration. At Profile 3 (Plate 18) coarse (1-2cms) and extensive relic root channels were present. As these were not infilled with soil material they could relate to a scrub vegetation (see Scaife, this vol) extant up to the building of the cairn. At Profile 1, the buried surface horizon has had much of its organic cover and root system replaced by iron and manganese (Plate

5). The surface vegetation cover itself appears to have developed a soil which had been previously tilled (Section 3E). Similarly, the single turf with which it is buried, exhibits strong ferro-manganiferous replacement of organic matter (Plates 2 and 3), including pseudomorphic root replacement by pyrite (Plate 4, Bullock, pers comm). That there undoubtedly is a buried turf (Sa2) at Profile 1 is demonstrated by the difference between the strongly formed pseudomorphic pan here, and the diffuse impregnation of the general mineral fabric at Profile 2, for example (Plate 13). In conclusion, it can be suggested that the turf (Sa1) probably from an earlier tilled area, was with others cut possibly in the area of one of the flank quarries - and laid at the edge of the cairn possibly as some kind of marker. Similarly tilled topsoils, but not always with an obvious herbaceous cover, were also cut, and used as an infilling in the cairn (Micro Sa 17), sometimes later tumbling into the adjacent quarries (Micro Sa 14; Plates 28 and 29).

3D Neolithic Occupation There is good evidence of Neolithic occupation at Hazleton in addition to clearance and agriculture. A large area of the buried landsurface is dark brownish, and because of the occurance of flints, charred grain and hazel nut shells, wood charcoal, cattle and sheep bone, and burned daub, has been designated a "midden" (Saville pers comm) area. In the microfabric (Sa15 and 16) there is evidence of large quantities of organic matter, charred organic matter and charcoal being present in the soil - as reflected in the chemistry (Table, Sa 16) - especially as very fine fragments in the matrix (Plates 22 and 23). There are also pieces of probable burned soil (Plate 21) which in thin section is dense, platy and reddened (Courty, 1984; Page and Courty, in press). These are clearly different from the relic Beta B clay described in Section 3A. Unfortunately, because of a number of factors (Allen and Macphail, AMLR 4583, 1985; in press) including post-burial hydromorphic affects on the soil iron (Bloomfield, pers comm), magnetic susceptibility enhancement data from surface horizons at Profiles 2 and 3 - which in any case are outside the "midden" area (Fig 1) do not provide useful corroboration of this burning. In fact, a subsequent MS assay of the midden area (Sa 16) came out again low at 31. Nevertheless, the existence of a probable hearth (Saville, pers comm), burned soil including daub, and all the charred organic maerials present, especially at sample 16, clearly indicate that fireplaces were present, and possibly also huts (Saville, pers comm).

The soil data suggests that the "midden" area is not a cumulative midden sensu stricto (see Micro 16), because the occupation materials are included (as a small percentage of the total mass) within the surface horizons of the soil, rather than being a dominantly occupation deposit which has accreted upon it. The large quantities of fine charcoal worked into the fabric, responsible for the dark colour, give it a missleading appearance. The agricultural activities that were probably contemporary and definitely post-dated (as described later in Section 3E) this occupation deposit(s) markedly affected it. Possibly similar reworked occupation soils, high in fine charred organic materials have been interpreted as in part relating to decayed or destroyed mud-walled huts (Allen and macphail, in press; see also Macphail and Courty, 1985). As burned daub has been recorded here, it is therefore possible that huts were present at the "Midden" area at Hazleton, as suggested by Saville (pers comm).

It can be recognised that much of the occupation materials are present within (at c.4-5cms depth) the buried soil (Plate 21). In addition the very high phosphate value - indicative of anthropogenic activity (eg bone) - at Profile 3 is not in the surface horizon but recorded from c.5-13 cm depth. These together with the conclusion that most of the charcoal present at samples 15 and 16 is very fine suggests some mechanism has worked the occupation materials into the soil, and at the same time thoroughly smashed up most of the charcoal. The occurence of large amounts of coarse and very dusty clay coatings - sometimes with included fine charcoal - in soil voids and on and within (the porosity of) coarse charcoal in these surface horizons, as argued in the next section, appears to strongly relate to tillage (Romans, pers comm), a phase of which very likely succeeded this (these) period(s) of occupation. These interpretations suggest that the suite of soil charcoal at Hazleton (Straeker, this vol) represents much of the "later" period of occupation as a high percentage of the "earlier" material was finely broken up, and thus unidentifiable.

The incorporation of organic materials into pre-barrow soils by Neolithic activities may also have occured at Lanhill (Plates 42 and 53).

3E Neolithic Agriculture The evidence of tillage at Hazleton (see Scaife, this vol) relates closely to the high concentration of textural pedofeatures at sample 16 (Plates 22, 23, 24 and 25) and also at sample 4a (Plates 11 and 12). As explained (see Micro Sa 16) these features - dusty clay and impure (with silt) clay pore coatings and infills - are unrelated to the soil's early history of clay translocation (lessivage) under forest. Instead these features which occur across the site (eg Micro Sa 18 and 19), and are also present in "turves" found in the cairn (Micro Sa 17) and in the quarry fill (Plates 28 and 29) apparently relate to soil breakdown and translocation under cultivation.

In studies of early agriculture the large scale soil features pertaining to modern agriculture (Michel, 1979) are not often present, although the microfabrics produced have features clearly related to those produced by modern cultivation (Jongerius, 1970, 1983; Macphail et al, in press). The raison d'être of tillage is to break up the soil for good tilth. This mechanical damage makes the soil vulnerable to slaking by rain/soil water. Unlike lessivage, not just fine clay is mobilised, but all of the fine fraction, including all size of clays, silt-sized material, and often organic matter fragments including charcoal, can be translocated, especially over short distances in the soil (Jongerius, 1970; 1983). Further downprofile, finer and finer material is moved (Federoff, pers comm).

Romans and Robertson (1983 a, b anc c) have shown that soils containing little organic carbon, and thus with structurally weak peds because of this lack of soil organic matter and resulting low earthworm activity are easily mechanically damaged and slaked by soil water. They showed that at Strathallan, Perthshire, "turves" from Neolithic soils which were mechanically damaged by cutting, carrying, dumping etc easily broke down under heavy rain and produced a suite of textural pedofeatures in the upper part of the mound. These coatings were not traced to the base of the monument. The soil beneath the mound, however, was characterised by high concentrations of similar textural features, and they suggested that this was the result of tillage, being the agency of mechanical damage. From their findings at Strathallan mound and henge, and at other Scottish sites, Romans and Robertson (1983b) suggest that as cultivation disrupts the soil at depths relating to the implement used, then the resulting coatings distribution would reflect this. They were able to demonstrate that on probable cultivation ridges "hoeing" produced coatings mainly near the soil surface, whereas "arding" gave rise to a concentration of these features at c.12cms. This interpreted depth relationship was possible because the monuments at Strathallan are situated on a flat river terrace site, and loss of soil depth by erosion must be considered at a minimum (Roman, pers comm).

At Hazleton, counting of soil porosity "clay" infills (see Micro Sa 4a and 16) indicated that although coatings were concentrated at 4-6 cms depth, the soil was probably ard cultivated, and that the profile had suffered some soil loss by erosion (see previous section) - hence, for example, no soil humps from tree throw were preserved at Profile 2. The slopes at Hazleton are only 2-4° but this is believed sufficient to allow erosion as according the the following, these soils maybe considered unstable (Imeson and Jungerius, 1974, 1976; Imeson and Vis, 1984): a) they contained moderately small amounts of stabilising organic matter, b) the soils were not characterised by stable biological aggregates, and c) from the coatings evidence, these soils slake easily. The present day dry valleys do not contain much colluvium (Bell and Macphail, in prep), and at Profile 4 particularly, the basal colluvial deposits are interpreted as modern from both the microfabric (Micro 12; Plates 32 and 33) and magnetic susceptibility data (Allen and Macphail, AMLR 4583 , 1985; in press). It should also be noted that the soils surrounding the cairn although having had 5,000 years longer to weather, have been eroded down (from decalcified argillic brown earths) to shallow calcareous rendzinas. This may suggest that, as elsewhere (Bell, 1983) early colluvial deposits at Hazleton may have been lost down-valley (Bell, pers comm).

Evidence of Neolithic agriculture can be cited from a number of sites in Scotland and England (Macphail et al, in press), but for brevity only a few examples are used here. At Kilham (Appendix 6C) Dr Cornwall's thin section from the lower part of the shallow (c.20cm) buried soil (Evans, 1972) shows exactly the same kind of textural pedofeatures (Plates 37, 38 and 39) as at Hazleton. In addition, at Kilham, there is corroborative soil pollen evidence (Dimbleby and Evans, 1974) for cultivation. Equally, molluscan data from Windmill Hill (Evans, 1972) indicates probable cultivation in an open woodland environment, which possibly gave rise to calcitic textural coatings and the mixing of organic matter and charcoal into the soil matrix (Appendix 6H; Plates 49 and 50).

3F Neolithic Landuse There is the probability that at Hazleton localised shifting agriculture was carried out, and from the distribution of microfabrics analysed it can be suggested that only small plots were employed (Fig 3). At sample 16 and probably also at sample 4a (Profile 2) cultivation was extant up to the time of cairn construction, and affected the area of occupation. The evidence from Profile 1 (Micro Sa 1 and 2) indicates that previously cultivated areas both on and around the cairn site were allowed to regenerate a surface vegetation cover. Possibly in this "clearing" (Profile 3) scrub woodland (see Scaife, this vol) may also have regenerated and around the site in general (see Bell, this vol). Similarly, at Windmill Hill, the molluscan data indicated cultivation in an open woodland environment (Evans, 1972).

At other Neolithic sites in England there is evidence of cultivation affecting the immediately pre-burial soils at Kilham (Appendix 6C) and Windmill Hill (Appendix 6H), and probably also at Nutbane and Willerby Wold (Appendices 6E, 6G). In Scotland, probable "slash and burn" cultivation affected the soils at Daladies, Angus (Romans and Robertson, 1975, 1983b, 1983c) whereas they found at Strathallan that a longer period of continuous cultivation had more strongly affected the soil. In short Scottish soils were markedly depleted of organic matter resulting in reduced earthworm populations and overall soil stability (Romans and Robertson, 1983 a, b and c). As discussed earlier (Section 3E) this probably also occurred at Hazleton, but to a lesser extent. Biological activity was similarly low at Kilham (Appendix 6C) probably for the same reasons, whereas the absence of earthworms at Willerby Wold was again ascribed to the affects of cultivation (Cornwall in Manby, 1963).

Prehistoric manuring, as suggested from molluscan data at Bishopstone, Sussex (Bell, 1981) and elsewhere from pollen data (Dimbleby, 1984 ; Scaife, pers comm), was possibly instigated as Neolithic cultivated soils were recognised as becoming depleted of organic matter. Equally, Romans (pers comm) suggests that cross-cut plough marks, for example at South St, Wiltshire (Ashbee, et al 1979; Evans, 1972), were perhaps a method to improve yields by employing the "edge effect" - cross-cut ploughing not immediately re-susing soil depleted by the previous crop. A Hazleton, agricultural activity shifted across the site, and it may be no coincidence that the best expressed cultivated soil occurs in probably the most fertile part of the site, in the "midden" area, which for example, because of occupation contained the most organic matter (Table 1, Sa 16).

The susceptibility of Neolithic cultivated soils to erosion because of their structural instability has already been noted (Section 3E) at Hazleton, although colluvial deposits of this age are missing. It is also likely that disruption of brown soils by forest clearance (Kwaad and Mücher, 1977, 1979) caused earlier erosion in the Neolithic, but probably to a lesser extent than those soils later progressively affected by agriculture (Imeson and Jungerius, 1974, 1976). Romans and Robertson (1983b; in press) demonstrated on-site erosion of soil by downslope movement caused by Neolithic tillage, whereas, on a larger scale dry valley sedimentation (Bell, 1983b) of Neolithic Age (Evans and Valentine, 1974; Burleigh and Kerney, 1982) has been related to clearance and cultivation, in general. Sequences of alluvial deposition have often been dated to later prehistory (Macphail, in press a), but in Sussex significant amounts of mineralogenic sediments have also been related to Neolithic forest clearance and agriculture (Burrin and Scaife, 1984). As we can see from these findings, Neolithic soil erosion, as previously prognosticated by Limbrey (1975), undoubtedly occurred, and it may be considered that some sites were abandoned because shallowing soils gave poorer crop returns as root depths diminished.

After cairn construction at Hazleton, unburied soils around the sides remained unvegetated before cairn wall collapse preserved them (Micro sa. 18, 19). In Sussex, areas around causewayed camp enclosure were often left to regenerate into scrub woodland (Thomas, 1982), whereas on many sites in Wessex, previously cultivated areas were turned over to pasture (Evans, 1971, 1972). The latter practice as we have seen (Section 3C) led to Neolithic monuments burying soils characterised by high biological activity as at Ascott-under-Wychwood (Plates 34 and 35) and Fussells Farm (Plates 36). This was also the case of land used for turves in the mound at Silbury Hill (Evans, 1972) although the actual buried soil is poorly drained and was moss covered (Dimbleby, 1984; Plate, 46).

Macphail, et al (in press) in a review of archaeological soils showed that the impact of later prehistoric pasturalism, agriculture, erosion and colluviation had in many cases destroyed much of the micromorphological evidence of primary forest soils and early clearance. Soil mapping around Hazleton long cairn (Bell and Macphail, in prep) and the examination of the Soil Survey map of the local area (Courtney and Findlay, 1978) clearly show that the buried argillic brown earth is practically unique in a landscape dominated by rendzinas and colluvial calcareous brown earths (Findlay, et al. 1983). The same can be said of the Neolithic decalcified brown soils (eg Kilham and Willerby Wold) in Yorkshire (Jarvis (R), etal 1983) and elsewhere (Jarvis (M) etal 1983). This relates to post-Neolithic soil erosion. For example, at Fussels Lodge Ashbee (1966) estimated 0.53metres of soil loss since the Neolithic.

3G Burial Affects Romans and Robertson (1983a) noted the localised movement of fine soil within mound material at Strathallan, although the buried soil itself was unaffected. Similar within-mound soil movement can be probably be identified at Willerby Wold (Appendix 6G). However, at Hazleton calcium ions from the limestone and "Marl" cairn were able to contaminate the upper parts of some areas of the previously decalcified buried Neolithic soil (Table 2, Sa 7, 8). At Avebury, Wiltshire (Macphail, in Keeley, AMLR 4490, 1984) and at Grimes Graves (Macphail, AMLR 1985) calcareous fine material was found to have washed down through fissures into the buried Neolithic soils from chalky overburden. At the latter site minor post burial earthworm penetration was revealed by their excremental calcite crystals in channels.

In many Neolithic buried soils, iron and manganese pans at 4.5 cm depth have been noted (Evans, 1971, 1972; Limbrey, 1975) although sometimes manganese impregnated soil has been wrongly interpreted as translocated humic material. In these surface horizons iron and manganese impregnation and pan formation are believed to occur as the result of long, and well sealed burial, relating to a change in soil redox through anaerobic decomposition of organic matter (Bloomfield, 1951, Duchaufour, 1982). The soil water table rises after burial to within 4-5cm of the old soil surface, so that one "pan" forms here, whereas another develops at the junction of the monument and buried soil (the OLS). This movement and change in crystal status of iron may produce artefactual MS unrealted to the previous unburied soil history (Allen and Macphail, AMLR 4583, 1985; in press).

In addition, even in these brown soils once anaerobic conditions prevail and this may be quite quick, the quantity of soil organic matter is little further reduced (Bloomfield, pers comm), so that amounts measured now may in fact reflect the organic status of earlier soils if they are well sealed.

Conclusions

1. Long weathering of the Hampen Marley Beds produced a red, ferruginous clay soil fabric at the junction of the soil and limestone.

2. Holocene pedogenesis took the form of continued decalcification and acidification, which with lessivage produced an Eb horizon depleted of clay (and some iron) and a Bt (argillic)horizon enriched in clay.

3. Tree throw, in probably Atlantic times, and possibly also later Neolithic forest clearances had the effect of totally disrupting previously formed fabrics in these shallow Holocene soils.

4. A high density of Neolithic occupation materials were incorporated into one area (the "midden") and gave evidence of food-processing, burning and possibly also of hearths and huts.

5. Neolithic cultivation shifted across the site, eventually reworking the occupation area - finely breaking up charcoal in the process - just prior to cairn construction. Cultivation, which had the effect of reducing soil stability through possibly depleting organic matter and the earthworm population, also caused some soil erosion even on this low slope site.

6. Local abandonment allowed regeneration of a herbaceous cover, and also possibly some scrub.

7. The cairn which included "turf" material was built in one place on a single turf foundation or marker.

8. Soils on the margin of the cairn were still unvegetated and eroding up and untill the collapse of the cairn walls which sealed them.

9. The Neolithic argillic brown earth, although affected by post-burial changes in redox and base status, are unique in a landscape now dominated by rendzinas and calcareous brown soils which result from post-Neolithic soil erosion.

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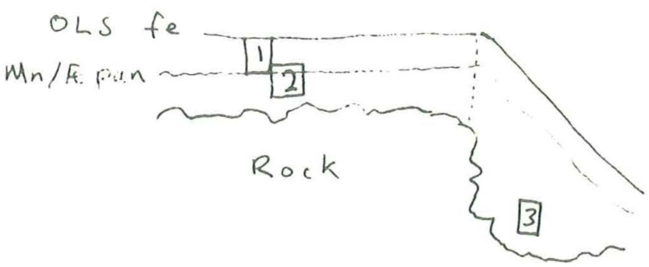
Acknowledgements

I gratefully aknowledge the following for technical assistance; M J Allen (grain size), INA P G Grignon (thin sections), Soil Survey, Rothamsted Experimental Station (Chemistry and Photography). Collaborators are listed in the Introduction. In addition I wish to thank Helen Keely and Alan Saville for their constructive criticism of the previous version of this report.

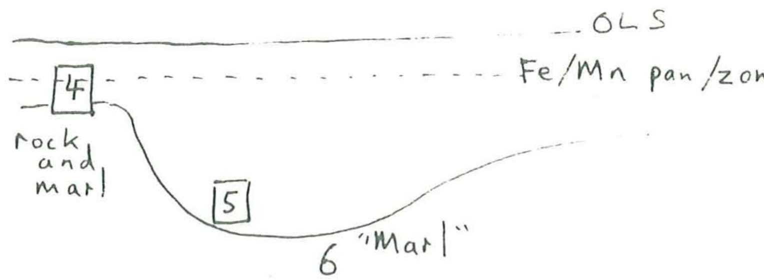
Fig 1.

HAZLETON LONG CAIRN: Location of soil samples from Profiles 1-

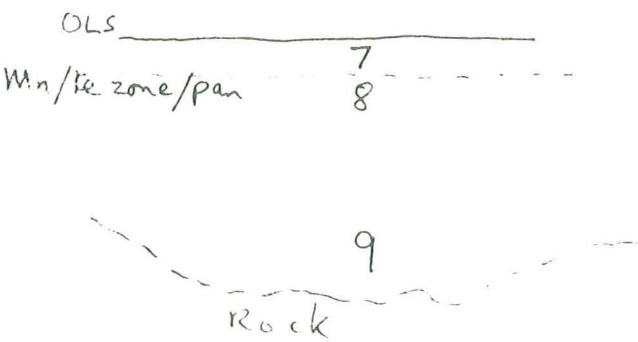
Profile 1 (Plate 1)



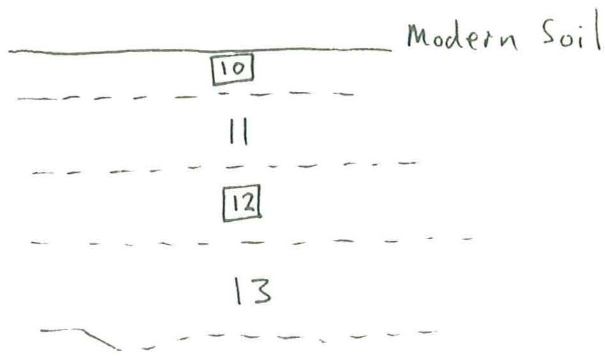
Profile 2 (Plate 8)



Profile 3 (Plate 18)



Profile 4 (Plate 30)



□ = thin section sample

HAZLETON LONG CAIRN: Soils Plan

N.B. Nos. 1-3 = Ha. 1.
4-6 = Ha. 3.
7-9 = Ha. 2.
15 = Ha. 4
16 = Ha. 5

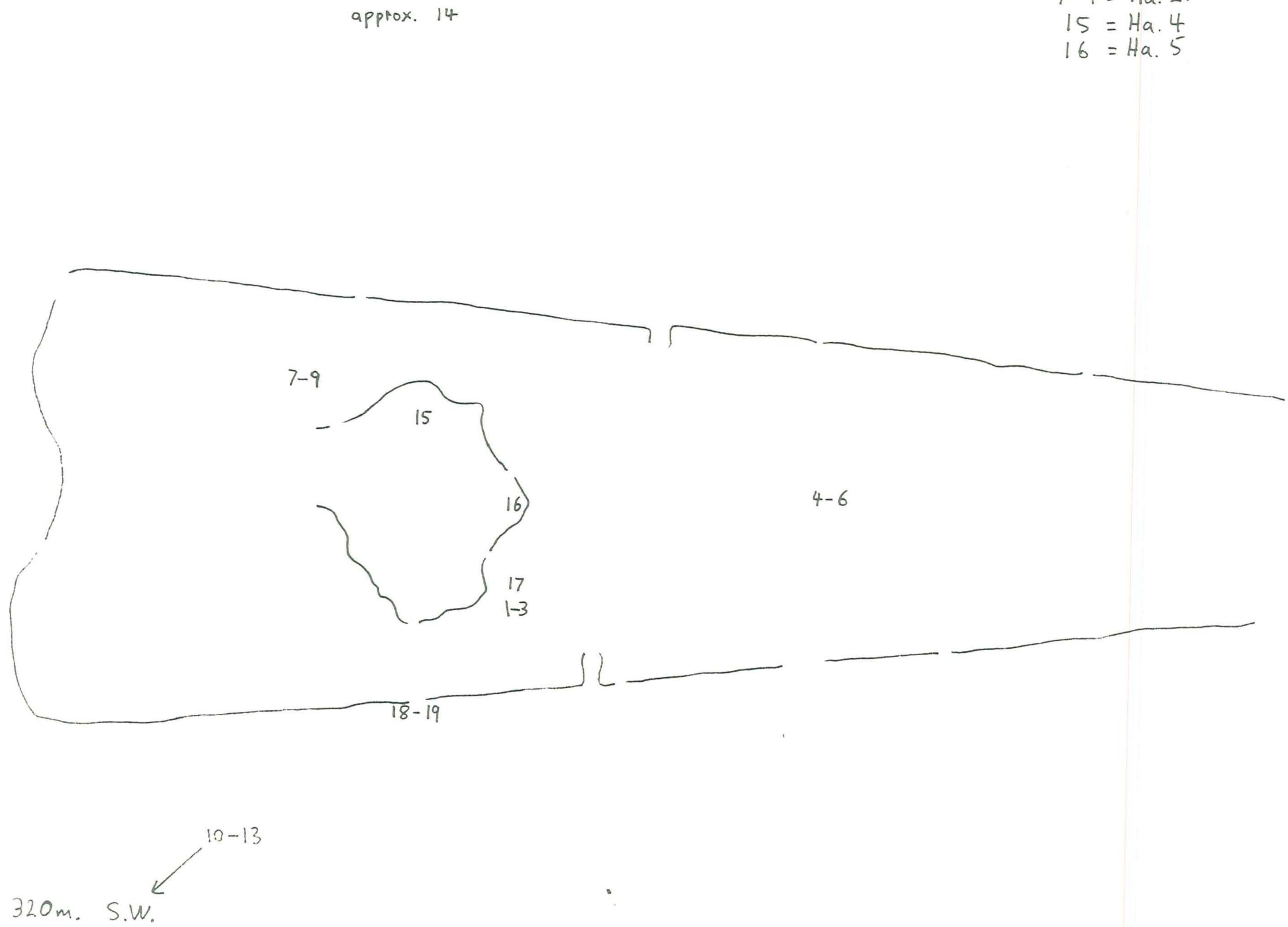


Fig 3

HAZLETON LONG CAIRN: Soil History

Key:

Immediate pre-cairn cultivation.

Immediate pre-cairn scrub?

Immediate pre-cairn grass cover

o Earlier cultivation

△ Earlier occupation

X Probable "Atlantic" tree hollows

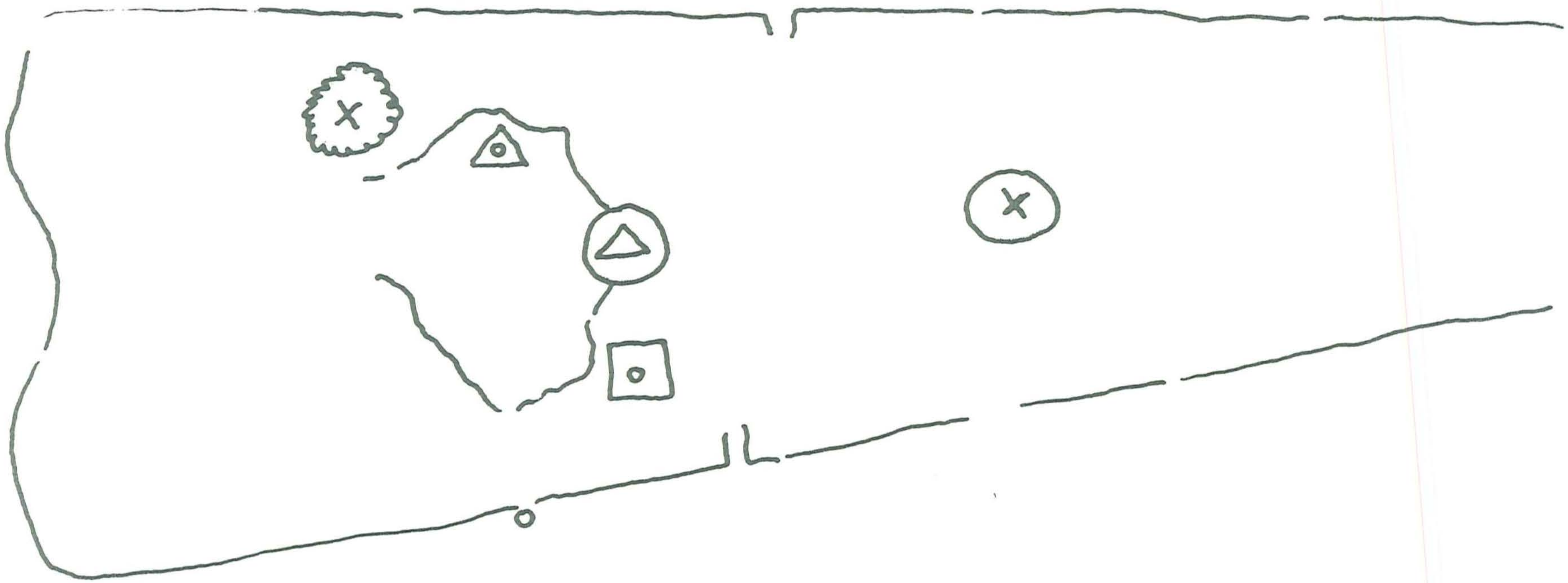


Table 1.

Basic Analytical Data

Sa No	Ha No	Horizon	$pH(H_2O)$	Loss on ignition*	%C	Clay	FZ	MZ	CZ	Silt	VFS	FS	MS	CS	VCS	Sand	Texture
Profile 1																	
1.	1	bAg(turf	6.9	5.16	.90	35	8	17	12	57	22	3	1	1	0	27	clay loam
2.	"	2bAg	7.4	5.28	.80	37	13	24	7	44	11	4	2	1	0	17	clay
3.	"	2bBt	7.4	5.64	.50	52	6	20	8	34	6	2	2	2	1	12	clay
Profile 2																	
4.	3a	bAg	7.7	3.58	1.22	-	-	-	-	-	-	-	-	-	-	-	
5.	3b	bBt	7.8	3.71	1.15	-	-	-	-	-	-	-	-	-	-	-	
6.	3b	C"Marl"	8.0	1.00	-	29	9	5	2	16	25	15	7	5	3	55	sandy
Profile 3																	
7.	2a	bA	8.0	4.32	.94	37	10	17	14	41	16	5	1	1	0	22	clay
8.	2a	bAg	8.1	4.13	.92	37	11	13	22	46	11	4	1	1	0	16	silty clay
9.	2b	bBtg	8.1	3.83	.84	44	8	14	13	35	17	3	1	1	0	22	clay
Profile 4																	
10.	Pit 1	Ap	7.7	11.24	3.48	43	10	14	10	34	13	4	2	2	2	23	clay
11.	"	B1	7.8	8.33	2.18	37	11	13	7	31	17	6	2	3	3	31	clay
12.	"	B(g)2	8.0	7.22	0.89	47	12	10	6	28	18	2	2	2	1	24	clay
13.	"	C2"Marl"	8.0	2.40	-	38	11	18	16	45	14	1	2	1	0	17	silty loa

Sa No	Ha Na	Horizon	$pH(H_2O)$	Loss on ignition*	%C	Clay	FZ	MZ	CZ	Silt	VFS	FS	MS	CS	VCS	Sand	Texture
14		NorthQuarry - "turf" 55(156-160cm)				44	9	19	13	41	7	5	2	1	0	15	clay
Context 561																	
15.	4	bA	8.0	3.75	1.06												
16.	5	bA	8.1	6.75	1.47												
Context 286																	
17.		"turf in mound	-	4.33	0.72												
Under Tumble																	
18.		bB(1)	-	3.63	0.35												
19.		bB(2)	-	3.44	0.84												

* over-estimated.

Table 2.

Nutrient Chemistry of Selected Samples

Sa No	Ha No	Horizon	P*	%N*	H*	Ca*	Mg*	K*	Na*	CEC*	%Base * Saturation	pH(H_20)	%C	C/n
Profile 1														
1.	1	bA(turf)	3.0	.14	0	.02	.43	.2	.1	.75	100	6.9	.9	6
Profile 3														
7.	2a	bA1-5cm	3.0	.10	0	37.6	.50	.4	.1	38.6	100	8.0	.94	9
8.	2a	BAg-13cm	19.4	.11	0	32.0	.60	.8	.1	33.5	100	8.1	.92	8
9.	2b	bBtg-27cm	4.5	.07	0	0.4	.50	.6	.2	1.7	100	8.1	.82	12
Profile 4														
Modern														
10.	Soil	Ap	8.2	.57	0	59.1	.90	.5	.1	60.6	100	7.7	3.48	6

* : analyses by Rothamsted Experimental Station (Avery and Bascomb, 1974)

CEC: me/100gms

P: Extractable P, mg/L

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Appendix 1

Hazleton: soil profile descriptions

Profile: 1, in Old Ground Surface (211) below cells N and P; drawing 154 (Ha.1)

Location: SP 07271891 Altitude: c. 250m OD. Drainage: now imperfect Site: shedding

Parent Material: Hampen Marley Beds, Great oolite Series, Jurassic.

Relief: top of interfluve. Aspect/Slope: South 2-4°

Soil: Tetbury series; Fine loamy over clayey, argillic brown earth (Courtney and Findlay, 1978, Findlay, 1976);

Tetbury series included in Ston Easton Association (Findlay, et al, 1983).

(Plate 1)

depth, cms.

Overburden of Oolitic Limestone slabs, Marl and small soil bodies.

bAg 0-4(8) (single turf)	Dark yellowish brown (10YR3/4 moist) moderately firm clay loam (see analytical data) with narrow (0.6cm) firm dark red (2.5 YR3/6) and black (2.5YR 2.5/0) ferro-manganiferous pan at surface; medium subangular blocky; few flints; fine charcoal, piece of bone present; smooth, sharp boundary.

Old Ground Surface

2bAg 4(8)-13	Dark brown (7.5YR 3/4) moderately weak clay with narrow (0.3cm) dark red (2.5YR 3/6) and black (2.5YR 2.5/0) ferro-manganiferous pan at junction; medium prisms; inclusions as above; common coatings; broken, clear boundary.

2bBt	Discontinuous strong brown (7.5YR4/6) weak clay; medium prisms; few small limestone stones; common coatings; sharp, irregular boundary.
R	Oolitic limestone, with soil inclusions.

Profile: 2 (As profile 1): Context 211, below cells G and H, drawing 411 (Ha. 3). Beneath mound, undulating surface.

(Plate 8)

depth, cms

bAg 0-8	Dark yellowish brown (10YR 4/6) very firm clay with narrow (.6cm) firm, red (2.5 YR 5/8) and black (5 YR 3/1), ferro-manganese pan at surface; more diffuse pan at 4-5 cm; common, faint, medium mottles; few charcoal; subangular blocky sharp, smooth boundary.
bBt 8-46 (subsoil hollow)	Dark brown (7.5 YR 3/4) very firm clay; with narrow (0.5cm), firm , red (2.5 YR 5/8) and (0.5cm) black (5 YR 3/1) ferro-manganiferous pan; few charcoal; common ped face and in-ped pore coatings; clear, smooth boundary.
(7)46-54 marl(C) 54+ R	Yellowish brown (10 YR 5/6) moderately weak sandy clay loam; massive; many medium Oolitic limestone stones; abrupt, irregular boundary.

Profile 3. (As Profile 1): contex 211, below Cells R and S, drawing 462 (Ha. 2). Beneath mound, smooth surface.

Plate 18

depth, cms

bA1 0-3(6)	Brown (7.5 YR 4/4) moderately firm clay, with narrow (0.4cm), firm ferr-manganiferous pan (as Profiles 1 and 2), few, medium, diffuse mottles; few large limestone stones; coarse blocky to medium prisms; few fine, and coarse (1-2cm). root channels; charcoal present; manganese nodules present; few fine coatings; sharp, smooth boundary.
bAg 3(6)-13	Reddish brown (5 YR 4/3) moderately firm silty clay, with narrow (0.4) ferro-manganiferous pan at junction above medium prisms; common, medium diffuse mottles; coarse root channels present; charcoal present; common ped-face, in-ped pore coatings; gradual, irregular boundary.
13-27 bBtg	Dark brown (7.5 YR 3/4) moderately firm clay; few mottles, "fine" prisms; very common coatings; abrupt, irregular boundary
27+ R	Fragmented Oolitic limestone.

<u>Profile 4</u>: Modern colluvial soil. (Pit 1). Lower Barrow Ground Field.

<u>Location</u>: SP07125 18590 <u>Altitude</u>: c. 229m. <u>Drainage</u>: mainly free.

<u>Parent Material</u>: Hampen Marley Beds Head. <u>Site</u>: receiving and shedding.

<u>Relief</u>: towards bottom of slope (valley bottom) south of (4-500 metres) barrows. Against wall. <u>Aspect/slope</u>: 5° south (valley 6° East).

<u>Soil</u>: Didmarton Series: deep clayey brown calcareous earths in Head and colluvium

containing limestone rubble (Courtney and Findlay, 1978, Clayden and Hollis, 1984)

Plate 30

depth, cms

Pasture cover.

Ap 0-24	Brown (10 YR 4/3) very firm clay; medium to coarse angular clods; common medium and small limestone stones; moderately humic; common fine roots; charcoal present; gradual , wavy boundary.
B 24-57	Strong brown (7.5 YR 4/6) to dark yellowish brown (10 YR 4/4) very firm clay; medium to coarse prismatic; many (and increasing) stones with depth; few fine roots; charcoal present; abrupt, smooth boundary.
B(g)2 67-83	Brown (7.5 YR 4/4) very firm clay with few discontinuous ferro-manganiferous pans and distinct, fine mottles; few stones; coarse prismatic; few fine roots; few coatings; manganese stained peds; clear, smooth boundary.
B/C 83-100	Brown (7.5 YR 5/4) and reddish yellow (7.5 YR 6/8) heterogeneous, moderately weak sandy clay loam; structureless/massive; common fine to coarse stones clear, wavy boundary.
C2(marl) 100-122	Light yellowish brown (2.5 Y 6/4) moderately weak silty clay; structureless; few stones; common manganese staining; clear, even boundary.
C3(head) 122+	

Appendix 2 Micromorphologcal Description and Interpretation

Sample 15 Hazleton: "midden" area; Ha. 4 sample 4: bA; 0-5cms (plates 19, 20)

Structure: medium moderately developed subangular blocky well accommodated "pseudo plates" (in top 1cm) no seperation (see Amorphous) subangular blocky structure with minor vesicular structure in top 2cm and moderate vughy structure in lower 3cm: Porosity compound packing voids; few fine (150 um) to coarse (600 um) elongate (5cm) channels; moderately smooth; moderately accommodated: frequent, common vughs (botton); fine to medium; smooth to undulating elongate to interconnected: porosity: 15-20% (top) to 40% (lower part):
Mineral: limit 10um; Coarse/Fine 60/40: Coarse: dominant fine with very fine sub-angular quartz; moderately sorted: rounded sharp edged nodules present: Fine: a) very dominant brown to dark (to darker with depth) brown (PPL) (Plate 31); pale to bright orange (RL); b) very rare (compact) very dark reddish brown (PPL); reddish orange (RL); almost opaque c) very rare reddish brown (PPL); pale orange (RL); speckled: Organic: Coarse: very few charcoal; plant fragments present: Fine: a) frequent to common cell fragments and amorphous organic matter, few charcoal/charred organic matter: b) amorphous organic matter present; charcoal absent: c) frequent organic matter; charcoal absent: Groundmass: a) low birefringence weakly speckled; porphyric: b) low birefringence, weakly striated; porphyric: c) moderately high birefringence, striated, prophyric: Pedofeatures: Excrements: very few thin, brown, dissaggregating, mineral; slightly calcitic; possibly compacted excremental fabric: Textural: very few, very thin to thin (30-120um) dusty clay, moderately birefringent coatings; non laminated with very few organic matter/charred/charcoal; undulating: on vesicles, channels; on lower part of voids: some faunally disrupted: possibly two phases.
Crystalline: few calcitic impregnation of fabric and excrements; low to moderate;

crystals in channel margins: <u>Fabric</u>: inclusion of 2 other fabrics (b), (c) and possible burned soil fragments of red colour: well incorporated fine birefringent material; few faunal passage features (Plate 20): <u>Amorphous</u>: few ferro-manganiferous moderate fine impregnative nodules and laminations the latter in the top 1cm. 5-6cm depth common weak ferruginous impregnation.

<u>Interpretation</u> This A horizon was selectively sampled from beneath the barrow because it appeared to have some worm-worked characteristics - a feature generally absent elsewhere. A mammoth thin section revealed the horizon to have had a faunal history - as evidenced by low overall birefringence, faunal burrows (Plate 20), and the dissaggregation and inclusion into the matrix of dusty coatings - and possibly the presence of soil fragments (papules) of a high birefringennt ("old" weathered subsoil) character (see Sample 5). Some compaction and localised anaerobic conditions (gleying or hydromorphism) is represented by laminated iron staining in the upper 1cm. Possibly two phases can be identified in the very few dusty clay coatings present, namely; rare pre-earthworm working and rare post-earthworm working. A fragment of possible burned soil was also noted (see 4B).

Apart from post-burial compaction and minor hydromorphism, the soil can be interpreted as having contained thin dusty clay coatings, but most of these had been apparently homogenised by faunal reworking. Possibly some very minor slaking of the surface soil occurred just prior to cairn construction. Thus, although this earthworm worked A horizon shows little evidence of immediate pre-cairn faunal activity (Romans, pers comm) or site disturbance, no "herbaceous" turf was apparent in the field or under the microscope. Perhaps the area of sample 15 (Ha.4), which is in the "midden" zone, was bare ground at time of burial, and had a declining earthworm population. In addition, the lack of high concentrations of fine and coase charcoal, and the presence of only very few textural features suggest that sample 15 (Ha.4) was both on the edge of area of domestic occupation and just prior to burial, little affected by cultivation (see Sample 16, Ha.5).

Sample 16; "Midden Area" 16; Ha5 bAp; 3-8cms. (Plate 21, 22, 23, 24, 25)

Structure: medium to fine well developed subangular blocky; well accommodated: subangular blocky structure with fine vughy structure in upper 4 cms, rather coarse vughy in bottom part; channel/crack structure: Porosity: 20-30%; top 2cm 10-15%: compound packing voids; few medium vesicles and vughs especially in upper part: frequent medium (400 um), elongate channels and cracks inter-connected by coarse (9^{00}-1,000 um) vughs: vertical orientation of vesicles and vughs and many cracks: Mineral: limit 10 um; Coarse/Fine, 60/40 (as above) very few bone: Fine: a) very dominant brown to dark brown (PPL); pale to bright orange with black areas (RL); speckled: b) very few black (PPL); bright orange; opaque (burned soil?): Organic: Coarse: few wood, hazel shell charcoal (Straeker, pers comm); few root fragments, plant remains set in fine fabric: Fine: a) frequent charcoal/charred plant material; common organic matter (as above): b) charcoal etc, absent; very few organic matter: Groundmass: a) as above (a); b) undifferentiated: porphyric: Pedofeatures: Textural: Few to frequent dusty clay coatings and infills; at least 2 major types: a) very few moderately fine (100 um) to medium (200 um plus) pale brown (PPL), pale yellow (RL); moderately dusty (relatively low limpidity) high birefringent at least 2 phase, void and channel coatings: with very few organic matter, charred/charcoal: (coating type (a), or as infillings on) b) frequent fine (60um) to coarse (600 um) multi-phase (and successive waves) very dark brown to black (PPL), pale orange (RL), moderately birefringent, very dusty to impure clay) infills and coatings: very few charred/charcoal and organic matter: occasionally silty: fragments of coatings washed away: Crystaline: very few, very localised calcitic impregnation around "marl". Fabric: incorporation of fabric (b) and "Marly" inclusions very coarse

(1-2cm) black and dark reddish brown (PPL); areas of dark reddish orange and black (RL); low coarse mineral; common probable amorphous and cell organic matter; includes coarse charcoal; non birefringent groundmass; predates later disturbance, ie includes thin very dusty birefringent clay coatings; possible burned soil: inclusions of disintergrating calcareous "marl soil"; with dusty coatings; few passage features: Amorphous: frequent, diffuse, coarse (1-2cm) impregnative ferruginous nodules, and thin (2-3mm) horizontal pans (2): below is coarse (6mm) ferro-manganiferrous horizontal diffuse pan; also common ferro-manganiferous nodules associated with ferruginous impregnations.

Interpretation: This area of A horizon under the centre of the cairn was generally dark in colour, and was seen in the field to contain large quantities of plant remains, charred grain, hazel nut shells, and possible burned soil fragments (Plate 5), and was described as a midden (Saville, pers comm).

The mammoth thin section clearly showed the inclusion of frequent coarse charred organic materials set in a fine fabric containing abundant fine charred organic matter (Plates 22 and 23). In addition, coarse (0.5cm) fragments of opaque soil material that are reddish in oblique incident light had been incorporated into the soil. Similar reddened soils have been recognised in thin sections in both prehistoric and experimental fire places (Courty, 1984; Page and Courty, in press). As fragments of daub had been recovered from the "midden" and probable hearth had been identified just south of the "midden" area (Saville, pers comm), it is probable that the reddened soil inclusions could be burned daub or fragments of hearth soil.

As at sample 15 (Ha 4) there is evidence of biological activity affecting some of the coarse charred material and also opening up the generally dense fabric in places (Plates 24 and 25). The incorporation of burned soil and coarse charred organic matter, and the formation of the biopores all appear to predate at least one phase of clay translocation. Here it is worth noting that clay translocation is a phenomenon usually only occuring in subsoil (Bt) horizons and relates to the pedogenic process of lessivage (Duchaufour, 1982; Federoff, 1982), whereas the deposition of clay (especially very dusty, or impure clay) in surface horizons (as at Hazleton) can be the result of tillage (Jongerius, 1970, 1983; Fisher, 1982; Romans and Robertson, 1983a, 1983b, 1983c; Macphail et al, in press).

Here at sample 16 (Ha 5) there are no textural coatings of the limpid and microlaminated type found to characterise (Federoff, 1982) illuvial (argillic) Bt horizons. In contrast, the textural features mainly comprise either brown or very dark brown (PPL) very dusty to impure clay coatings, containing both silt-size quartz and fine charcoal, all derived from the matrix. Coatings can be up to 600um thick, and in places are multi-phase showing successive waves of translocated fine material. These textural features appear to both pre-date and post-date the inclusion of coarse charred organic materials and biological activity in general.

Later, post-burial features were also noted. For instance the buried soil in this area was marked by a reddish weakly formed iron pan (or staining) associated with much more diffuse manganese nodular concentrations. The latter tended to darken an already dark soil matrix. This ubiquitous post-burial natural feature occurred at an average depth of 4cms in many areas across the site (see also Plaste 8 and 18), although a different situation occurs at samples 1 and 2 (Ha1).

Sample 16 (Ha5), although featuring a concentration of material relating to domestic occupation, is not interpreted as an accumulation midden sensu stricto. For example, middens elsewhere are accumulations of anthropogenic materials - such as ash, bone, seeds and coprolites at Potterne, Wiltshire (Macphail, in prep) and shell and bone at Westward Ho!, Devon (Balaam, et al in prep) with very little included natural soils or sediments. In contrast, the dark area at Hazleton is dominantly made up of the local soil, and although the included quantities of anthropogenic materials are not insubstantial, they do not so much make up a vertical accumulation as reflect the incorporation of occupation materials into the soil. The agencies for this incorporation may be listed as minor biological activity, pedogenic shrink and swell and probable human trampling being probably less important than cultivation, as explained below.

The most obvious indicator of tillage are the large number of very dusty clay and impure clay coatings and infills throughout the sample. Natural (eg forest, grassland) soil structures (peds) are stable (Imeson and Jungerius, 1974; 1976; Imeson and Vis, 1984) and do not easily slake under rainfall. However, when under arable conditions soils are mechanically disturbed they do slake more readily when wet and the resulting mobilised soil is translocated - forming (poorly) birefringent coatings and infills mainly in and close to the "plough" zone (Jongerius, 1970; 1983). Successive (21) horizontal (7cm long) transects were carried out to count numbers of pores with textural coatings and infills in sample 16, from an approximate soil depth of 2.5cms to 8.5cms. The count showed that numbers of "pore infills" increased from c.50 around 3cm depth to c.120-150 between 4 and 6 cms depth, declining to c.50-80 with increased depth. This distribution compares well with results from studies carried out by similar methods on other probable Neolithic cultivated soils (Romans and Robertson, 1983a, 1983b.). Even though the gently sloping edge site situation at Hazleton and other data (Section 3C) may suggest some loss of soil depth by erosion, the curve of "pore infills" down the sample may indicate ard cultivation (Romans, pers comm) at sample 16 (Ha 5) (see sample 4, Ha5). In addition, the generally dense charcoal rich fine fabric, the vughy porosity and common textural pedofeatures may all suggest the complete reworking of most of this soil horizon by cultivation.

In summary, the evidence indicates that at sample 16;

a) There was probable highly concentrated domestic occupation - fires, foodstuff processing etc.

b) Because the anthropogenic material was incorporated into the soil, rather than accumulated on top of the soil, this domestic occupation was not an immediately pre-cairn event.

c) The presence of both coarse materials and very fine charcoal (and also small fragments of reddened soil) in the fine soil fabric, suggest that the agencies (see e) of incorporation and homogenisation were active both during and after the coarse material had been worked into the soil. Equally homogenisation had not persisted so long after domestic occupation to the extent of breaking up all the charcoal for example.

d) Agencies such as minor faunal working, pedogenic shrink and swell and human trampling would not in themselves have been sufficient to create a fabric so full of fine charcoal, but cultivation, as strongly suggested by the concentration of textural coatings in this surface soil, would.

e) The presence of textural coatings in "relic" porosity and within the coarse charcoal may further indicate cultivation was the last activity here.

f) The above findings infer that charcoal analyses are only dealing with the last materials to be incorporated, because earlier charcoal has been broken up, Samples 4a, 4b and 5 (Ha 3) (Plates 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17; Profile 2)

3b: bA/pan/B and Marl: upcast from tree throw (Sample 4)

bA/pan (4-8cm depth). 4a.

Structure: medium angular/subangular blocky; well developed; moderately accomodated: subangular blocky with moderate vesicular microstructure: minor cracked Porosity: 10-15%: very few medium (300 um) elongate (4cms) channels/cracks; smooth, undulating walls; few fine (180 um), smooth walled vesicles; very few, very coarse (6mm) vughs: vertical cracks; vesicles random or associated with fine channels: Mineral: Coarse as above with very few limestone "Marl" fragments: Fine: a) very dominant brown to very dark brown (PPL): pale orange to reddish orange (RL) very few blackish spots: lightly speckled b) few, dark brown (PPL); orange (RL); heavily speckled: Organic Coarse: very few limpid, reddish plant fragments: very few fragments dark brown ferruginised amorphous organic matter; very few charcoal: Fine: a) very few charred/charcoal fragments; few amorphous and cell fragments of organic matter: b) few charcoal/charred plant remains; frequent organic matter: Groundmass: a) moderately high birefringence; darkish brown; speckled porphyric: b) moderately high birefringence; dark reddish brown; speckled and slightly striated; prophyric: Pedofeatures: Excrements: very few, possible, very thin; ferruginised; originally organic: Textural: frequent, weak to strongly formed coarse (100um), interlaced intercalations: associated with common, moderate birefringent dusty clay (vesicle, vughs, cracks) void coatings (100-400um) and infills (1,000 um) infills of old cracks now compacted: various phases: earlier phase light brown (PPL), with common silt-size opaques and quartz: later phase especially at c.4-5cm depth generally rather less birefringent but more fine (Plates 11 and 12): all contain organic matter: within early dusty phase get very few, bright red fine (90-120um), limpid clay coatings free of opaques and organic matter now often ferruginised; often fragments found elsewhere: most groundmass comprises infill which includes fragments (90 um long) relic "coatings" etc which are moderately birefringent; infilling between old peds same as "earlier" phase: (fabric b) fragment old soil with intercalations/infills: Fabric: see above (b) for inclusions: Amorphous: common dark reddish brown very coarse, diffuse, ferruginous impregnation of groundmass and organic matter: diffuse ferruginous pan (.5cm), horizontal above black spotted, ferro-manganiferous (0.5cm) pans. (Plate 13).

3b cont: below pan

b B and mixed "marl" (8-12 cm depth). 4b

Structure: medium to coarse angular blocky well developed; moderatly accomodated: cracks to channel microstructure; moderately vesicular:

Porosity: 15-20%: few very coarse (3mm) cracks: elongate very few very coarse vughs: few medium vesicles: very few, very fine (20um) channels: subvertical cracks: Mineral: Coarse/Fine in places 10/30: generally 30/70: quartz as above: in lower part 40% oolitic, marly limestone (Plates 15 and 16); very dominant fine sand size ooliths (mied with fine matrix): few shell fragments: few small stone size limestone fragments: Fine: dominant (a) - as above : b) very few reddish brown (PPL); pale orange (RL) (Plates 9 and 10); speckled: c) very few bright reddish brown (PPL); orange (RL); slightly speckled d) rare yellow brown (PPL); dull brown (RL); limpid: Organic: coarse: very few charcoal: Fine: a) rare charcoal frequent amorphous organic matter: b) rare charcoal; frequent amorphous organic matter: c) no charcoal; rare amorphous organic matter: d) absent: Groundmass: a) as (a) above: b) moderate birefringence; dark brown; speckled: c) moderate high birefringence dark orange brown; speckled, weakly striated: d) as (c), striated: Pedofeatures: Textural: few (probable last phase) yellow brown very dusty clay, very fine (30-60um) coatings; in channels voids etc; common organic matter; very few charred/charcoal; high birefringence: common (earlier phase), very dusty, medium (400-500um) coatings and infills; voids, very few organic matter and charcoal; low birefringence: very few (relic phase part emplaced at time of tree throw settling) orange brown, very fine and fine (50-150 cm) moderately dusty coatings and infills; voids and channels; few organic matter; moderately high birefringence; disrupted character - possible channel reworking; possible relic coatings at base of old soil parent material margin (see Fabric): very few fine intercalations, with "rolled" infills Crystalline: frequent, minor calcitic impregnation in mixed marly limestone/soil fabric(Plates 9 and 10): Fabric: few, moderately high birefringent, orange brown, medium to coarse soil fragments; related to relic coatings above; possibly same original fabric: frequent marly limestone/mixed orange brown fabric - part of upthrow: Amorphous: frequent ferruginous impregnation of channel and void boundaries: few fine ferro-manganiferous, clear-edged nodules: few fine ferro-manganiferous sharp-edges nodules.

3a: bBt (tree hollow) (Sample 5)

36-43 cms.

Structure (prismatic), fine subangular blocky within; vughy to channel microstructure: Porosity: 20% frequent very fine (60 um), fine (150 um) and medium (300 um) elongate, interconnected smooth walled channels: few coarse to very coarse (700-4500um) vughs; few fine and medium vesicles: Mineral: coarse/fine: 50/50 coarse: as 4 : rare fine limestone fragments: Fine: a) dominant as (a) above (bA): b) common bright reddish brown (PPL) (c above 3b, bA); bright orange (RL); slightly speckled (Plates 14 and 15): c) very few dark reddish brown (PPL); bright orange (RL); speckled to almost opaque: d) as above Organic: Coarse: rare charcoal and plant fragments: Fine: very few charcoal/charred plant remains: few single cell, cell fragments, amorphous organic matter: b) few charcoal/charred; frequent organic matter: c) very rare charcoal/charred; few organic matter:

Groundmass: a) moderately high birefringence; speckled and weakly striated; dark yellowish brown: b) high birefringence; speckled, moderated striated; orange brown: c) high birefringence; "patchy" and striated; reddish brown: Pedofeatures: Textural: a) very few, (last phase) very fine (30-60 um) yellowish brown, moderately dusty clay channel coatings: rare charcoal and organic matter: b) (earlier phase) common dark yellowish brown medium to coarse (3-600um), moderately to very dusty clay coatings and infills; high birefringence; rare charcoal, few organic matter; rare silt; 2-3 phases: c) frequent (early phase - immediately after tree throw), orange brown, very fine (60-100 cm) infills and coatings (within peds), slightly dusty clay (Plates 16 and 17); very few to few organic matter; rare charcoal; very rare silt: high birefringence; few laminated; sometimes diffusing into yellowish brown groundmass; also diffusing in relic low dusty to near limpid clay fabrics (see Fabrics): very few intercalations; coarse, silty and clay layers (infill phase); Fabric: frequent very coarse bright reddish brown areas; coarse/fine, 30/70 (high fine) birefringent; relic B horizon with remobilised infills; also relic limpid clay fragments - possibly not old coatings but clay fabric fine fabric (a): Amorphous: common coarse, diffuse, ferruginous impregnation of orange brown fabric: few very fine (50um) ferro-manganiferous, clear edge nodules: common very fine (20 um) sharp edges ferruginous nodules.

Interpretation This is the interesting area of the probable tree-throw hollow (Plate 8) - the up-throw deposits and hollow area examined for snails by M Bell, who (1983) found some molluscan evidence of an Atlantic woodland fauna. Mammoth slides were made of the bA horizon developed on the up-throw material, and the Bt horizon present at the base of the subsoil feature.

The microfabrics are very complicated. These and the textural coatings in particular are described according to the probable order of events. The earliest fabric which is best expressed in the Bt horizon is a bright reddish brown, strongly birefringent (beta B horizon, Catt, 1979) clay material (Plates 14 and 15). It has been disrupted and features infillings of related bright reddish brown "matrans" or possibly intercalations (Plates 4 and 5). Other semi-contemporary infills (Plates 16 and 17) are more yellow brown, dusty clay coatings and fine fabric of a less ferruginous character, that occur around large fragments of the reddish soil. The latter mixed with Oolitic parent material also occur in the upthrow are at the junction with the yellow subsoil (Plate 8, 9 and 10). Even deep in the hollow, the yellow brown infills and fine fabric are much more organic, possibly containing some fine charcoal, in contrast to the reddish clay fabrics. Also present in the soil are few yellowish brown limpid clay fragments. Lastly, there are two types of later coatings. Of these, the very latest phase (Plates 11 and 12) probably just pre-dates cairn construction, whereas the earlier more significant coatings appear to cover a longer time span. As elsewhere, the upper soil is characterised by post-burial iron and manganese nodular pan formation (Plate 13), and again the soil shows little evidence of being biologically reworked prior to burial.

The thin sections can be interpreted as suggesting that the bright reddish brown fabric (see Plates 14 and 15) is the oldest part of the soil developing as a "weathering" Bt horizon at the soil/limestone (see Plates 9 and 10) junction (Federoff, 1982, pers comm). Alternatively, this may possibly be an interglacial event, the fabric relating to paleo-argillic (Bt) horizon formation (Avery, 1980; Bullock, pers comm). The limpid yellow brown clay fragments which are present are probably associated with less ferruginous early Holocene "Bt" horizon formation away from the junction with the limestone. Tree-throw, as inferred (see Discussion 3B), completely disrupted the soil. Fragments of the bright reddish brown B't horizon became mixed for example with the marley subsoil. Gaps left in the soil fabric, as lumps of soil fell back into the hole were infilled by a) remobilised (slaked) bright reddish brown clay, b) less ferruginous Bt and much more organic Eb and A horizon material (see Plates 16 and 17). This must have happened rapidly because there is little evidence of fauna intruding into the hollow and reworking the above materials (Courty, pers comm) - as seen elsewhere (eg Balksbury Camp, Hants. Macphail AMLR 4621, 1985). Possibly, the tree-throw was not totally natural and the tree stump removal allowed quicker infilling or even was purposely infilled.

After this massive tree-throw disturbance, and the associated infills, coatings and possible intercalations formed, a whole series of soil translocation occurred producing very dusty and impure clay coatings which contain organic matter and fine charcoal (Plate 11 and 12). These latter relate to continuous usage of the site - probably for tillage (see Sa.4; Section 3E). Again transect counts of pores with these textural features from c.5 to 7.5cms depth indicated that numbers of coated pores declined from around 115 at 5cms to 75 at 7.5cms. Although counting was rather unsatisfactory because a) textural features were often heavily obscured by impregnative iron and manganese (see Plate 13), and b) complicated by within-soil mass movement due to earlier "tree throw" disruption, the data still seemed comparable with sample 16, indicating cultivation of this area as well. It is possible that this activity smoothed off any soil humps commonly associated with "tree-throw" (Lutz and Griswold, 1939; and by analogy, modern examples), and as inferred at Sample 16 some soil loss by erosion. As noted earlier, no faunal worked A horizon was present, but this may be associated with ecological conditions pertaining to Neolithic tillage (see Discussion). In addition, post-burial hydromorphic affects formed a zone of ferro-manganiferous impregnation of the soil (see Plate 13) at 4-5cms depth.

Samples 1, 2 and 3; Ha.1) (Plates 1, 2, 3, 4, 5, 6 and 7; Profile 1)

bAg (single "turf stack") (Sample 1)

(top iron pan to bottom iron pan 0-3(4)cms).

Structure: (medium subangular blocky); channel microstructure: Porosity: 15-20% dominant medium to coarse (4-700um) elongate channels interconnecting medium to coarse vughs; underlating sides; well accomodated: possible very few fine vesicles in upper part: frequent fine vughs intrapedally:

Mineral: Coarse/Fine 65/36: Coarse: very dominant angular to subangular, silt and very fine sand size quartz: rare, very fine limestone fragments:

Fine: brown (PPL); pale orange (RL); speckled:

Organic: Coarse: very few charcoal: very dominant "replaced" (see Amorphous) amorphous organic matter/"plant material" in upper 6-900 um (Plates 2 and 3); with in situ root penetration to 2.700 mm (Plate 4); probable in situ "turf1". base of slide, "turf" of old ground surface, 2.400 mm thick, level and undulating: very few organic matter elsewhere:

Fine: frequent charcoal/charred plant material: few to frequent amorphous and organic matter fragments. Groundmass: moderate to moderately high birefringence; pale brownish; speckled and minor striated; prophyric: Pedofeatures: Excrements: very few, extremely thin, organic: possible few, thin mineral, - dissaggregated: Textural: common, fine (30um) very dusty, dark brown, low birefringent clay coatings (PLates 6 and 7)and infills in voids and matrix with organic fragments and charcoal; these are present immediately under "turf" in mineral soil, infill material increasing to approximately 100-150 um with depth: fabric with moderate birefringence, merging in with speckled birefringent groundmass, due to shrink and swell, becomes common to dominant with depth:

Depletion (see below) Fabric: very few fine rounded fragments of fine moderate birefringent fabric (no coarse) included in groundmass; aligned charcoal fragments and relic birefringent (old coatings) around vugh - mixing evidence: Amorphous: uppermost 2-3mm of "turf" ferro-manganiferous replacement (See Plates 2, 3 and 4); lower part of turf mainly ferruginous replacement of amorphous organic matter; plant remains, in situ roots: (possible crystalline iron hydroxide replacement of root): strong ferro-manganiferous impregnation of soil in 2nd pan at 3-4 cm depth; pseudomorphic organic matter replacement

2b Ag: 4(8)-13cm. Old Ground Surface (Sample 2)

Structure: medium subangular blocky, becoming fine prismatic: channel to vughy microstructure:

Porosity: 25%: fine to medium elongate (vertical) channels with medium to very coarse vughs fine vughs intrapedally: Mineral Coarse/Fine: as above: Coarse (as above) very few limestone/marl fragments: Fine: brown (PPL); orange; speckled: Organic: Coarse; very few charcoal; upper boundary of slide is pan; 2.4 mm thick "in situ" turf; organic matter replaced by ferro-manganiferous material (Plate 5; Courty, Bullock, pers comm); amorphous and root pseudomorphs; undulates: narrow horizon is micro (180-200um) laminated: similar to top pan; top 200um almost pure organic matter, then becomes more mixed with mineral. Fine: frequent charcoal/charred plant material frequent organic matter. Groundmass: moderate birefringence; pale brownish; speckled porphyric: Pedofeatures: Excrements: (as above); possible calcitic mixing: Textural: common, very dusty very fine to medium (40-300um) unlaminated very dark brown clay coatings and infills; organic matter, rare charcoal; in channels and voids: Fabric: shrink + swell dominant in matrix: probable elongate, medium to coarse intercalations: coatings etc thicken down-slide. Depletion: A horizon moderately depleted of iron (see fine mineral RL of Bt below). Fabric: minor marl fabric mixing: Amorphous: upper part of horizon - top of old ground surface is "organic replaced turf line"; organic rich uppermost zone 3-450 um wide replaced by extremely ferruginous material (very dark red) rest of (1500um) less ferruginous - rest of pan marked by specks of ferro-manganiferous nodules for 0.5cm. (See Plate 5)

2b Bt (13-21cms) (Sample 3)

Structure: (medium prisms); channel microstructure: Porosity: 10-15%: fine (150um), moderately elongate, interconnected channels; with fine and medium vughs: Mineral: Coarse/Fine, 40/60: Coarse: very dominant silt with frequent very fine sand size quartz; subangular to angular; rare mica: rare limestone fragments: Fine: a) very dominant brown (PPL); bright orange (RL); speckled: b) frequent bright reddish brown (PPL): orange to bright orange (RL) (less coarse material) c) dark brown (PPL); very few, bright orange (RL); speckled to opaque (Excrements? see below): Organic: rare, red, limpid amorphous organic matter fragments: very few "rounded" charcoal: Fine: a) very few charcoal/charred plant material; few to frequent organic matter b) rare to very few charcoal; very few to few organic matter: c) few charcoal; common to dominant organic matter: Groundmass: a) moderately high birefringence; pale reddish brown; speckled to weakly striated; porphyric: b) moderately high birefringence (higher than (a)); orange brown; speckled and moderately striated; prophyric: c) moderately low birefringence; pale reddish brown; speckled; porphyric: Pedo features: Excrements: in very coarse blunt rounded channel, very few thin, rounded, mineral with high organic content; possibly dissaggregating from moderately broad and elongate infill in "tubule": Textural: a) common infills as common last phase, moderately dusty, dark brown; clay coatings; very few organic matter and silt; high birefringence; common void coatings very fine to fine in thickness; coat earlier b) orange brown, moderately dusty clay infills and coatings; high birefringence; frequent organic matter rare silt: over c) very few, orange almost limpid or slightly dusty clay infills - possibly 1st phase high birefringenc; low organic matter: Fabric possible excrements, fine fabric (c): fine fabrics a) and b): Amorphous: frequent fine, clear edged ferro-manganiferous nodules.

Interpretation Three levels were examined; namely; the bAg, 2bAg and 2bBt horizons. The top of the bAg horizon (immediately beneath the mound) is marked by an iron and manganese pan (2-3mm in thickness) (Plates 2, 3 and 4). There is also an undulating pan marking the boundary between the bAg horizon at the base of which is a "reduced" grey zone and the underlying 2bAg horizon. Detailed studies and checks (Bullock, pers comm; Courty, pers comm) indicate both pans to relate to turf lines - the organic matter of an herbaceous cover and its fine roots have in most cases been replaced by ferro-manganiferous (amorphous) and iron hydroxide (crystalline) materials (Plate 5). This interpretation differs completely with the situation examined at sample 3b, where the mineral soil fabric of the lower A horizon has become naturally impregnated by amorphous ferro-manganiferous material by post-burial soil water and redox effects (see Plate 13). Here, at sample 1, a single turf (bAg) as laid on a pre-existing turf area of buried soil. The top turf also contains dusty clay coatings (Plates 6 and 7), which may relate to both previous disturbance and mechanical damage during cutting and placing as inferred in the turf sequence at Strathallan mound, Perthshire. The shrink and swell birefringent fabric suggest the soil was little worm-worked prior to cutting.

The 2bAg horizon is similar to the turf above, the dusty coatings possibly originating in part from the turf above. Earlier coatings can be associated with on-site disturbance . Again the shrink and swell birefringence indicates little recent worm action here.

The underlying 2bBt horizon, which is shallow extending only to 21 cms depth even in the limestone hollows (Plate 1), contains evidence of various pedogenic events and the impact of man on the site. Firstly, as in sample 5a, fragments of bright reddish brown fine fabric may be associated with a disruption event, possibly by clearance and the pulling-up of tree roots. A possible "primary" phase of micro-laminated void and infill coatings may be due to this early period of disruption and the settling of the soil material. These are followed by clay translocation which are again interpreted as representing phases of cultivation. The presence of a more moderately well developed shrink and swell coatings in the two topsoil samples than present, for instance at sample 16, may suggest this area and the original area of turf 1 were not so recently cultivated - allowing a pre-cairn herbaceous cover to form.

Thus at sample 1, the history of the soil can be summarised as, clearance disruption, tillage, and the regeneration of an herbaceous cover which was little affected by earthworm working.

"Turf" from mound,Sample 17, Context 286; (above sample 1)

Structure: fine subangular blocky, channel/vughy microstructure: Porosity: 15-20%; few medium (450um) moderately elongate channels; very few fine channels; frequent medium vughs: all smooth-walled:
Mineral: Coarse/Fine; 50/50: Coarse: very dominant silt, very fine sand, fine sand size quartz; angular to subangular; very few limestone fragments: Fine: a) very dominant pale brown (PPL); pale orange (RL); speckled: b) frequent, dark reddish brown (PPL); dark orange (RL); speckled: Organic: Coarse; few charcoal: Fine: a) few charcoal; few to frequent organic matter: b) very few charcoal; very few organic matter. Groundmass: a) moderately high birefringence yellowish brown striated; porphyric: b) medium birefringence, reddish, speckled, prophyric; Pedofeatures: Textural: few last phase very thin (30um), very dusty dark brown clay coatings: over frequent thick (450um) coatings and infills; high

birefringence; contain very few fine silt, charcoal: frequent birefringent shrink and swell fabrics inclusions of fabric b): Amorphous; dominant ferruginous and (nodular) ferro-manganiferous impregnation of fabric(b); dominant weak ferruginous impregnation of coatings and infills.

Interpretation This is seen as coming from an upper soil horizon, which is interesting in that again two phases of dusty clay coatings can be compared. It can be suggested that the very thick (450um) primary coatings relate to on-site disturbance prior to mound construction, whereas the later, less well developed single phase may originate from mechanical disturbance of this "turf" during cairn construction.

Sample 14 Turf from North Quarry (55:156-160cm) (Plates 27, 28 and 29)

Structure: Fine subangular blocky: vesicular/vughy microstructure: Porosity: 20%: frequent medium and fine vesicles, and interconnected vughs; fine channels all smooth-walled: Mineral: coarse/fine, Coarse: very dominant silt and very fine sand size quartz (as above): very few limestone fragments. Fine a) reddish brown (PPL): orange (RL); speckled: b) common very dark brown (PPL). Coarse: orange and blackish (RL); speckled. Organic: rare, reddish, limpid organic fragments; few charcoal; Fine: a) few charcoal; few organic matter b) few charcoal; common organic matter: Groundmass: a) low birefringence; speckled; porphyric: b) moderate birefringence; speckled, weakly striated; porphyric: Pedofeatures: Textural: common, last phase, dark brownish, very dusty, thin (70 um) medium (300 um), coatings and infills; some fine silt included and organic matter (Plates 28 and 29): some last phases very dark brown, moderate high birefringence; mainly in vesicles etc; coatings post date mixing of more organic fabric (b) with (a); fabric (a) includes mainly earlier infills: Fabric: large (2 cm) to coarse and medium size more organic fabric(b), integrated in matrix: Amorphous: areas of (b) heavily impregnated by ferro-manganiferous nodules: fabric (a) few (as above): common very fine sharp-edged ferruginous nodules.

Interpretation: This "turf" contains areas of A horizon fabric, indicating that this piece of soil was taken from the junction of the upper B horizon and lower A horizon. Again, although the sample was not oriented, it is probable that the last very dark coatings relate to the disturbance and burial of this soil fragment in the quarry. The earlier phases of dusty clay illuviation are again interpreted as probable evidence of tillage seen in the in situ buried soils.

Samples 18 and 19 Under Wall (Mound) Slump (near sample 1) (Plate 26)

0-3cms: 1. (Sample 18)

Structure: Fine prisms; channel/vesicular microstructure;
Porosity: 10-15%; frequent fine (150um), smooth walled, interconnected vesicles; few very fine, elongate channels to vesicles and medium vughs; Mineral: C/F, 60/40: Coarse: very dominant silt and very fine sand size quartz, common fine sand: Fine: very dominant brown to dark reddish brown (PPL); pale orange to orange (RL): Organic: Coarse few charcoal: Fine: very few charcoal frequent organic matter: Groundmass: moderately high birefringence; speckled; slightly striated; porphyric: Pedofeatures: Textural: last phase, common impure (with silt, organic matter, charcoal) clay and dusty coatings and infills, brown to very dark brown; moderately high birefringence: dominant part of fine fabric comprises earlier infills of dusty clay: Fabric: frequent medium fragments of oriented dusty clay in matrix: Amorphous: frequent clear, fine, ferro-manganiferous impregnative nodules; old channel related; frequent diffuse and few clear ferruginous impregnations.

0-3:2 (Sample 19)

Structures: Fine prisms: channel/vesicular microstructure: Porosity: 15-20% : common fine smooth-walled vesicles; few very fine to fine elongate channels interconnecting vesicles and medium to coarse vughs: Mineral: Coarse/Fine, 60/40: (as above): Fine: dark brown (PPL), orange (RL), speckled: Organic: Coarse (as above). Fine: few fine charcoal; few organic matter: Groundmass: moderately high birefringence; speckled; weakly striated: Pedofeatures: (as above).

Interpretation Two samples were examined and these suggest that the pre-Cairn fabrics present in the buried soils were disrupted by minor churning around the boundary of the monument. In fact, sample (18)bB(1), because of its very low organic matter content (Table 2) may indicate actual erosion. Also post-cairn activity gave rise to a certain amount of disturbance, producing phases of coatings in these soils. The fact that the last phase of pedofeatures relates to these disturbed conditions suggests that the collapse, which sealed the soil, occurred before any real vegetative stabilisation of the site.

Samples 10 and 12 Pit 1 (Present day colluvial soil) (Profile 4; Plates 30, 31, 32 and 33)

Ap (0-24 cms - upper part). (Sample 10)

Structure: medium to coarse, well developed clods: crack microstructure: Porosity: 20% interpedal (10-15% intrapedal): common very coarse (5 mm) elongate, interconnected cracks: few medium vesicles and vughs intrapedally: Mineral: Coarse/Fine, 40/60: Coarse: dominant silt and very fine sand size, with fine sand size quartz: rare biogenic calcite: few small stone size limestone fragments (Plate 31); rounded: Fine: a) dominant brown to dark brown (PPL); whitish (RL).

Organic: Coarse: frequent plant remains; roots - parenchymatous tissue: much in situ within voids; others in matrix: cells, amorphous fragments in matrix: very few charcoal: Fine: a) frequent charcoal/charred plant material; frequent cells, cell fragments, amorphous organic matter: b) very few organic matter: Groundmass: a) moderate birefringence; very pale brown; speckled: b) high birefringence; whitish yellow; weakly striated: Pedofeatures: Excrements: few mammilated thin in porosity: very few (in channel) very to extremely thin chewed over plant fragments; partial calcite replacement; calcite replaced 140 um long segmented "worm" fragment of thin (300 um) squarish (plates?): very few thin to moderately broad, calcite replaced, excrements; other mineral excrements indistinct; eg silt tubules - no fines: 750 um by 120 um: Crystaline: minor calcite impregnation of organic matter and matrix (Plate 31): Amorphous frequent, fine, sharp edged ferruginous nodules.

B(g)2 (67-83 cms - c.73-78cms) (Sample 12)

Structure: (prisms) very fine prisms; minor fine subangular blocky: channel/vughy microstructure: Porosity: even 25% few medium (300 ums) moderately elongate channels (Plates 32 and 33), interconnected with medium and coarse (500 um) vughs: frequent fine (120 um) smooth-walled vughs intrapedally: Mineral: Coarse/Fine, 40/60: Coarse: dominant silt and very fine sand sized quartz moderate sorting: rare fine to very coarse limestone fragments: rare mica: Fine very dominant brown (PPL); brownish orange (RL); speckled: Organic: Coarse; few charcoal, root and tissue fragments: Fine: few charcoal/charred plant remains: frequent cell and amorphous organic matter: Groundmass: moderate birefringence; yellowish brown; speckled to very weakly striated porphyric: Pedofeatures: Textural: few very fine to fine (60-150 um) dark yellowish brown, moderately dusty, with silt, clay coatings (Plates 32 and 33); moderately high birefringence; non-laminated contain very few charcoal, and few organic matter;

few weak medium intercalations: Crystalline: few calcitic medium fabric impregnations: Fabric: few moderately high birefringent, pale yellow brown (PPL), calcitic "marly" fabric; well integrated: very few rounded, fine, reddish brown (PPL), moderate birefringence, fine fabric (similar to 3): Amorphous: common, fine rounded weak to strongly formed ferro-manganiferous nodules (Plates 32 and 33); including organic matter impregnated by iron: frequent fine, diffuse ferro-manganiferous nodules.

Interpretation (Ap horizon). This example of a present day cultivated soil is most useful for comparison with the Neolithic soils. Although fertility and tillage methods are not the same, some principles can be established. Firstly this modern A horizon, differs by containing a high proportion of recognisable organic matter (Tables 1 and 2) and by featuring marked faunal activity. The latter is in part responsible for the lack of shrink and swell birefringent fine fabric (Plate 31) so common in the Neolithic topsoils.

(B(g)2 horizon). A number of features can be noted here. Firstly this colluvial deposit contains eroded fragments of the highly recognisable reddish brown and bright reddish brown fine fabric of the previous argillic brown soil cover in the area. The horizon also contains quantities of included rather fine organic matter. What is of greatest note however, is the paucity of dusty clay coatings (Plates 32 and 33)in a soil developed out of modern ploughing. Of course at this depth the horizon may be little affected by any present day surface slaking, but it appears that in the past only sparse amounts of clay were actually washed down-profile in comparison with the Neolithic soils. Three reasons may be cited. These are the higher organic matter and associated faunal activity in the modern soils which in addition are not decalcified - all factors aiding soil structural aggregates to hold together - thus producing little material for translocation.

Appendix 5: Comparable Neolithic Soils

Introduction This is an investigation of thin sections of Neolithic buried soils and mound material, as well as associated modern soils, from Dr Ian Cornwall's reference collection at the Institute of Archaeology. This review was carried out with Dr Cornwall's blessing, as he realised that the science of soil micromorpholgy had advanced greatly since the 1950's and 60's when he was active. The sites comprise Ascott-under-Wychwood, Fussell's Lodge (Farm), Kilham, Lanhill, Nutbane, Silbury Hill, Willerby Wold and Windmill Hill. The sites all occur on calcareous rocks, such as the Chalk, Oolitic Limestone and the Cornbrash, and are comparable because the Neolithic soils are either rendzinas, or brown soils exhibiting varying amounts of decalcification. In addition to microfabric studies, other environmental data from these sites (Cornwall's respective published reports; Cornwall's unpublished notes; Evans, 1971, 1972; Dimbleby and Evans, in Manby, 1976; Dimbleby and Evans, 1974; Dimbleby, 1984), the detailed studies from Hazleton and the recent work of Romans and Robertson (1983a, b and c - access to the thin sections has also been allowed to the author) have all been taken into consideration - the aim being to produce material for a general discussion on Neolithic soils and their utilisation (see Discussion 2).

3A Ascott-under-Wychwood (SP 299175) Oxfordshire, Jurassic Limestone (Plates 34 and 35). Evidence from the thin section of the buried soil and the work of Evans (1971) shows the barrow at Ascott to be on a slighly different parent material than that present at Hazleton. Evans (1971) describes the former as "Oolitic Limestone and Clay" which had produced a loamy soil. This is confirmed by the sandy texture viewed in thin section. As Evans (1971) found, the soil is not fully decalcified, having a recognisable calcitic fine fabric (although this may in part be associated with solution from the calcareous mound); and it is on average somewhat deeper (0-25 to 50 cms in hollow) at Ascott than at Hazleton.

In brief, the microfabric shows a history of possibly being an upper B horizon, with few relic coatings and fabric (from a deeper horizon), that has been biologically reworked. The latter has destroyed the "wetting and drying" birefringence (seen in some of the buried soils at Hazleton). The present birefringence relates to a noticeable, but low, calcitic character. Inclusions of moderately higher birefringent limpid Bt horizon fabric and other probably non-A horizon material, although comparable to a faunally worked horizon may also suggest a possible earlier history of disturbance - perhaps relating to the clearance of the site.

A grassland phase prior to burial (Evans, 1971, Dimbleby and Evans, 1974) is corroborated by the microfabric analysis, although the earlier history of the site is less well understood. A low organic matter content in this sample was however noticed which may suggest this was not a virgin cleared soil converted to grassland.

3B Fussels Lodge (Farm) (SU 19203246) Wiltshire, Chalk (Plate 36).
This long barrow buries a very humic rendzina, with a surface some 53 cms (1 foot 9 inches) above the modern soil (Ashbee, 1966). It is a faunally reworked fabric, comprising much chalky, calcitic fine material. It apparently represents a fairly stable period of grassland growth before mound construction. There is no evidence of the previous landuse.

3C Kilham (TA 056673) N. Yorkshire, Superficial Deposits on Chalk (Plates 37, 38 and 39). Evans and Dimbleby (in Manby, 1976) described the buried soil (20 cms of "brown soil" over Chalk; Evans, 1972) as an argillic brown earth (probably from Cornwall's unpublished interpretation, Evans 1971) - the sample investigated being the "Bt" horizon. As the site was decalcified no mollusca were present, but Dimbleby (with Evans, in Manby, 1976) suggested from the soil pollen that two phases of cultivation, separated by a stable grassland period, could be identified. This may be reflected in the microfabric.

Firstly, no limpid Bt fabric of a natural undisturbed argillic brown soil developed under woodland is identifiable. A primary phase of dusty clay coating illuviation comprises a very small percentage of the total coatings which probably reflects the amount of soil reworking during the stable period and later cultivation. A second phase of coatings predominates (Plate 37). As an example a root channel cutting through the matrix is lined by this very dusty to impure translocated clay - representing 2-3% "illuvial material" present in the soil as a whole. These coatings contain clay and many micro-contrasted silt-size "opaques", including fine charcoal (Plates 38 and 39). A final phase of minor biological and post-burial compaction can also be identified.

At this well understood example of Neolithic activity it is necessary to speculate on the pre-tillage history of the site. As shown, the soil contains no evidence of the undoubted pre-clearance forest cover. Either this evidence (ie limpid clay skins and void infills) never existed, and an argillic brown soil did not form under the previous woodland cover, or clearance and tillage disturbance thoroughly reworked the 20 cms of brown soil. The latter may be the best explanation, as woodland clearance has already been shown to be destructive of Bt horizon fabrics (Appendix 4C), whereas arding will certainly convert a soil into an Ap horizon.

A soil history may be suggested

a) Clearance disturbance - possibly agriculture.

b) Stable grassland conditions - biological mixing.

c) Major disturbance - probable agriculture, and

d) Possible short-lived stable conditions - minor biological mixing before burial.

These findings are closely in line with the independent pollen evidence (Dimbleby with Evans, in Manby, 1976).

3D Lanhill, Wiltshire, Cornbrassh Beds (Plates 40, 41, 42 and 43). At this site re-dug by Grant King (1966), attention centred on samples from the mound and the buried soil. In contrast to soils developed on the Oolitic limestone and the Chalk, the Cornbrash Beds, which are moderately calcareous, have here given rise to a very ferruginous clay-rich brown soil. The sample of the mound material is of interest because it contains very high quantities of amorphous organic matter, charcoal and plant remains, in a mixed fabric of A, B and C (calcareous) material.

The buried soil, is apparently a B horizon, and comprises dominant clay and ferruginous fine fabric. Little limpid matrix material is present, and although it contains very little charcoal, or coatings indicative of soil surface disturbance, the fabric has a character of being disrupted at some time previous to mound construction.

3E Nutbane (SU 330495) Hampshire, Superficial Deposits on Chalk (Plates 44 and 45). This Neolithic long barrow is believed to bury an area of argillic brown earths developed on Clay-with-Flints (de Mallet Morgan, 1959). The buried soil contains only small quantities of organic matter and charcoal, and although the microfabric itself has been much re-worked by earthworms (Plates 44 and 45) (calcite crystals in voids apparently relate to this probable post-burial faunal activity), it is probable that the soil is truncated. The thin section is therefore of a B horizon rather than a A horizon. The modern A horizon is comparably more humic - the buried soil only containing 0.26 mgms of alkali soluble humus (Cornwall, in de Mallet Morgan, 1959; Cornwall, unpublished notes). The probable post-burial biological mixing has introduced calcareous material, including chalk fragments.

Importantly, some relic fabric and coatings remain. Some infills are "dirty" and include organic matter, which suggests surface slaking. Here again, there is no evidence of a limpid "woodland" microfabric.

The truncated soil, which exhibits such features may well have been affected by marked disturbance, probably tillage. Here, like Kilham and Willerby Wold, there is little evidence of pre-Neolithic brown soil formation on decalcified parent materials, although at Nutbane these seem to occur in tree hollows (de Mallet Morgan, 1959) and this may therefore suggest a possible overall loss of soil cover before barrow construction.

<u>3F Silbury Hill (SU 100685), Wiltshire, Superficial Deposits on Chalk</u> (Plate 46). Cornwall's thin section from the buried soil exhibits perfect (anaerobic) preservation of the moss sward developed in the A horizon of a loessic" incipient stagnogley" (Dimbleby, 1984) present in open country conditions (Evans, 1972). It is not apparent how the soil was affected by clearance previous to the formation of the moss cover.

3G Willerby Wold (TA 02761), North Yorkshire, superficial Deposits on Chalk (Plates 47 and 48). Cornwall (in Manby, 1963) described the buried soil on this site as an almost decalcified (pH 6.4) brown earth, with small root holes suggesting an herbaceous, pre-barrow, vegetation (see also Cornwall's unpublished notes). Cornwall's thin sections of the Neolithic buried A horizon, mound material and comparable modern unburied soils, were studied.

Firstly, the dumped mound material is useful because it contains both B horizon and A horizon fabrics (Plates 47 and 48). It is possible to differentiate the original B horizon fabric, pedogenic events relating the the mound construction and later (post-mound construction) environmental events on the site. It is clear that the sequence of very dusty clay coatings followed by highly birefringent fine clay infills, can be interpreted as: a)mechanical disturbance and slaking of the mound material, during and shortly after construction (Romans and Robertson, 1983 a and b), and (b) a later phase of woodland regeneration on the site (Slager and van der Wetering, 1977; Courty and Federoff, 1982).

In the mound the B horizon fine fabrics with a recticulate birefringent pattern, contain much fine organic matter, and a strange pattern of coarse inclusions, including bright reddish brown fragments. The latter previously described at Hazleton, may relate to an earlier (paleo-argillic?) pedogenic phase. The character of the mixed B horizon material suggests that its appearance does not relate to a dumping episode, but was an already disturbed soil - as in the tree-hollow at Hazleton - prior to mound building. The B horizon in fact, exhibits no limpid coatings, only infills of matrix material.

The buried A horizon can be described as containing highly humified organic matter (34 mgms Alk sol humus) and much charcoal (Cornwall unpub notes). The porosity pattern noted by Cornwall (in Manby, 1963), the character of the organic matter (Cornwall, unpub notes) and the presence of phytoliths, all suggest an herbaceous cover. However, this buried A horizon is somewhat heterogeneous, containing both Ah and probable "Eb" horizon fabrics.

From the above evidence a site history can be inferred. Woodland clearance (or tree-throw) gave rise to the mixed B horizon fabrics present in the mound and produced a rather heterogeneous A horizon containing charcoal. An herbaceous cover did develop on the site prior to mound construction, but this may have formed in a soil already moderately disturbed by cultivation. Cornwall (in Manby, 1963), because it would be expected that a rendzina would develop in this shallow soil over chalk, also suggests earthworms were not active and that the decalcified soil had been disturbed, probably by cultivation.

3H Windmill Hill (su 087715) Wiltshire, Chalk (Plates 49 and 50). Cornwall (unpub notes) describes this site as burying an A/C horizon developed on Chalk. The thin section is characterised by chalk and "fossil shell" and mollusc fragments. The fine fabric is almost totally calcitic. Infills are quite dusty, with fine opaque inclusions organic mater and charred materials. Fragments of bone (?) are also present. These analyses suggest truncation of the Neolithic rendzina, one suggestion being turf stripping before mound construction (Evans, 1972). Anthropogenic activity mixed the calcareous soil with fine charred organic matter - perhaps indicating some cultivation under open woodland conditions (Evans, 1972; Dimbleby and Evans, 1974).

List of Plates: Captions

Plate 1. Profile 1: soil pit in buried soil, showing pale 1st turf, the iron and manganese pan on the old ground surface, and the variations in soil depth over the rubbly limestone parent material.

2. Photomicrograph: Profile 1, Sa.1. iron and manganese replacement of organic matter at the surface of the 1st turf. Plane Polarised Light (PPL), frame length 5.225 mm.

3. As 2; Oblique Incident Light (OIL).

4. Detail of 2; pseudomorphic root replacement by iron hydroxide. Half Crossed Polarised Light (XPL) frame length 1.348mm.

5 Photomicrograph: Profile 1, Sa.2. "turf line" of old ground surface; strong pseudomorphic replacement of organic matter by iron hydroxide and just below, by manganese. OIL, frame lengh 5.225 mm.

6 Photomicrograph: Profile 1, Sa.1 1st turf, very fine sand-size and silt-size quartz set in a shrink and swell birefringent very dusty clay fine fabric; thin very dusty clay void coatings. PPL, frame length 1.348.

7 As 6, XPL.

8 Profile 2: "tree-throw" hollow; "Marly" upthrow to left; soil infill material is mainly decalcified down to 30-40cms; a weak iron and manganese pan can be noted.

9 Photomicrograph, Profile 2: Sa 4B; upthrow area, note mixed areas of highly birefringent oolitic limestone material; limpid, red Beta-B clay; and decalcified silty clay mineral soil. PPL, frame length 5.225.

10. Photomicrograph, Profile 2 Sa4a, upper soil; typical birefringent fine fabric with common very dusty clay void coatings. PPL, frame length 5.225 mm.

12. As 11, XPL.

13. Photomicrograph, Profile 2, Sa4a, uppersoil; diffuse ferro-manganiferrous impregnation of fine fabric. OIL, frame length 5.225 mm.

14. Photomicrograph, Profile 2, Sa5, subsoil hollow; mixture of ferruginous, red Beta-B clay; and yellowish brown (and silty) material, containing more organic matter and less iron; the latter fabric relating to Holocene A1, Eb and Bt horizon formation. PPL, frame length 1.348 mm.

15. As 14, XPL.

16. Photomicrograph, Profile 2, Sa5, subsoil hollow; fine fabric differences, sequential infills of various fine materials and intercalations are all evidence of within-soil mass-movement. PPL, frame length 1.348 mm.

17. As 16, XPL.

18. Profile 3: area of deep ("hollow") buried soil; note coarse root channel (right of top of scale).

19. Neolithic buried soil; label marks dark soil area examined in Sample 15.

20. Photomicrograph: Sample 15; relic faunal burrow; few fine charcoal present in this edge of "midden" area; manganese staining present. PPL, frame length 5.225 mm.

21. Neolithic buried soil: centre of "midden" area examined in Sample 16; note presence of iron and manganese pans, and large quantities of charred materials worked into the soil.

22. Photomicrograph: Sample 16; detail of dark soil fabric, a piece of included charred hazel nut shell, and extremely dusty, low birefringent (see XPL) void clay coatings. PPL, frame length 1.348 mm.

23. As 22, XPL.

24. Photomicrograph: Sample 16; relic porosity with dusty clay coatings. PPL, frame length S.225 mm.

25. As 24, XPL.

26. Neolithic soil buried by cairn wall collapse, samples 18 and 19.

27. North quarry fill: included "turf" (No 55) examined in Sample 14.

28. Photomicrograph: Sample 14; birefringent fine fabric with very dusty clay void coatings. PPL, frame length 1.348 mm.

29. As 28, XPL.

30. Profile 4: present day colluvial brown calcareous soil over Marly dry valley deposits.

31. Photomicrograph: Profile 4; Sample 10; recently arable Ap horizon with low birefringent faunally worked fine fabric, with common calcitic fragments. XPL, frame length 5.225 mm.

32. Photomicrograph: Profile 4; Sample 13; colluvial B2 horizon with moderately birefringent fine fabric, common rounded (transported) nodules, diffuse ferro-manganiferrous impregnations; "red soil" inclusions, and thin dusty clay void coatings. PPL, frame length 5.225 mm.

33. As 32, XPL.

34. Photomicrograph: Ascott-under-Wychwood; buried soil; generally low birefringent, faunally worked, fine sandy loam soil. PPL, frame length 5.225 mm.

35. As 34, XPL.

36. Photomicrograph: Fussels Lodge (Farm); buried A horizon; high biological activity in humic rendzina containing chalk fragments. PPL, frame length 5.225 mm.

37. Photomicrograph: Kilham; buried "Bt" horizon; large quantities of translocated dusty clay producing birefringenet coatings on porosity including relic root channels. XPL, frame length 5.225 mm.

38. As 37; detail of very dusty void coating. PPL, frame length 1.348 mm.

39. As 38, XPL.

40. Photomicrograph: Lanhill; mound material; low birefringent A horizon soil containing many plant fragments - some ferruginised. PPL, frame length 5.225.

41. As 40, XPL.

42. As 40; buried soil; fine sand and silt set in very ferruginous clay matrix, minor wetting and drying birefringence; moderately heterogenous. PPL, frame length 1.348 mm.

43. As 42, XPL.

44. Photomicrograph: Nutbane; buried soil; well developed probable earthworm "excremental" fabric with generally low birefringence and earlier pedofeatures worked into matrix. PPL, frame length 5.225.

45. As 44, XPL.

46. Photomicrograph: Silbury Hill; buried soil; perfectly preserved "moss" sward on silty A horizon; very dense "lamina" fabric due to compression. PPL, frame length 5.225.

47. Photomocrograph: Willerby Wold; mound material; comprises both dark brownish, humic, low birefringent and loamy A horizon material; and fragments of yellow brown, moderately birefringent clay Bt horizon material. PPL, frame length 5.225 mm.

48. As 47, XPL.

49. Photomicrograph: Windmill Hill; buried A/C horizon; strongly calcitic and birefringent brown fine fabric, with abundant chalky fragments and fossils of parent material origin; mollusc fragments and mixed in dusty mineral soil and fine charcoal. PPL, frame length 1.348 mm.

50. As 49, XPL.