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Soil Report on Balksbury Camp, Hampshire

R I Macphail 1985

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Introduction

During the summer of 1981 the Iron Age Camp at Balksbury, Andover, Hampshire was excavated by the Central Excavation Unit (Director, Ken Smith). The extensive site which had been partially excavated previously, occurred on the Chalk. Parent materials varied from shallow superficial deposits beneath ramparts on plateau areas, and deep soliflucted head (clay-with-flints) where the earthworks extended across the lower slopes.

Methods

Buried soils were examined from beneath the "Southern Rampart" on the upper plateau, and from beneath the rampart at the "North Gate". To put these buried Iron Age soils in context periglacial features were examined across the site. A typical "tree-hollow", and a sequence of deposits and soils in the "hollow-way" were also investigated.

Samples were analysed for grain size, pH, loss on ignition and organic carbon (Avery and Bascomb, 1974). Thin sections were also examined (Bullock, etal. in press) from these four contexts. In addition, A horizons buried by two phases of southern rampart construction were analysed for nutrients and cations (Peter Loveland, Rothamsted Experimental Station).

Results

The results are presented in the Appendices (tables 2, Description). The two unburied sequences at the "tree-hollow" and the "hollow-way" are described first as these give evidence of the environment both before and after Iron Age occupation.

Hollow-way. On the north side of the Chalk plateau a prehistoric hollow-way (plate 1) ran diagonally across the slope. Turf stripping prior to excavation had exposed the chalk parent material or shallow mineral soil across much of the site (eg Tree Hollow), except for the low ground towards the North Gate where deeper brown soils were present (see North Gate). An exception is the hollow-way which is infilled to a depth of approximately 60cms with mineral deposits. A section was examined to see how these deposits related to the archaeology. The deposits themselves because they were preserved in the "hollow-way" would also represent the oldest sediments on the site thus giving a clue to the pre-Iron Age pedogenesis at Balksbury.

Profile description, chemical analysis and micromorphological studies (Appendices 1, 2 and 3) show the hollow-way to be a stream-cut channel cut in the Chalk, presumably during the last Glacial period. The deposits themselves appear to be of Late Devensian origin - the soils developed in them only affected by Holocene pedogenesis (Bullock, pers comm).

Firstly, the chalk is a permeable medium and so such a channel could only be cut when the rock was affected by permafrost. The basal deposit (Bc horizon) is enigmatic, but appears to represent the deposition of aeolian silts and eroded soil fragments (Plate2 presumably of earlier Quaternary age) after wind sorting and transportation (Bullock, pers comm). Similar loose packed sediments of

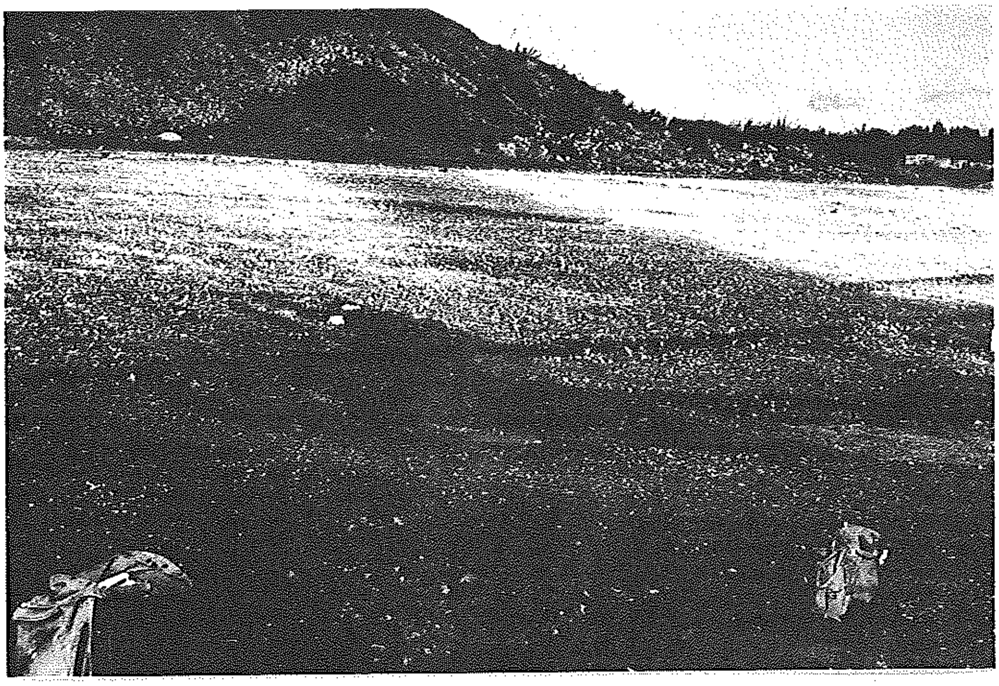

Plate 1 Field photograph: The 'hollow-way'.

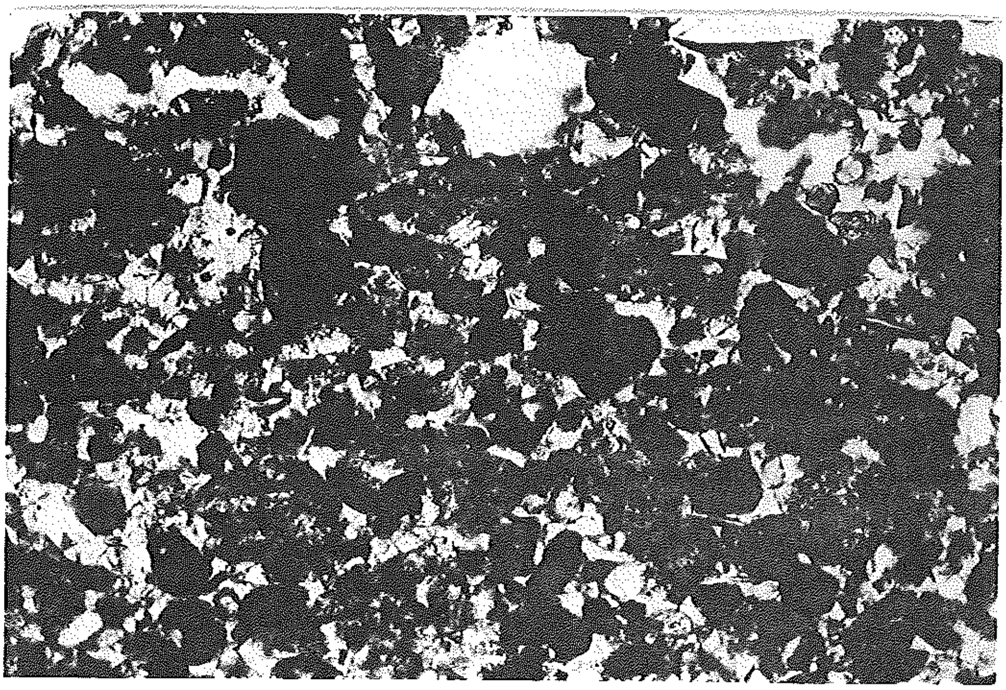

Plate 2. Photomicrograph: "Hollow-way", Bc horizon; loose fabric of silt-size quartz and very fine sand-size rounded soil-pellets, and later calcitic impregnation: Plane Polarised Light (PPL); length of frame is 1.328 mm.

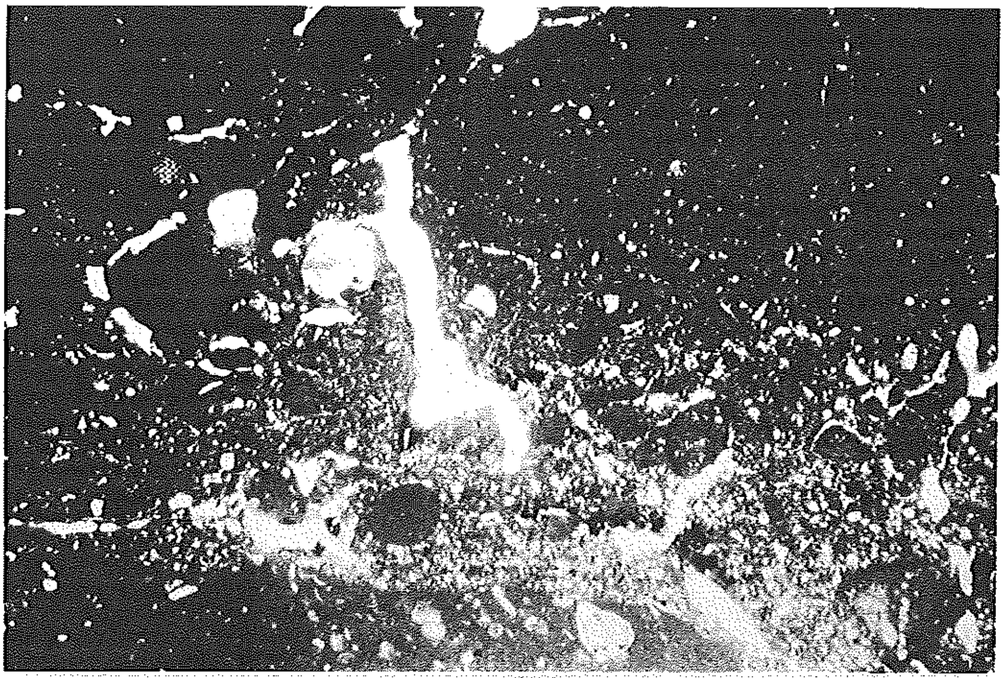

Plate 3.Photomicrograph:'Hollow-way',B/C horizon;Chalk gravel set in a matrix of finer Chalk fragments, soil pellets and soil; black ferro-manganiferrous staining ; dusty clay void coatings.PPL;length of frame is 5.225 mm.

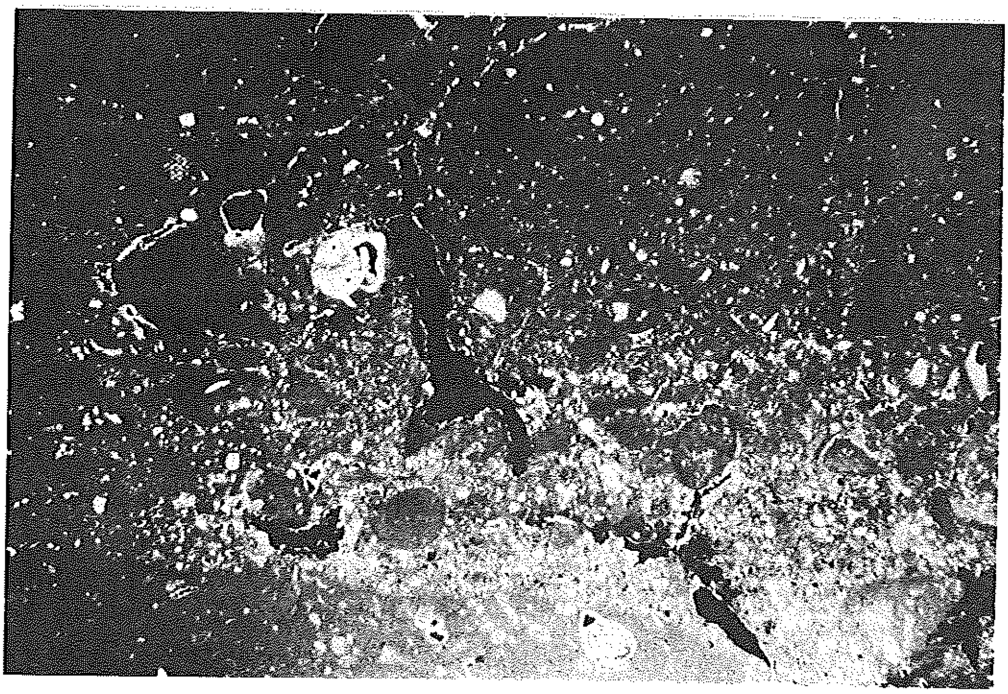

Plate 4 As above ;XPL.

rounded soil fragments were reported from Layer 13a of the Lower Breccia at Brean Down, Somerset (Cornwall, in Apsimon, 1961). A review of the thin section, and Cornwall's interpretation may also support a wind blown origin, although colluvial reworking is a possibility at Brean Down.

The next horizon (B/C) probably represents a high energy fluvial or soliflucted deposit, because of the pre-dominance of small stone-size chalk fragments (Plates 3 and 4). Finer chalk fragments, soil pellets (as in the Bc below) and fine mineral soil infill the voids. This horizon may be the source of the calcareous solutions affecting the Bc horizon.

The porosity in this B/C horizon has been influenced by calcareous impregnation, and also filtered-out clay, translocated from the overlying deposits. It is interesting that these clay coatings are very dusty.

The overlying horizons (0-44 cms) represent Holocene pedogenesis of an argillic brown earth (Avery 1981) in a silty clay deposit. The Eb horizon has been completely homogenised by biological activity (Plate 5), whereas the Btg 2 horizon exhibits relic parent material layering (Plate 6). The deposition of loessial deposits in southern England has been investigated by Catt (1978, 1979), and similar clay and silty layering has been noted by Avery, et al (1959). The experimental work of Mücher and De Ploey (1977) suggest this layering is not the result of colluvial deposition after water erosion of the loess. Rather, the clear clay and silt layers suggest possible sorting of a loessial deposit in "standing" water (something like a varve) or by stream flows of alternating (seasonal?) velocity (Bullock, pers comm).

The material has subsequently been affected by Holocene decalcifcation and lessivage, and minor hydromorphism. Textural coatings can be divided into a

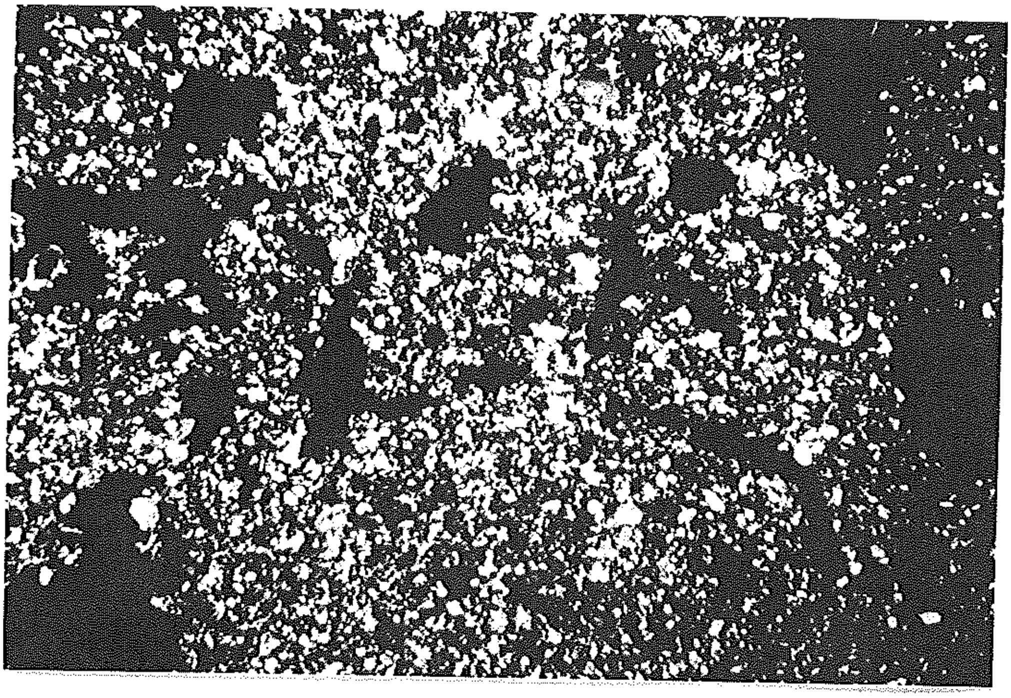

Plate 5. Photomicrograph:'Hollow-way',Eb horizon ;original loessial parent material biologically homogenised into an open fabric:XPL ; length of frame is 5.225 mm.

Plate 6. Photomicrograph: "Hollow-way", Btg2 horizon; layered "loess" (clay and silt bands). Crossed Polarised Light (XPL); length of frame is 5.225mm.

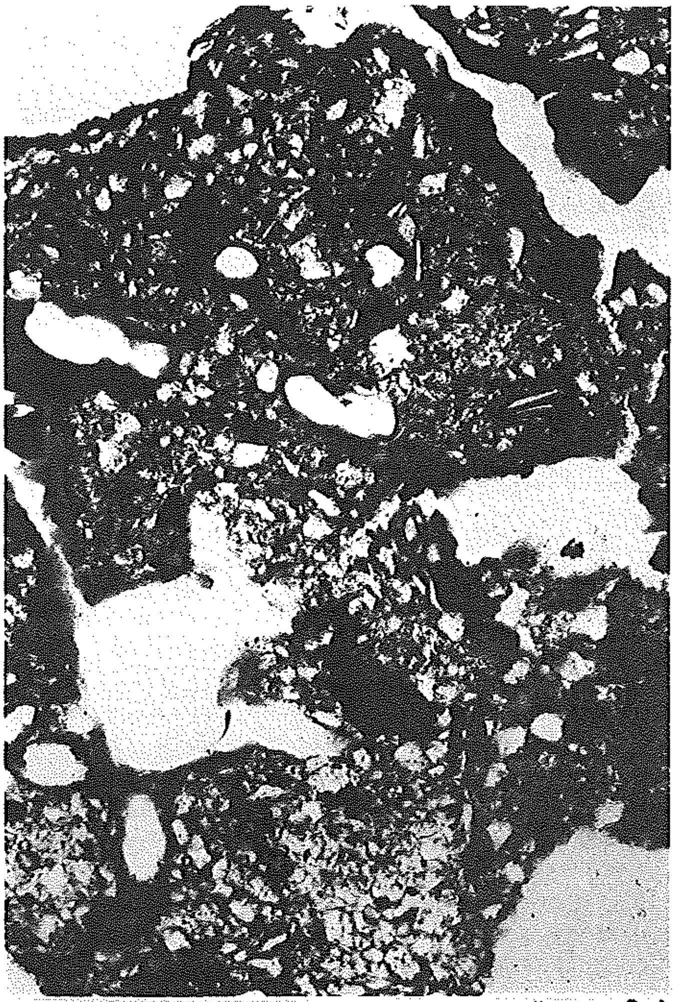

Plate 7. Photomicrograph: "Hollow-way", Btg2 horizon; argillic Bt fabric formed in loess (see Plate 8) showing limpid clay translocation succeeded by coarse dusty clay translocation. PPL; length of frame 1.348mm.

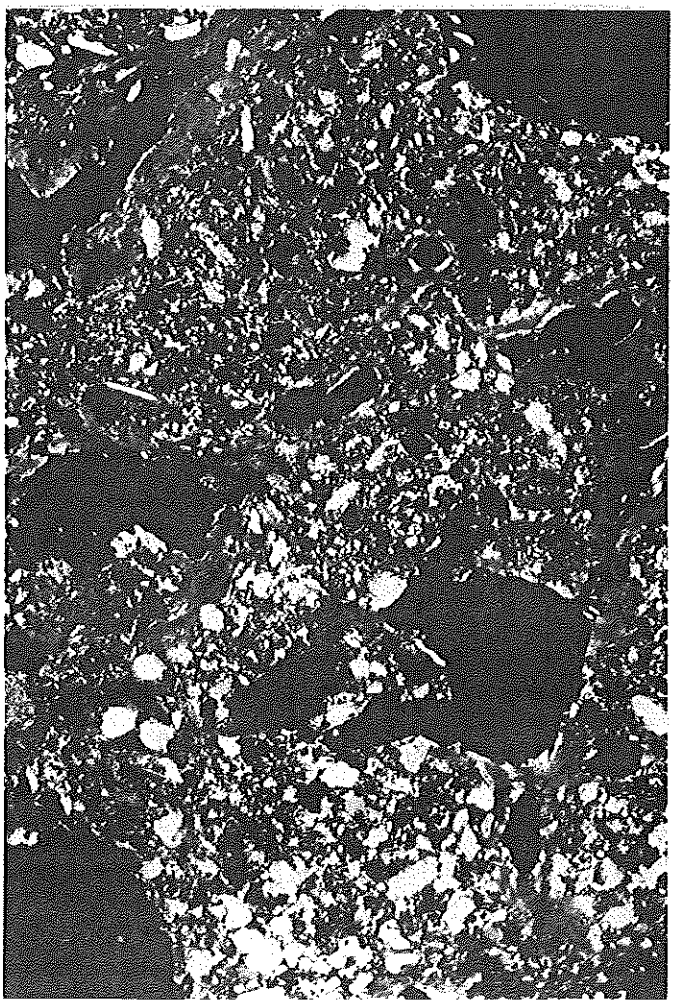

Plate 8. As above; XPL.

generally earlier phase of limpid clay, followed by later micro-laminated and dusty clay, types. Analyses of such coatings elsewhere (Scaife and Macphail, 1983; Romans and Robertson, 1983; Macphail, 1984; in press) infer a pedogenic history affected by clay translocation first under undisturbed forest, and later under conditions of woodland clearance, and other more intense anthropogenic disturbance, such as tillage. This succession of textural coatings, (Plates 7 and 8) which can be compared with those of a buried soil (North Gate) are believed to represent, at this depth, mainly features of the prehistoric history of the site - ie primary forest, clearance and tillage, whereas the very dusty coatings in the Eb horizon must relate to modern cultivation practices.

Tree Hollow where turf-stripping had cleared the shallow rendzinas from the site the Chalk substrate revealed a number of features. These were a) periglacial polygons and stripes of "soil" and also sand, and B) circular soil features, which can be described as asymetrical or banana shaped soil infills of hollows in the Chalk. Such features have been described elsewhere (Evans, 1972; Limbrey, 1975), and were interpreted as tree hollows. In the area under study these were very numerous.

The "tree hollow" examined (Plate 9) was approximately 2 metres across, one half comprising mainly a chalk subsoil, the other had a calcareous brown earth (Avery, 1981) make-up. The fill had two horizons of similar organic status and texture (Appendices 1, 2 and 3). The lower B2 horizon reveals that the original woodland on the site had produced probable shallow argillic brown earths, but tree-throw (Lutz and Griswold, 1939) mixed calcareous subsoil horizons with the decalcified upper soil. It is evident that the hollow filled in, in two distinct phases, and it is also clear that these two phases were seperated by many years. The first phase of hollow infill is represented by the B2 horizon, which is characterised by evidence of high biological activity (plate 10) - fauna presumably attracted by organic

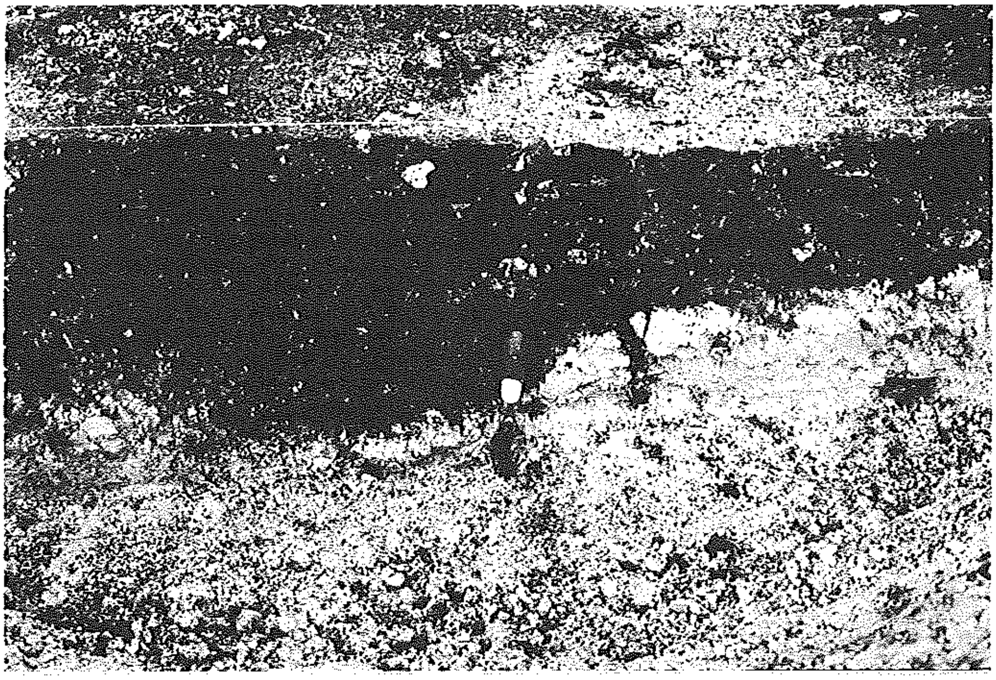

Plate 9. Field photograph: The "tree-hollow".

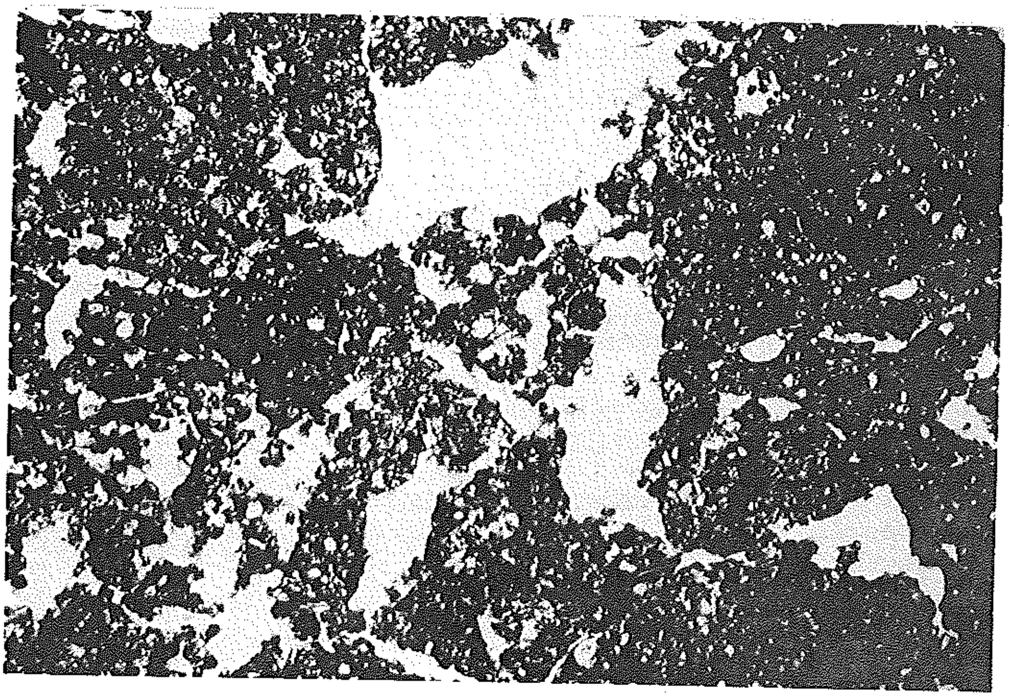

Plate 10. Photomicrograph:'Tree-hollow',B2 horizon ;biologically worked open fabric
PPL; length of frame is 5.225.mm.

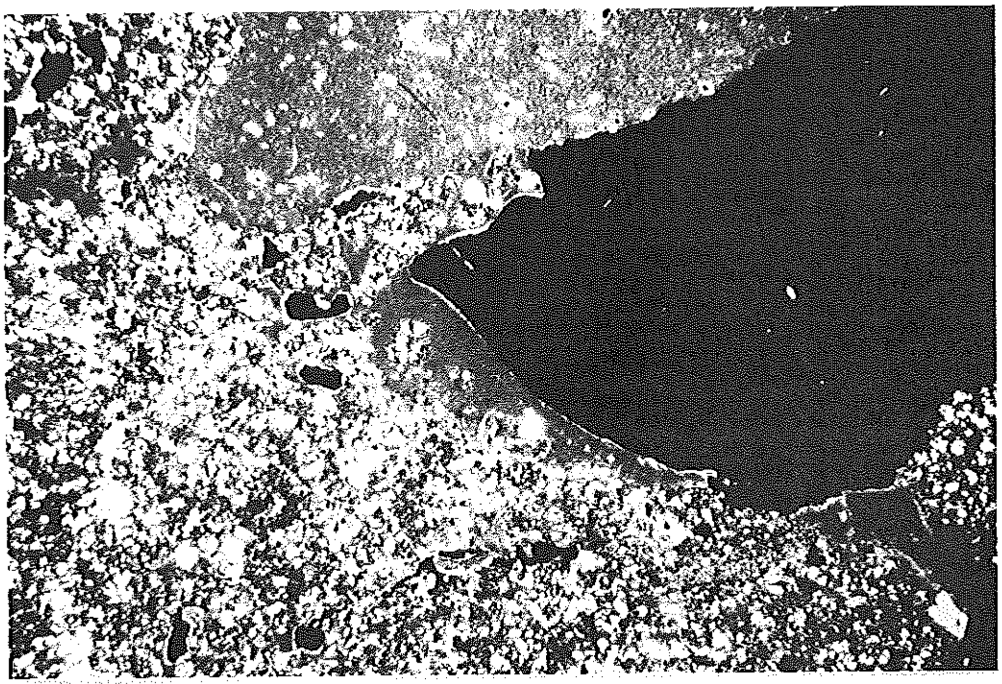

Plate 11. Photomicrograph:'Tree-hollow',B2 horizon;dusty calcitic void coatings adjacent to Chalk fragment:XPL;length of frame is 1.348 mm.

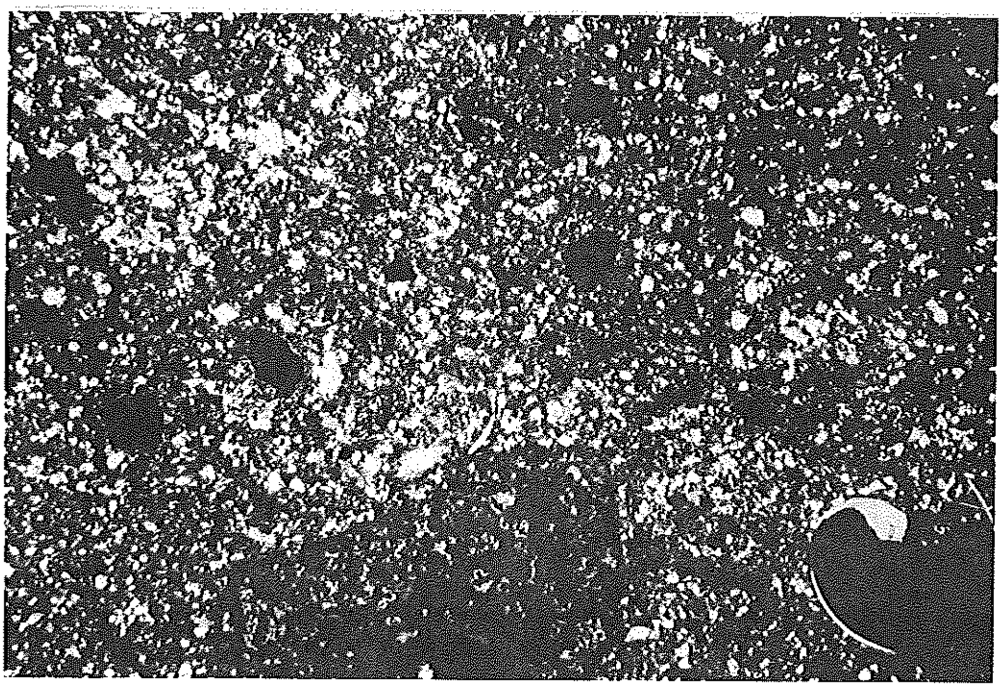

Plate 12. Photomicrograph: 'Tree-hollow', B1 horizon;dense colluvial soil with intercalations of fine material:PPL;length of frame is 5.225 mm.

matter accumulating in the hollow. This "faunal fabric" was then impregnated by calcitic material - helping to preserve its structure - and much void-space was infilled with dusty calcite or fine chalky dusty material (plate 11). The latter may derive from the surrounding calcareous soil brought in by solution, or relate to the washing-in of fine chalk mobilised by tillage "eroding - down" to the chalk substrate.

The second phase represented by the B1 horizon is a dense colluvial deposit little affected by biological activity (plate 12). It shows evidence of having a physically mixed fabric and possibly results from a ploughwash infill.

As tree-hollows elsewhere have been associated with an Atlantic Forest cover (Evans, 1971, 1972; Limbrey, 1975; Macphail, 1984) these features at Balksbury may be of similar date. Therefore the B2 horizon may be of early prehistoric date. It is therefore tempting to suggest that the later calcitic features and the B1 horizon may relate to the first period of major anthropogenic activity on the site - and thus be Iron Age.

<u>Southern Rampart</u> Soils were examined from beneath the primary and secondary banks (Plate 13; Appendices 1, 2 and 3), which are believed to vary in date by approximately 400 years (Ken Smith, pers. comm). Both banks bury moderately humic mull A1 horizons, but the later soil (59b) is several cms shallower. The parent materials at this section are superficial deposits over the chalk of i) weak light brown clay loam, overlain by ii) discontinuous layers of yellowish red silty clay loam, acting as, b B/C and bBt horizons respectively. It may be suggested that these horizons relate to soil formation in late Devensian deposits of wind transported soil pellets (in i) and loess (in ii), as described from the "Hollow-way".

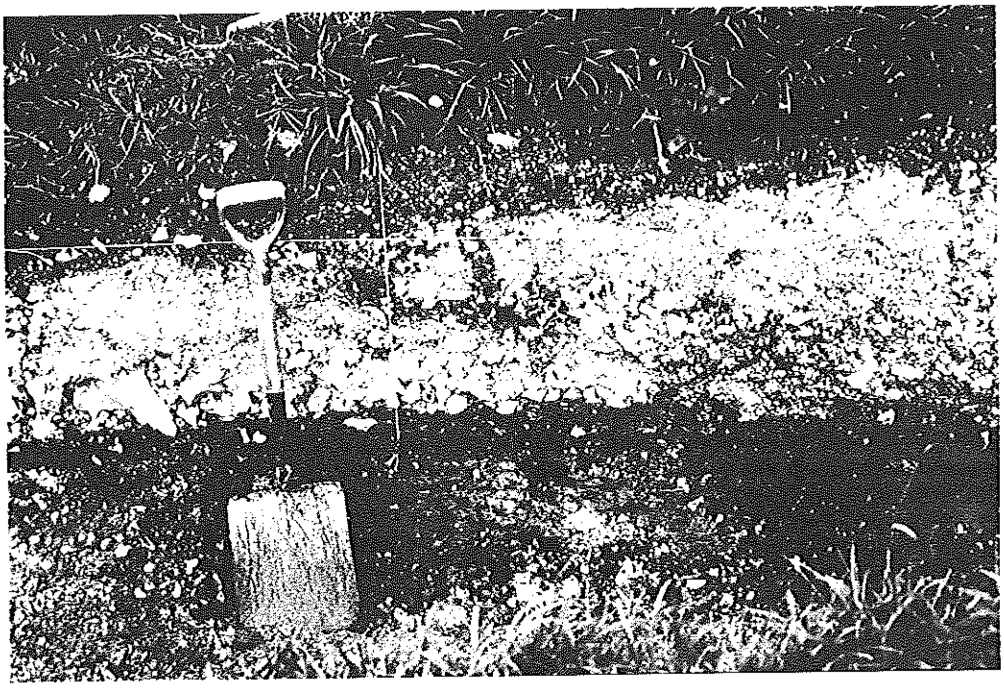

Plate 13. Field photograph: The Southern Rampart; phases 1 (left) and 2 (right).

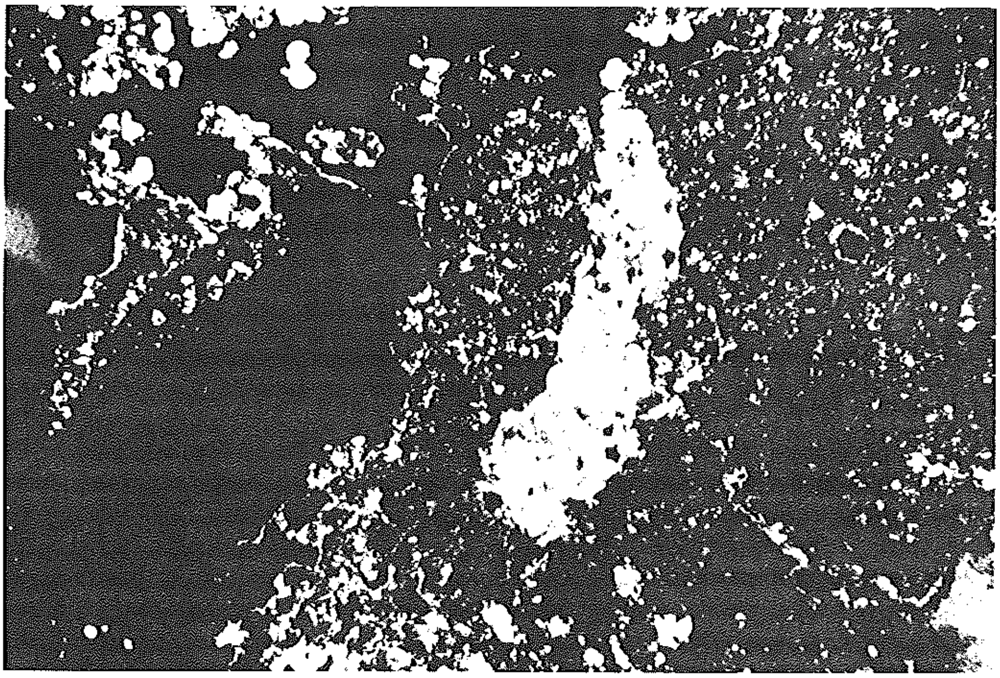

Plate 14. Photomicrograph: The southern rampart,bA horizon (59b); mull fabric charcoal and calcite crystals of probable earthworm origin . XPL;length of frame is 1.348 mm.

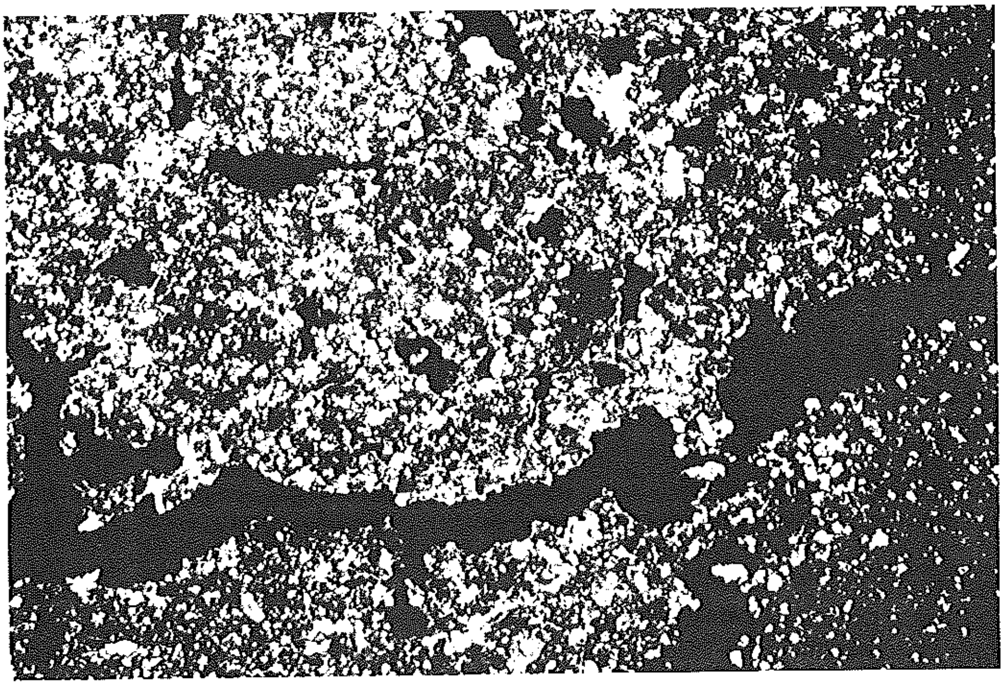

Plate 15. Photomicrograph: The Southern Rampart; bB(t) horizon; relic argillic fabric (reddish area in centre) worm-worked into matrix (note presence of in-pore calcite crystals of faunal origin - see below). XPL; length of frame 5.225mm.

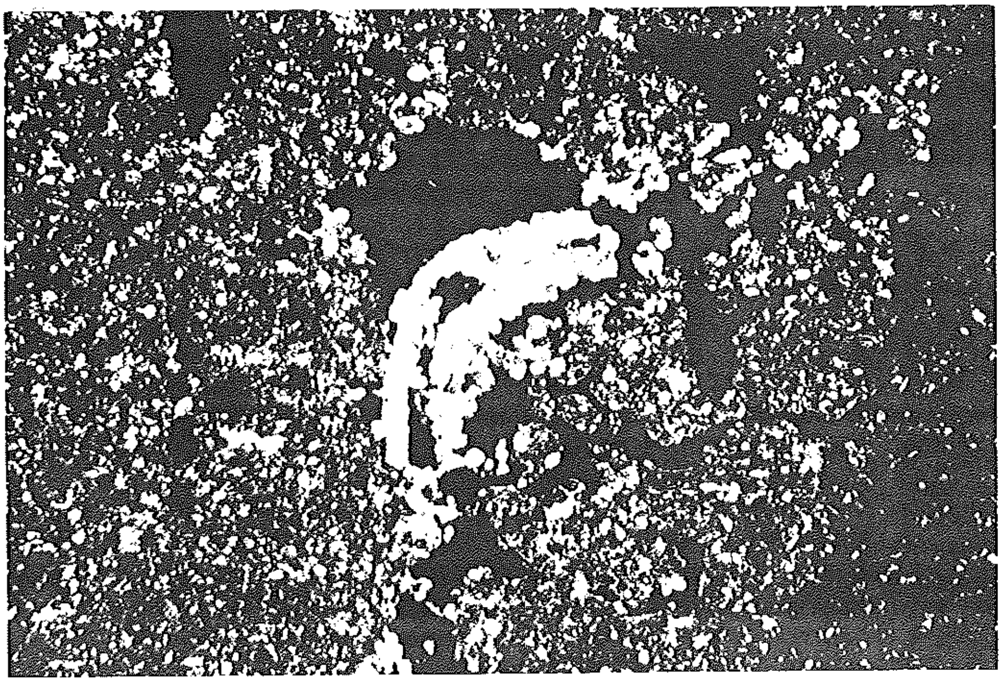

Plate 16. Photomicrograph: The Southern Rampart; bB(t) horizon; in-pore calcite crystals from

Both the nutrient chemistry (Appendix 2.2) and the micromorphology show the primary bank to bury a probably fully decalcified and moderately leached earthworm worked mull A1 horizon. The soil had also been affected by anthropogenic activity mixing-in fragments of pottery and much charcoal (charred material producing a rather high C:N; Macphail, 1984). The moderately high phosphate level may relate to anthropogenic activity. In contrast, the secondary Bank buries a very much more calcareous (see CEC) mull A1 horizon - suggesting significant reworking of calcareous material (plate 14), probably from the local Primary Bank, by earthworms. At first glance the buried Bt horizon appears as a earthworm worked Bw horizon. However, close inspection shows numerous relic areas of an argillic fabric (Plate 15), where earthworms (plate 16) have reworked the original void and channel coatings into the matrix. It is difficult to clearly interpret these earlier coatings, but they possibly relate to a history of i) <u>lessivage</u> under forest, and ii) later clay, and dusty clay translocation during anthropogenic usage of the site - possibly including cultivation. Because of the shallow nature of the horizons, and the lack of biological working of the subsoil, it may be inferred that some soil erosion took place under cultivation, and that the upper soil was converted into a Mull by earthworms during a grassland phase, before burial.

<u>Rampart by North Gate</u> Both profile description and organic matter analysis suggest erosion of the A horizon prior to burial - the soil having no humic A horizon as compared with the South Rampart. The deep argillic brown earth is developed on thick superficial deposits of clay-with-flints, which with increasing depth become more heavy textured and stoney, and less affected by Holocene pedogenesis. In this receiving site thicknesses of periglacially soliflucted Head may have been thickened by additions of reworked "loess" present in protected areas higher up the slope (eg Hollow-way) as identified in thin section (see Appendix 3.4).

As at the Hollow-way and South Rampart a pedogenic history of biological working of the primarily loessial parent material of the Btg2 horizon is accompanied by clay translocation. A primary phase of limpid/microlaminated clay coatings is succeeded by illuviation of more ferruginous clay containing higher quantities of micro-contrasted particles. This sequence may relate to Atlantic lessivage causing the soil to become less well drained as suggested from Pegwell Bay loess, in Kent (Weir, etal 1971). Alternatively, or partially, the later phase may relate to soil disturbance as a result of ploughing - allowing the washing in of matrix clay rather than clay purely from the eluviated Eb horizon. The latest suite of dusty clay and impure clay coatings undoubtedly relates to on-site tillage.

Discussion

Soil Cover The large area of Balksbury Camp contains a variety of soil types developed on superficial deposits and on the Chalk proper. The modern soils are mainly of the Andover (silty clay loam brown rendzinas) Association (Jarvis, etal, 1983; Clayden and Hollis, 1984) the patterned ground (periglacial features) being typical. Deeper pockets of soil in "tree hollow" features (plate 9) may be described as typical brown calcareous earths (Panholes series). The "hollow-way" (plate 1) preserves an area of mainly silty clay typical argillic brown earths (Charity 2 series), which as we have seen (beneath South Rampart; Plate 13) were probably more widespread in the Iron Age. The south Rampart itself buries a shallower silty clay loam version of the above soil (Charity 1 Series). Iron Age activities also produced a spread of colluvial brown calcareous earth (? Millington Series) against the North Rampart, although these may bury examples of the Batcombe Series (typical stagnogleyic paleo-argillic brown earths), developed on Clay-with - Flints Head. However, micromorphology shows that the fabric of the upper soil formed in silty clay loessial material is Holocene, an thus is non paleo-argillic.

Site History: (Table 1) Late Quaternary A probable clay-with-flints cover on the exhumed sub-Eocene surface (Hodgson, et al 1967) of the Chalk at Balksbury Camp was eroded into areas of low ground, possibly in the Late Devensian. Cryogenic activity leading to the solifluction of these deposits downslope, also produced patterned ground on the Chalk plateau, in areas now carrying soils of the Andover Association. During the periglacial regime surface water probably cut a channel into the frozen Chalk (Hollow-way). At this time there may have been very little superficial cover on the Chalk. However, a phase of soil erosion and wind sorting (aeolian activity) gave rise to the deposition of silt size quartz (loessial orgin) and very fine sand-size soil pellets into the new dry hollow-way and possibly also across much of the area. Microfabric analysis of these soil pellets (Plate 2) suggest they derive from a variety of horizons from earlier paleosols. Similar Late Quarternary fabrics have been noted from Brean Down, Somerset (see Results).

A further phase of possible solifluction produced a slurry of chalk gravel and soil to be deposited over the primary aeolian layer, although no major cryogenic mixing occurred.

The area was then affected by a loessial cover, typical of the Late Devensian (Avery, et al 1959; Hodgson, et al 1967; Catt, 1979). In the hollow-way persisting cold conditions allowed standing water or seasonal water alternations to produce silt and clay layers from re-worked loess (Plate 6).

Early Holocene Post Devensian climatic amelioration and vegetation development continued the trend of soil decalcification begun under the more cool but more efficient (in terms of more rapid decalcification) conditions of the Late Devensian (Macphail, in press b). There is no doubt that by the Atlantic period a forest cover occurred over decalcified and acid soils of varying depths (eg deep by the North Rampart, shallow at the "tree-hollows"). Early Flandrian lessivage (clay translocation) and minor hydromorphism on loess has been reported from Pegwell Bay, Kent (Weir, et al, 1971), and the microfabrics across the site suggest similar argillic brown earth (Avery, 1981) formation at Balksbury (Plates 7 and 8). The large number of tree-hollow features across the site may infer a dense forest cover on the Chalk at this time, which is supported by pollen evidence from southern England in general (Scaife, in press).

Forest clearance is not dated on the site. Indeed, the tree hollow (Plate 9) examined seems to have occurred through natural wind-throw, the hollow staying little infilled for some time - unlike for example the tree-hollow at Hazleton Long Cairn, Gloucestershire which was rapidly infilled (Macphail, 1984).

Iron Age Iron Age people inherited a generally decalcified soil cover (except for areas of tree-throw mixing) of argillic brown earths developed on superficial deposits which had become biologically mixed to some depth. However, Iron Age ramparts bury soils showing parent material layering relatively close to the surface. His infers Iron Age soil erosion. The presence of dusty clay coating sequences in the argillic fabrics and the presence of colluviums by the North Gate strongly suggest cultivation and resulting soil erosion on site. At the "tree-hollow" the rapid infill in the upper part probably relates to a primary ploughwash colluvium infilling it (possibly during the Iron Age).

However, although cultivation continued within the camp, as evidenced by the accumulations of colluvium up against the North Rampart, the South Rampart (Plate 13) actually buries a mull horizon probably relating to a grass vegetation developing on fully decalcified argillic brown earth which had been eroded by presumed Iron Age ploughing. The presence of a Chalk rampart (1st phase) accelerated earthworm reworking of the local soil (to be buried by the 2nd phase) destroying and recalcifying the Bt horizon (Plates 15 and 16). It is probable that Iron Age erosion at Balksbury contributed much to the reversal of the pedogenic trends of decalcification and acidification (also lessivage) of the early Holocene, to recalcification (formation of rendzinas and brown calcareous earths) now evident on limestone terrains in England (Macphail, in press b).

Table 1

Balksbury Camp, Hants: Summary of Environmental History from the Pedological Evidence

PERIOD	PHASE	SOIL	EVENT
Later	Cultivation/Pasture	Rendzinas, Brown Calcareous Earths, Colluvial Soils.	Erosion Recalcification
Prehistoric			
	Cultivation/(Pasture)	Argillic Brown Earths	Erosion/Dusty clay translocation
	(Clearance)	" "	Dusty clay translocation.
Early	Broad-leaved Forest	" "	Lessivage (fine clay translocation)
Holocene	" "	" "	Minor hydromorphism Acidifcation Decalcification
Late	Aeolian/Fluvial	Deposition of Loess	
Quaternary	?Solifluctin/Fluvial	" " Chalk Gravel.	
	Aeolian	" " Soil pellets.	
	Fluvial	Stream cut channel	
	Cryogenic/Solifluction	Patterned ground; ?Erosion of Clay-with-Flints.	

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Appendix 1.

Soil Profile Description: Balksbury Camp

Profile. Hollow-way (Plate 1)

Slope: 6°E   Relief: shallow depression (infilled) in

Chalk slope   Parent Material: superficial deposits over chalk.

Horizon, depth cms.

Truncated surface (turf and A horizon removed)

(A1) Yellowish red (5YR5/6) moderately
0-8 weak silty clay (Table 4); well developed medium blocky to prismatic structure; rare very small stones; rare fine roots; faint manganese staining; few fine clay skins; gradual, wavy boundary.

Btg Yellowish red and strong brown (5YR5/8 and 7.5YR5/6)
8-20 moderately weak silty clay with common large diffuse mottles; stones (as above) well developed coarse prisms; rootless; manganese staining; clay skins; gradual, irregular boundary.

Btg2 Yellowish red and strong brown (5YR5/6 and 7.5YR5/6)
20-44 moderately weak to weak silty clay with common large diffuse mottles; stones (as above) well developed coarse prisms; manganese staining; well developed clay skins; narrow, irregular boundary.

B/C Reddish yellow (7.5YR6/6) moderately weak to firm clay loam around,
44-47 abundant small stone-size chalk fragments and flint; poorly developed coarse blocky to prismatic structure; calcium carbonate efflorescence; narrow, smooth boundary.

Bc Strong brown (7.5YR5/6) weak clay loam; few stones (as above); poorly
49-59 developed prisms; minor calcium carbonate efflorescence; narrow, irregular boundary.

C2 Chalk
59+

Profile 2: "Tree Hollow" (plate 9)

Slope: 2° S.W. Relief: lower slope of chalk plateau Parent Material: superficial deposits on Chalk (soil preserved within tree Hollow). Truncated surface (mineral rendzina stripped from Chalk A horizon removed from deeper soil in hollow).

B1 Brown (7.5YR4/4) moderately
0-12 weak silty clay loam (Table 4); abundant small to large flints; very small flints also present; medium prisms; rootless; minor calcium carbonate efflorescence; gradual, wavy boundary.

B2 Strong brown (7.5YR4/6) very weak silty clay loam; many small flints;
12-39 medium prisms; minor calcium carbonate efforescence/ earthworm channels; clear wavy boundary.

B/C Light brown (7.5YR6/4) very weak clay loam; stones (as above), abundant
39-44 chalk fragments; very weak prisms; calcium carbonate efflorescence.

(Deepest soil development in the hollow).

Profile 3: Section 59 (through southern Rampart)(plate 13)

59a. Primary Bank

bA1 0-11(14)	Dark brown (7.5YR3/2) moderately weak silty clay loam (Table 4); many small stones and chalk fragments; fine to medium blocky; rare fine roots; minor calcium carbonate efforescence; common charcoal, pottery present; earthworms; abrupt, smooth boundary.
bBw 11(14)-21(27)	Discontinuous brown to light brown (7.5YR5/4-6/4) very weak silty clay loam; few small and large flints; medium blocky to prismatic structure; calcium carbonate efflorescence; earthworms present; broken, clear boundary.
B/C 14(27)-36+	Pink (7.5YR7/4) moderately weak silty clay loam; chalk fragments; weak prisms.

59b: Secondary bank

Unclear boundary between Chalk bank and buried soil.

bA1 8-10	Dark brown (7.5YR3/2) moderately weak silty clay loam; common fine flints and chalk fragments; medium blocky; rare fine roots; calcium carbonate efflorescence; charcoal present; abrupt, irregular boundary.
bBt 10-13(16)	Yellowish red (5YR4/6) very weak to weak silty clay loam; few small flints; fine prisms; earthworm channels with A1 material; gradual, wavy boundary.
bBw	Discontinuous brown to strong brown (7.5YR5/4-5/6) moderately weak

13(16)- silty clay loam; small stones (as above); medium prisms; some mixing
16)30 with bBt above; broken; irregular boundary.

bB/C Pink (7.5YR7/4) weak clay loam; chalk fragments; weak prisms; over
(16)30-40 chalk.

C
40+

Profile 4 (by North Gate)

Slope: 6°SE Relief: lower slope receiving site. Parent Material: Superficial deposits, Clay with Flints Head. ("Disturbed" boundary between chalk rampart and buried soil).

bA1/Eb Brown (7.5YR4/49 weak silty clay loam; abundant small to large flints;
0-16 medium subangular blocky to prismatic structure; rare fine roots; charcoal present; gradual, irregular boundary.

bEbg Strong brown and yellowish red (7.5YR4/6 and 5YR4/6) weak silty clay
16-33 loam; many coarse faint mottles; moderately flinty; medium to coarse prisms; charcoal present; few thin clay skins; gradual, irregular boundary.

bBtg Reddish brown to yellowish red (5YR4/4-4/6) weak silty clay loam with
22-33 mottles; (as above); moderately flinty; coarse prisms; common clay skins; gradual, irregular boundary.

bBtg2 Yellowish red (5YR4/6) moderately firm silty clay with mottles (as above); moderately flinty; well developed coarse prisms; well developed clay skins; manganese staining; gradual boundary to

Ctg "Clay-with-Flints" Head.
58+

Appendix 2

Table 2 Balksbury Analytical Chemistry

Hollow Way	pH	Lossonlgn	Org.C.	ovenwt.
Eb	8.1	2.20	0.20	0.9699
Btg	8.1	2.28	0.15	0.9749
Btg2	8.0	2.40	0.27	0.9747
B/C	8.5	2.51	0.46	0.9857
Bc	8.4	1.93	0.19	0.9818
Rampart by North Gate				
bAl/Eb	8.4	3.03	0.48	0.9883
bBtg	8.0	1.47	0.19	0.9875
bBtg2	8.0	2.09	0.22	0.9793
Southern Rampart 59a				
bA	8.3	2.96	0.78	0.9803
bB	-	1.10	0.29	0.9843
bB/C	-	2.96*	0.12	0.9895
Southern Rampart 59b				
bA	8.3	4.18*	0.79	0.9713
bB	8.2	3.14	0.39	0.9757
bB2	8.3	9.81*	0.24	0.9839

Tree Hollow

B1	8.3	9.12*	0.83	0.9763
B2	8.3	9.00*	0.71	0.9773
B/C	-	N/D		

* probably over-estimated because of calcium carbonate present

Table 3. Balksbury. Nutrient Chemistry.* (Rothamsted Exp. Station)

	Moisture	P	N	H+	Ca	Mg	K	Na	CEC	Sat.	C/N
59a bA	1.89	12.1	0.06	0	0.8	.05	.04	.02	0.9	97	13
59b bA	1.92	8.5	0.06	0	28.5	.03	.20	.10	29.1	100	13

Table 4. Balksbury Grain Size

	Clay	FZ	MZ	CZ	Z	FS	MS	CS	S	
Hollow way										
Eb	36	11	24	22	57	4	2	1	7	silty clay
Btg1	38	7	22	26	55	7	-	-	7	silty clay
Btg2	36	7	27	24	58	6	-	-	6	silty clay
B/C	32	19	15	11	45	14	5	4	23	clay loam
Bc	31	10	26	23	59	5	4	1	10	silty clay loam
Rampart 59b										
bA1	32	12	19	26	57	9	2	-	11	silty clay loam
bB1	33	6	20	31	57	9	1	-	10	silty clay laom
bB2	28	17	22	26	65	11	1	1	12	silty clay loam
59abB/C	23	18	18	15	51	19	3	4	26	clay loam

Tree Hollow

B1	30	13	20	26	59	6	3	2	11	silty clay loam
B2	30	11	20	28	59	8	3	2	13	silty clay loam

(with Table 3)

* NB. P: Ext. P. mg/L.

N: Total N. %

Exchangeable Cations: %

CEC: By addition m.e. /100gr

Sat.: Saturation, bases %

Appendix 3

Balksbury Camp Micromorphological Description

1. Hollow-way: Bc (Plate 2): 49-59cm (over Chalk)

Structure: massive to weak prisms; massive to vughy microstructure (dense fabric relates to "colluvial" origin, in part perforated by few voids): Porosity 10% very dominant medium to coarse, mainly rounded to subrounded, few elongate, mainly undulating to rough edged vughs (mainly faunal in origin, with localised impregnation of calcitic amorphous and crystaline material) Mineral; Coarse/Fine Limit 10um: Variable ratio: 70/30 (but 30/70 where heavy calcitic impregnation) Coarse: dominant medium silt-size (20-40um) subangular to subrounded quartz: common medium to coarse silt size (40-50um) and very fine sand size (60-70um) rounded soil pellets, comprising low birefringent reddish brown fine fabric and included silt - also various yellow brown and strong reddish brown pellets (well sorted silt-size material of probable aeolian origin, and soil pellets derived from A, B, strongly weathered B horizons); few small stone size calcareous soil (C horizon) fragments including fine to medium sand-size chalk; which also appear singularly; rare fine silt-size magnetite, silt-size "limonite". Also glauconite. Finea) Dominant pale brown, speckled; pale orange (RL), medium birefringence: b) common grey brown, speckled; grey (RL), high birefringence (see Groundmass) Organic: coarse; rare organic matter; very few charcoal fragments. Fine possible few organic matter in matrix and some soil pellets. Groundmass: porphyric; undifferentiated, crystallitic (calcitic fine fabric, and calcitic impregnation produce high birefringence. Pedofeatures: Textural: Some of the calcitic void infills contain mineral material also "washed" in Amorphous: few, fine ferro-manganiferous nodular impregnation; clear edge. Fabric: passage features; faunally rounded pores; faunally fragmented void boundaries -

?excrements? Excrements: as above. Crystalline very fine calcite in fine fabric matrix;: common dusty - impure calcareous void infills and fabric impregnation: common last phase "coarse" calcite crystal growth within void space.

Interpretation: Soil horizon comprises a loosely packed sorted sediment of possibly wind transported (sorted and rounded) very fine sand-size soil pellets and medium silt-size quartz (possibly of the same specific gravity). Undoubtedly this occurred under periglacial conditions. The soil was later faunally perforated, and impregnated by phases of calcareous material inwashing; and calcareous waters flushing through. The origin of the eroded material which make up the deposit are B horizons of brown soils (possibly also some A horizons as well), chalky C horizon material, and possible aeolian silts. The deposit therefore possibly represents a wind-blown sediment, of periglacial origin, in a periglacial stream-cut channel; affected by later calcification.

B/C: 44-47cms (Plates 3 and 4)

Structure: poorly developed blocky to prismatic with massive, and minor crack (vertical) microstructure. Porosity: 10%; dominant very coarse undulating to smooth-walled vughs; common very fine, very elongate, vertical channels/cracks, smooth walls (vertical cracking of deposits). Mineral: Coarse/Fine (as above) 80/20: Coarse: Common small stone size (6mm) chalk fragment, generally subangular; few stone size flint; common subrounded subangular; subangular medium to coarse silt-size quartz; few very fine sand size rounded soil pellets very few silt size opaques and glauconite. Fine a) dominant grey, speckled, grey (RL), high birefringence b) frequent pale brown, speckled, pale orange (RL), medium birefringence. Organic: Coarse not apparent: Fine; possible common charred, charcoal, organic matter in brown fabric and mineral void coatings. Groundmass: porphyric; undifferentiated, crystallitic (even ferruginous fine fabric exhibits calcitic impregnation). Pedofeatures: Textural: common fine (60um), very dusty clay void coatings, various birefringence (amorphous Fe/Mn and calcitic impregnation), some heavily obscured; various phases of translocation of dusty fine silty material; also very few limpid clay infills. (An approximate sequence of a) very dusty, moderately dusty/some limpid, c) very dusty and impure coatings. Also frequent calcitic (impure) coatings possible washed in). Amorphous: frequent, fine to medium ferro-manganiferous staining of matrix, and chalk fragments. Fabric Possible very few faunal passage pores. Crystalline. Common, very fine calcite in matrix - as above. Interpretation: A chalk gravel and coarse sand size chalk deposit, with a matrix of finer chalk fragments, rolled soil and very few fine quartz grains - all held by a calcitic fine fabric. The bulk possibly deposited as a high energy slurry of eroded chalk with a minor in-put of mineral soil material once in place, porosity possibly affected primarily by solution, and later by a variety of textural coatings and infills according to environmental events. Later phases of redeposition or washing of calcitic material, and gleying are visible. The latter impregnating the textural coatings, and even the chalk gravel with ferro-manganiferous nodular material.

Btg2: c. 36-40cm (Plates 6, 7 and 8)

Structure (prismatic); channel/vughy microstructure.

Porosity: variable 30% - 20% (according to biological perforation); common narrow (2-300 um), but elongate (1cm) vertical channels interconnecting coarse to very coarse vughs; common medium to coarse vughs; moderately smooth sided few fine vertical elongatate (3cms) cracks. Mineral: Heterogenous - Coarse/Fine a) 95/5 ("clean silt band") b) 5/95 ("clay band") c) 50/50 ("mixed areas") Coarse very few fine sand size quartz and flint, very dominant silt-size quartz (and opaques) very fine sand size soil fragments. Fine very dominant pale brown, orange (RL), moderate birefringence (variations in colour according to degree of impregnation by amorphous material - see below); Organic: possible fragments of charcoal;

Fine: very few OM Groundmass: porphyric; clay zones reticulate striated. Pedofeatures: Textural: many microlaminated void coatings, rare limpid; occassionally not oriented (?soil movement?) many impure clay infills; few matrix type: Fabric common horizontal silt and clay bands (loessial origin), biological and possible mild freeze-thaw churning of layers: to produce many intercalations etc. Amorphous: frequent impregnative diffuse and clear edge ferro-manganiferous nodules.

Interpretation: "loessial" clay and silt layers probably reworked by water locally. Later dominant biological disturbance alterred much of the layering to produce homogeneous zones, and intercalated zones with some relic clear horizontal layers remaining. Soil also affected by history of clay translocation, of both limpid and generally later micro-laminated and dusty clay material. Subsequently soil was affected by hydromorphism.

Al/Eb: 2-6cms (Plate 5)

Structure: medium blocky; vughy microstructure Porosity 30%; few very coarse vughs common medium vughs, mainly rough edged, few smooth, rounded and short elongate. Mineral Coarse/fine: 55/45. Coarse few small stone-size flint; frequent fine sand-size quartz and flint; very abundant silt-size quartz, mainly subangular to sub-rounded. Fine: very dominant dark brown, pale orange (RL), low birefringence. Organic. Coarse: common fine charcoal. Fine few fine organic fragments Groundmass porphyric, undifferentiated. Pedofeatures Textural rare dusty "matran" coatings. Crystalline: common impregnation of matrix by and coatings of calcium carbonate: Amorphous few ferro-manganiferous impregnations. Fabric: common faunal passage features, like total excremental fabric.

Interpretation Soil material as described from the Btg has been totally reworked by biological agencies. The presence of fine charcoal testify towards an anthropogenic impact on the soil. Rare dusty coatings indicate arable agriculture, although biological activity, especially faunal, has destroyed most evidence of this - even recent ploughing.

2. Tree Hollow: B2: 12-39cms (over Chalk) (Plates 10 and 11)

Structure: (prismatic) vughy microstructure. Porosity 30%, dominant very coarse to fine rough and smooth edge vughs (according to presence of coatings or faunal smoothing). Mineral: Coarse/Fine - heterogeneous; a) rare silty areas 80/20; b) few B/C areas 40/60; c) dominant 50/50 areas. Coarse: few medium sand size flint and chalk; common fine to very fine sand-size chalk in (a); very dominant silt-size quartz. sub-angular to sub-rounded. Fine a) very dominant brown, pale orange (RL), high birefringence; b) few brown, orange (RL), low birefringence Organic Coarse few charcoal and plant fragments: Fine common fine organic matter; frequent charcoal. Groundmass: prophyric, (a) undifferentialted crystallitic (calcitic fine; (b) fabric with reticulate striated. Pedofeatures Excrements strongly excremental fabric; possibly mineral excrements in voids. Textural rare dusty clay coatings (see below). Crystalline. common, grey thick (100-250um) infills and coatings of "chalk fines" with calcite edge to coatings: dominant calcitic impregnation of fabric, calcitic coatings and infills. (Possibly calcareous infills could be included in "textural" as these may relate to the washing-in of chalk fines). Amorphous: few very diffuse fine ferro-manganiferous nodules. Fabric: common passage features; common chalk subsoil fragments, frequent silty parent material and "Bt" fragments: intercalations of various materials (differing silt and clay content - see Btg of Hollow-way).

Interpretation: The micro-fabric is comprised of silty material, relic argillic (Bt) fabrics, chalky subsoil material (B/C) and dominant calcareous Bw horizon soil. It is apparent that within this deep soil of the tree hollow an argillic Bt formed on silts and clays (as in the hollow-way), but that tree-throw mixed all these components. These all became highly perforated by biological activity and calcareous subsoil material re-calcified the fabric. Subsequently, this B2 horizon was affected by the massive translocation of "chalk fines" possibly through tillage, or alternatively from the chalky subsoil surrounding the tree hollow.

B1: 0-12 cms (Plate 12)

Structure: (prismatic) vughy microstructure. Porosity: 15%; dominant medium smooth vughs; very few fine channels. Mineral Coarse/Fine, 50/50. Coarse; few very coarse flints; few fine quartz sand; very dominant silt-size quartz; sand size biogenic "calcite". Fine: brown, orange (RL), moderate birefringence. Organic: Coarse: few charcoal, plant fragments: Fine: frequent charcoal and common organic matter. Groundmass: porphyric, undifferentiated crystallitic. Pedofeatures: Crystalline: very dominant calcitic; very few "fine chalk" coatings impregnations. Fabric: intercalations of clay and silty fabrics, and rare areas of possible argillic material; few passage features. (Again mixing of various soil materials, but here much less obvious biological mixing of this very dense fabric) Amorphous: as B2.

Interpretation: Presumably tree throw mixing of the various parent materials and relic fabrics and other agencies have produced a far more homogenous soil than B2. The dense fabric suggest little faunal activity when compared with B2 which also in contrast contains washed in "fine chalk". It may be that this upper horizon has had a slightly different history. The evidence suggests it is a rapid infill possibly a ploughsoil colluvium, although this maybe difficult to reconcile with its protected position in the tree hollow.

3. Southern Rampart (59)

(59b) bBt 10-13(16)cms (Plates 15 and 16)

Structure: (prismatic). Vughy/channel microstructure. Porosity: 25%, common medium to coarse mainly rough edged vughs and frequent fine to medium moderately rough edge channels, few fine cracks. Mineral: C/F: 55/45. Coarse: very dominant silt size quartz; few very fine and fine sand size quartz and flint: pottery present few very fine biogenic calcite (from earthworm gut in pores).

Fine: a) dominant brown, pale orange (RL), low birefringence b) common reddish brown, orange (RL), medium birefringence ((b) refers to incorporated translocated clay). Organic Coarse very few organic, frequent charcoal. Fine organic; few charcoal. Groundmass: porphyric; a) undifferentiated b fabric b) weakly strial (reworked clay skins) - the whole rather "silasepic". Pedofeatures Textural: rare very dusty clay coatings; very abundant argillic fabric (see Fabric), probably comprising many laminated clay coatings and infills (only very few remain after biological reworking) some also possibly dusty: Crystalline: occassional biogenic calcite crystals - earthworm excrements in pores. Fabric: abundant passage features, and reworking of argillic fabric into matrix. Amorphous: many diffuse, medium ferro-manganiferous nodules. Excrements: see above. Interpretation. This horizon represents a Btg horizon-like that at the Hollow-way, but more homogenised - which has been faunally reworked. Clay translocation formed an argillic (Bt) horizon, but through faunal action this was reworked and clay coatings were mixed into the mattrix. The shrink and swell birefringence was also partially alterred. The soil was also affected by a possibly second phase of translocation of impure or mattrix material to form dirty coatings. As few coatings of any kind appear in voids containing earthworm calcite crystals, then it may be that this faunal activity is the last event and represents a recalcification of this soil.

59a bA; 0-11(14): (below Primary Bank)

Structure: (blocky) vughy microstructure. (Porosity: 15%; fine to medium moderately rough edge vughs. Mineral coarse as above; few very coarse chalk fragments; biogenic calcite as above. Fine a) very dominant dark brown, brownish orange (RL), moderate to high birefringence, b) very few reddish brown, orange (RL) moderate birefringence (relic Bt fabric). c) pale brown, pale orange (RL) moderately birefringence. Organic: Coarse: frequent organic matter, common charcoal. Fine common to dominant organic matter and charcoal. (Much coarse charcoal broken by shrink and swell and faunal working). Groundmass porphyric;

a) undifferiated crystallitic; b) as bB. Pedofeatures. Textural: few dusty clay and matrix coatings: (also relic argillic fabric fragments). Crystalline: many earthworm calcitic crystal infills or excrements: very abundant calcitic impregnation of matrix: occassional possible inwash of "fine chalk" Amorphous: many medium diffuse nodules. Fabric: juxtaposition of organic A and non-organic B horizon (and relic Bt) fabrics: Excrements: see above.

Interpretation: buried earthworm worked mull A1 horizon with some physically mixed B horizon soil. An anthropogenic origin is indicated by the very high charcoal content and the presence of pottery. It is possible that the soil underwent minor recalcification by the chalk bank - calcite entering pores in the pottery - and that some the earthworms activity post-dates burial (see bB). In wash of "fine chalk" may relate to bank construction. An organic A1 horizon was affected by anthropogenic activity which also led to the mixing of B horizon and chalk fragments into a decalcified soil.

59b; bA0-8(10): (below Secondary Rampart) (Plate 14)

Structure: (blocky) vughy microstructure. Porosity as 59a Mineral Coarse as 59a. Fine a) dominant dark brown, orange (RL) moderate to high birefringence. b) frequent greyish, very pale orange (RL), very high birefringence (the latter are chalky A/C material). c) very few as (c) 59a. Organic: Coarse as A in 59a. Fine a) as 59a b) frequent organic, and few charcoal. c) very few OM or charcoal. Groundmass: porphyric: a) weakly strial. Pedofeatures: Depletion possible "iron" movement from areas of (c) into (a).

Crystalline: very abundant calcitic impregnation; many pore infills of biogenic (earthworm) calcite. Amorphous: frequent diffuse f-m impregnation; especially around borders of (a) and (c). Fabric: abundant passage features: mixture of three soil materials - very dominant A, few B/Bt and few chalky A/C material:

physically mixed. Excrements, see above. Interpretation A soil similar to 59a, but additionally contains fragments of A/C and B/C chalk material (probably deriving from bank), from physical and faunal mixing. An originally decalcified Al horizon, became recalcified because of proximity of the primary chalk bank, further encouraging earthworm activity - probably leading to the reworking of the Bt horizon beneath (see above).

4. By North Gate: bBtg2: 33-58cm

Structure: (prismatic) vughy microstructure. Porosity 10%, dominant fine moderately rough, or lined vughs; few horizontal channel/cracks (filled with clean silt). Mineral C/F 55/45 (variable very silty areas (see Btg of Hollow-way versus clay enriched zones. Coarse very dominant coarse silt (very fine sand size) quartz, few fine sand, very few coarse flint. Fine brown, orange (RL), moderately birefringent. (Silty areas less dark) Organic very few fine fragments. Groundmass: porphyric; weakly strial. Pedofeatures: Textural abundant clay coatings: probable earlier phase of laminated: followed by probably shorter lived very dusty/impure clay coatings. Primary phase much higher birefringence. (Argillic features also worked into matrix). Amorphous abundant f-mn nodular impregnations: Clear edge nodular areas also present Fabric: parent material variations still persist-silty areas, silt in cracks? (see Btg Hollow-way). Argillic fabric worked into matrix (possible earlier soil phase).
Interpretation This subsoil sample, although still retaining some parent material features (ie layering of "silt and clay bands") is mainly been homogenised biological activity including faunal perforation. The most important features are textural. Two major types can be differentiated a) highly birefringent limpid or microlaminated clay coatings and b) a later phase of often poorly birefringent, very dusty to impure clay coatings. These later coarse grain coatings are also more ferruginous, but this may relate to

post-depositional adsorption of amorphous fe + mn, or the inclusion of micro-contrasted particles (possible fine nodules), which may relate to slaking of matrix soil (up-profile). The less ferruginous earlier coatings may have originated as translocated "eluviated" clay from an Eb horizon.

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Soil Report on Balksbury Camp, Hampshire

R I Macphail 1985

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R I Macphail 1985

Introduction

During the summer of 1981 the Iron Age Camp at Balksbury, Andover, Hampshire was excavated by the Central Excavation Unit (Director, Ken Smith). The extensive site which had been partially excavated previously, occurred on the Chalk. Parent materials varied from shallow superficial deposits beneath ramparts on plateau areas, and deep soliflucted head (clay-with-flints) where the earthworks extended across the lower slopes.

Methods

Buried soils were examined from beneath the "Southern Rampart" on the upper plateau, and from beneath the rampart at the "North Gate". To put these buried Iron Age soils in context periglacial features were examined across the site. A typical "tree-hollow", and a sequence of deposits and soils in the "hollow-way" were also investigated.

Samples were analysed for grain size, pH, loss on ignition and organic carbon (Avery and Bascomb, 1974). Thin sections were also examined (Bullock, etal. in press) from these four contexts. In addition, A horizons buried by two phases of southern rampart construction were analysed for nutrients and cations (Peter Loveland, Rothamsted Experimental Station).