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SOIL REPORT ON THE UPPER PALAEOLITHIC AND EARLY MESOLTHIC SITES AND LATE GLACIAL AND FLANDRIAN SOIL FORMATION AT HENGISTBURY HEAD, DORSET.

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R I Macphail BSc MSc PhD
(contribution by R L Otlet and A J Walker, Low Level Measurements Laboratory, Harwell).

Summary

Late glacial and Holocene soils were examined through ten thin sections and the analysis of grain size, iron, aluminium, carbon and nitrogen. These studies, with two C14 assays of soil, were carried out to help establish the environmental conditions pertaining to, and taphonomically influencing the evidence of; Upper Palaeolithic and Early Mesolithic flint scatters and later prehistoric activities, especially in the Bronze Age and early Iron Age. The presence of intact freeze/ thaw microfabrics probably relating to conditions during the Late Devesian interstadial, undisturbed by the Zone III periglaciation encouraged the belief that the Upper Palaeolithic flints were similarly little disturbed, possibly because they were protected by locally blown sand. The Early Mesolithic flint scatter was also influenced by local aeolian activity including a deflationary phase(s). During the Flandrian a sequence of brown soil and argillic brown soil formation was succeeded by initial podzolisation of the Head under a coat of oak woodland (pollen evidence) during the Bronze Age, as dated by C14 assays of organic mattter in a podzol Mor horizon buried by a Late Bronze Age/ Early Iron Age bank and from a cemented Bhs horizon of an unburied podzol (mean residence date). After bank construction, final clearance of the oak woodland allowed Calluna to permanently invade (pollen evidence) continuing the podzolisation of the Head. The study is supported by 19 colour plates.

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PART 1

1.1 Introduction The Upper Palaeolithic and Early Mesolithic sites at Hengistbury Head were excavated (Director,Dr Nick Barton) in 1981-84 by a team organised from the Donald Baden-Powell Quaternary Research Centre, University of Oxford (including the geologist Dr Simon Colcutt), and Bournemouth Corporation. Pedlogical studies were carried out in 1982,1983 and 1984 and reports were submitted in October 1982 (Macphail,1982,AMLR 3811) and July 1985. The latter, after discussions with Drs Barton and Colcutt, is presented here.

Materials and Methods

At Hengistbury Head parent materials include sediments of various textures of the Bracklesham Beds (Eocene) and Superficial deposits (gravels, sands and diamicts). For convenience, the Hengistbury study area is divided into the Eastern Depression (the Upper Palaeolithic site, Fig 000) where sediments have often been reworked from soliflucted head deposits, and Warren Hill (the Early Mesolithic site) to the west where probable blown sands occur over superficial gravels. The area was examined by an auger survey and at quarry, gully and cliff sections. Four soil profiles were studied. These are, in the Eastern Depression, Profile 1 (Plate 1) - the buried soil (and pollen profile) beneath a probable Late Bronze Age/Early Iron Age bank; Profile 2 (Plate 6) - the Mace/Campbell Upper Palaeolithic site; and Profile 3 (Plate 7) - the best expressed well drained podzol on cryoturbated gravelly head to the west of the Eastern Depression (The Transverse Quarry); and on Warren Hill, Profile 4 (Plate 14) - the Powell Mesolithic site.

Soils were described (Hodgson, 1974) and selectively sampled (Figure 2) for micromorphology and the analyses (Avery and Bascomb, 1974) of grain size, pH, organic carbon, iron, aluminium and nitrogen (C, Fe, Al and N data from Dr Peter Loveland, Soil Survey England and Wales, Rothamstead). Ten large (5cm x 6-13cm) thin sections prepared at the Institute National Agronomique, Grignon, France, were described according to Bullock, et al (1985), Murph y, et al (1985) and Courty et al (in press).

Part Two. Results and Discussion: The Eastern Depression

2.1 The Late Glacial. The Upper Palaeolithic (12,500 ± 1150 years bp) artefacts occur in the lower Ea and upper Bh horizons of the present day cover of (nodular) gley podzols (Appendix 1; Profile 2) developed in reworked Bracklesham Beds. The lowest deposits below the artefacts are mainly coarse (sandy loams, sands and gravels) and poorly sorted (Table 1, Sa 24), and when seen in gully and quarry sections show evidence of cryoturbation. In the upper metre of the soil, however, later mixing and Flandrian soil development has obscured such features if they ever existed. Also the soil itself is better sorted comprising mainly fine and medium sand (Table 1, Sa. 6, 7, 8,) and lacking significant gravel (cf. p.000). At depth the soil also includes includes patches of sandy loam associated with argillic (Avery, 1980) features (Appendix 2, Thin sections C and D).

Early soil fabrics were identified at the well drained southern end of the Transverse Quarry (Profile 3; Plate 14). These are specific periglacial features preserved where the base of the present day podzol meets the cryoturbated parent material. These features described in thin section (G) as silt and clay pans, caps and link cappings, are referred to elsewhere as "silt droplets and cappings" because of their mode of origin (Romans, et al 1966; Romans and Robertson, 1974 see thin section G). This silt and clay pan microfabric at a contemporary depth of 125 cm is very strong and continuous formed (Plates 10-13) and shows no sign of being disrupted by later periglacial activity (Romans, pers comm). A survey of this fabric type in alpine and upland soils across the British Isles has shown that fabrics dating to the Pre-Boreal (Zone IV, Flandrian Ia) occur at increasingly higher altitudes and decreasing depth, with distance from the Scandinavian ice sheet (Romans and Robertson, 1974). In addition, such fabric types of this date were only weakly and patchily formed in the southern periphery of the British Isles (eg. Brecon Beacons) because the cold climate at this time was modified by maritime influences (Romans, et al, 1980).

In short, the link cappings at Hengistbury Head are both too deep and too well formed to be Pre-Boreal in origin. Rather they seem to relate to the extreme dessication of the soil through freezing under a continental climate, spring ice melting of the surface causing abrupt slaking and translocation of unsorted fine soil into the bone-dry subsoil. As the soil water was rapidly absorbed into the dry soil the transported load was suddenly deposited to form very sharp edged (top) and strong pans and cappings. Thus, these freeze-thaw features probably pre-date the Upper Palaeolithic occupation, occuring early in the Late Devensian Interstadial (Zones Ia, Ib and II), or possibly earlier in the Devensian (Romans, pers comm).

The presence of these pans at the Transverse Quarry also shows that at this time the area was acting as an well-drained convex slope to Warren Hill, because these features do not form on low slope, poorly drained areas.

Romans and Robertson (1974) also suggest the general disruption or removal of these freeze-thaw fabrics by the effects of the intense cold conditions of Late Devensian Zone III. The preservation - intact - of these earlier freeze/thaw fabrics in the Transverse Quarry at Hengistbury Head indicate that these were protected by deep burial, mostly under successive soliflucted layers. This interpretation in part stems from the analysis of Late Devensian freeze-thaw fabrics in subsoils at Chysauster, Cornwall (Macphail, 1987, AMLR III/87). Here earlier strongly formed Late Devensian silt pans had been fragmented by periglacial activity in Zone III, and a weakly developed silt pan and massive fabric of Zone IV date superimposed upon them. Such findings compare well with those of Romans and Robertson (1974; Romans pers comm) for the British Isles as a whole.

As noted earlier the Upper Palaeolithic artefacts themselves occur in better sorted sediments (Table 1, Sa. 6,7,8) than those produced purely by solifluction (Table 1, Sa. 18). A continued accretion of the former deposits, probably by local aeolian activity (see SNC) during the Late Devensian Interstadial may have to be envisaged to bury them deeply enough to survive at least since Zone IV, until the development of the depression threatened them. Infact, the subsoil microfabric at the Mace/Campbell site (Profile 2; Plate 6) still shows relic continuous massive structure and silt and sand segregations (thin section D), but these are unfortunately not diagnostic of any particular Late Devensian period.

2.2 The Early Flandrian. The affects of Flandrian pedogenesis have also to be considered. For example, those moderately sorted sands associated with the Late Devensian period and Upper Palaeolithic occupation have also been influenced by soil formation later than the Pre-Boreal which would have been for instance responsible for the loss of any fine material, especially clay, from the upper soil. Early pedogenic effects active even in the Late Glacial were decalcification, weathering and biological homogenisation (Catt, 1979). In theory (Macphail, 1987 pp. 335-336), with warmer conditions and the eventual establishment of a forest cover (see Scaife this volume), well-drained and poor Eocene sediments rapidly weather (erdefication; Conacher and Dalrymple, 1977) to produce , at first a Bw horizon (Avery, 1980; see Warren Hill for further evidence). Under the effects of organic leachate from the forest canopy, fine clay mobilised in the upper soil is translocated down profile into the Bt horizon (Duchaufour, 1982; Fedoroff, 1982). Clay translocation, but of a more coarse and dusty type, also continues if the forest is disturbed by human activity (Scaife and Macphail, 1983; Macphail, 1986). Micromorphological evidence at Profiles 1(C) and 2(D) in the Eastern Depression and at the Transverse Quarry (Profile 4, J and K) shows that Bw horizon formation and clay - including dusty clay - translocation occurred in the early Holocene, forming an argillic brown sand soil with a Bt horizon (Plates 4 and 5). These findings compliment the pollen evidence (see Scaife this volume) of a post glacial deciduous forest which was extant until the later Flandrian.

Although water tables at this time were perhaps lower (see below) than at present, it is believed that the soils were not droughty because of the underlying loamy sands maintaining a perched water table, as now. The micromorphological evidence may also suggest rather poor root penetration into the subsoil when the soil was a brown sand. Thus the site has a long history of imperfect soil drainage to the present, which indicates that contemporary measurements of soil moisture for thermoluminescent dating on the site (see Plate 6) may accurately reflect past soil water conditions, although surface runoff has probably accelerated as the cliff encroached.

2.3 The Late Flandrian. There is ample field and micromorphological evidence of the progressive leaching and acidification (leading to podzolisation) of the soils of the Eastern Depression during this period. This is provided by the buried soil (Profile 1) beneath the Bank feature; by the present day soil (Profile 2) 20-25 metres downslope at the Upper Palaeolithic site, with which it is locally compared; and by the freely draining podzol at the Transverse Quarry (Profile 3). These profiles have already been used to describe early Flandrian soil formation from their relic microfabrics. Attempts to date later pedogenic and environmental events at Hengistbury Head rest on two c14 dates. One from the H(Oh) horizon from the buried soil (Profile 1), and one from the cemented Bhs horizon of a modern podzol (Profile 3).

At the Bank and Ditch feature, which runs North/South across the Head, more than 40 cms of overburden, comprising dumped soil derived from a gleyed podzol (similar to the buried soil and those now locally present), buries a gleyed podzol with a 2-3 cm thick H horizon. This buried Mor humus horizon, which was sampled for c14 dating, was well sealed by possible turves overlain by subsoil overburden, and was thus unlikely to be contaminated by more recent organic matter. We know from the pollen column (see Plate 1; Scaife AML Report) and from the microfabric analysis (Plates 2 and 3) that the buried soil formed under oak woodland and that the H horizon represents a mainly <u>vertical</u> accumulation of (coprolitic) Mor humus, little affected by biological activity, similar in some ways to a peat (thin section A). Moderate Ultra Violet light flourescence also indicates good preservation of pollen. Therefore, when interpreting the c14 date the Mor humus horizon accumulation was regarded first as a fossil deposit, and secondly <u>generally</u> free of residual or older organic matter (Guillet, 1982; Macphail 1987 pg. 360). Thus the date of 3350 $\pm$ 90 bp (1400 bc) (HAR - 6186) is interpreted as suggesting that the Bank and Ditch feature was constructed in Late Bronze Age/Early Iron Age times. Other evidence presented below tends to support this conjecture.

Scaife (Ancient Monuments Laboratory Report) suggests from his two pollen profiles (one from the buried soil, the other from a nearby shallow valley-head peat) that Bronze Age forest clearances accelerated peat formation in this headward sapping valley, an erosion process which was active until later coastal cliff recession reduced the catchment. Decrease of evapotranspiration after primary clearance not only may have encouraged peat formation, a phenomenon common to southern English mires through anthropogenic disturbance (Moore & Wilmott, 1976), but also raised the already high (see above) water table sufficiently to produce progressive surface erosion of the Eastern Depression. This mechanism may account for the present lack of Upper Palaeolithic finds east of the present site, along a zone close to the thalweg.

In addition to shallow peat formation, hydromorphism is reflected in the morphology of the podzols through the leaching of microfabrics and the deposition of (nodular) amorphous iron (Plates 4 and 5, Table 2, profiles 1 and 2). Pollen shows that woodland dominated by oak, regenerated and was extant up to the construction of the bank. Since the bank buries a typical gley podzol (profile 1) and is itself composed of dumped soil from such a podzol (nodular Bsg horizon material being present in the overburden) it indicates that podzolisation had occurred under an oak woodland cover, by the date suggested earlier. Similar instances of podzols formed under an oak cover, without a history of heath, can be cited from Woodhall Spa, Lincolnshire, by the Atlantic period (Valentine & Dalrymple, 1975), from Black Down, Dorset, by the Bronze Age (Dimbleby, in Thompson & Ashbee, 1957), from Caesar's Camp, Keston, Kent, by the Iron Age (Dimbleby, 1962) and from the New Forest, by the present (Dimbleby & Gill, 1954). The Mean Residence Time (MRT) date of 1,700 +/- 90 yrs bp (HAR-6185) obtained from a Bhs horizon at Hengistbury Head possibly indicates podzolisation by the later Bronze Age, in contrast to earlier dates similarly obtained from podzols influenced by Mesolithic (Scaife & Macphail, 1983) and Neolithic (Perrin et al, 1964) activities. Woodland regeneration at Hengistbury, however, would have been aided by a lack of droughtiness, of the type which affects many lowland heaths.

Oak woodland on poor parent materials produces an acid organic leachate which progressively acidifies soils, which at Hengistbury were already being leached of cations and clay whilst still argillic soils. Decreasing pH caused the disappearance of earthworms and irreversible soil acidification, further acidifying the oak woodland leachate and initiating the podzol process (Dimbleby, 1962). Clay is actively destroyed by acidity in the upper soil as organic chelates mobilise and translocate sesquioxides (Al and Fe) downprofile (de Coninck, 1980; Duchaufour, 1982; Mokma & Buurman, 1982). Organic matter is also translocated downprofile into the Bh horizon, eventually leading to the development of humic Ah, bleached Ea and dark brown Bh and Bs horizons typical of podzols.

We can compare the buried Late Bronze Age/Early Iron Age podzol formed under oak woodland, with the nearby present day podzol (profile 2). The former can be regarded as a well-sealed buried soil, even whilst it is likely that its subsoil has continued to be influenced by hydromorphic processes. In contrast, the latter, although now truncated and buried by bleached sand had however continued to develop under Calluna probably until the 20th century disturbances noted by Collcutt (pers comm).

Both gley podzols are severely leached (Table 2, Nos 1-13) but, because of hydromorphic effects, they have illuvial horizons only weakly enriched in organic carbon and sesquioxides. The large quantities of amorphous nodular iron seen in the soil profile and in thin section (D) are associated with concentrations of "residual non-podzolic" (Bascomb, 1968) dithionite extractable iron. Relic argillic features (C & D) have also been influenced by podzolic leaching and hydromorphic depletion (Plates 4 & 5). Both profiles contain quantities of iron in their Ah horizons (Table 2, Sa. 4, 5 & 6) which is linked to their original surface organic matter (Macphail, 1979; Mokma & Buurman, 1982). However, profile 1 beneath the bank contains significantly greater amounts of aluminium, which is presumably still mobile because of anaerobic burial (Scaife & Macphail, 1983). This is possibly as

a result of the oak woodland raw humus being richer in aluminium than that under *Calluna* Mor (as at profile 2) which has existed across the Headland since bank construction (Scaife, this volume). Other differences between the character of Mor humus developed under oak woodland and under *Calluna* were noted in thin section. Ah horizons developed under *Calluna* have very low levels of biological activity (Duchaufour, 1982) and this is reflected in both well-drained and wet buried Ah horizons from, for example, the Experimental Earthwork at Wareham, Dorset and West Heath, Sussex (Scaife & Macphail, 1983; Fisher & Macphail, 1985). At Hengistbury Head, the wet H and Ah horizons (Sa A and B) developed under oak woodland are moderately perforated by biopores (Plate 2), possibly because soil conditions under oak were less acid than under heath (Simmons & Tooley, 1981). This difference in pH is not clear at Hengistbury Head, although at the Iron Age Caesar's Camp, Keston in Kent, the buried podzol which formed under oak woodland (Dimbleby, 1962) has a generally higher pH and a possibly more biologically worked Ah horizon than the overlying podzol formed under *Calluna* on the rampart (Cornwall, 1958; Macphail, 1985).
Examination of the microfabric of the Hengistbury H and Ah horizons by Ultra Violet Light showed almost all the organic matter to be amorphous and although derived from coprogenic residues (as "mobile" organic matter) actual excrements are generally absent, hence it is an H layer rather than an F layer. The moderate fluorescence of the layer apparently relates to the presence of much residual pollen and whereas most were coated by organic precipitates some individuals, including oak (Plate 3) and the spore *Polipodium*, showed up clearly (Van Vliet *et al*, 1983). The age character of buried organic matter has been commonly described (Babel, 1975; Fisher & Macphail, 1985; Macphail, 1985), and shows that the biopores at Hengistbury were contemporary with the oak woodland.

As a comparison with the gley podzols formed in the centre of the Eastern Depression we can describe the well-drained, well developed humo-ferric podsol present on the western margins of the depression (profile 3). Here, strongly formed illuvial Bh and Bhs horizons (Table 2, Sa 15 and 16); thin sections E and F) have developed under a present cover of *Calluna*. This profile is a type P (or Plateau) humo-ferric podzol (Macphail, 1979; 1983a), the best expressed podzol at Hengistbury Head, formed by dominant vertical eluviation and illuviation. Thus, this profile was the best choice for a C14 assay of illuvial organic matter in Bh horizons as a means of dating the onset of podzolisation on the heath (Perrin *et al*, 1964; Guillet, 1982). In theory a Mean Residence Time (MRT) date (which differs from the "fossil" date obtained from profile 1) gained by C14 dating of a Bh horizon occurs as a result of a supposedly constant input of poorly biodegradable organic matter, especially under acidophilic heathland. Bh horizons formed beneath woodland, which tend to give rather younger dates in Righi and Guillet (1977) and De Coninck (1980), have shown that the oldest dates occur in cemented monomorphic fabrics. Thus, the Bhs horizon (thin section F; Plates 8 and 9) was selected for analysis although it in fact contained less organic matter than the overlying Bh horizon. For the analysis the organic matter was not chemically fractionated, and so the MRT date must be regarded as an average of all the organic components (Guillet, 1982).

The MRT date of 1,700 +/- 90 yrs bp (HAR-6185) was obtained from the Bhs horizon at profile 3. This date may be interpreted as suggesting that major podzolisation at Hengistbury Head began in the Late Bronze Age, about the same time as on many other heathlands in Southern Britain (Cornwall, 1958; Dimbleby, 1962; Macphail, 1987). For example, it can be compared with MRT dates of 3,770 yrs bp (Scaife & Macphail, 1983) and 1,580-2,800 yrs bp (Perrin et al, 1964) for Bh horizons at heathland sites associated with known Mesolithic and Neolithic woodland disturbances, respectively. At West Heath, Sussex, the MRT date was associated with the early appearance of Calluna (Scaife & Macphail, 1983) and it may be that at Hengistbury this 'short' date of 1,700 yrs bp may relate to Calluna coming in later, perhaps in the Late Bronze Age. Guillet (1982), for example, found in the Vosges (France), that a series of well developed podzols produced a correlation between the dates of the appearance of Calluna (established by palynology) and the age of organic matter in the Bh horizons of these profiles, thereby suggesting that the MRT 'apparent ages' are about half that of the establishment of heathlands responsible for the formation of podzols. This in turn may suggest that the construction of the bank and ditch feature at Hengistbury, which has an interpreted Late Bronze Age/Early Iron Age date, led to final woodland clearance and the establishment of Calluna heath and this continued the podzolisation already begun under the oak woodland cover, but produced a better developed and less biodegradable Bh horizon (Guillet, 1982). In terms of its archaeological significance, the bank and ditch feature at Hengistbury can probably be regarded as a land boundary, typical of the Bronze Age (Balaam et al, 1982).

More recently, surface disturbance of the heathland, probably due in part to 19th century ironstone quarrying and later gunnery practice in World War II, have caused shallow erosional features and shallow buried humic horizons which are unrelated to the prehistoric archaeology of the Headland (Macphail, 1982).

WARREN HILL

The parent material at profile 4, in which the Early Mesolithic artefacts occurs (in the Ea2 horizon), is less coarse (i.e. less medium sand) and better sorted than in the Eastern Depression. On Warren Hill these sands often occur over superficial gravels which themselves rest on Bracklesham Beds deposits. However, at the Mesolithic site the sands directly overlie the Tertiary series, and are dominated by very fine and fine sands (Table 1, Sa 21-23; thin sections I and J) suggesting these have a windblown origin, presumably relating at least in part to Late Glacial conditions (Catt, 1979). Although some fine material in the deeply underlying B(t)sg horizon (Table 1, Sa 24; thin section K; Plates 10 & 11) is illuvial, the pre-soil parent material may still only have contained little silt and clay. Such a wind sorted and deposited parent material was no doubt easily disturbed during the Mesolithic occupation (TL dated to 9,950+/-950 yrs bp), although the degree of soil development in a period ranging from the Pre-Boreal to the Boreal must be conjectural. Certainly the artefacts appear still to be in the upper part of the soil, mainly in the Ea2 horizon, although also occurring throughout the overlying 60 cm of Ea1 and Ah/Ea horizon material which can be rather more poorly sorted (Table 1 Sa 19-20; thin section H; Plates 15-16).

Flandrian_Soil_Formation

A soil history similar to that of the Eastern Depression can be described from Warren Hill, but in more detail because the subsoil levels at the Mesolithic site (profile 4) have been much less affected by podzolic and hydromorphic depletion. The present day soil is a humo-ferric podzol as demonstrated by soil ignition and other analyses (Table 2 Sa 19-24); thin sections H-K; Plate 17). In addition, its subsoil horizons show traits of an earlier brown soil origin (Plates 18, 19). Grain size (Table 1) and microfabric analyses (K) suggest that most of the clay that is present in the subsoil is argillic (Avery, 1980). It coats sand size skeletal grains including weathered glauconite. A possible sequence of a Bw microaggregate (erde) fabric, succeeded by primary limpid clay translocation and later dusty clay translocation can be recognised. This fabric, representing brown sand/brown argillic sand soil formation, has been preserved from podzolic leaching by depth (1 m) and also by later ferruginous cementation of the soil peds relic of this early brown soil phase.

Elsewhere, limpid clay followed by dusty clay illuviation has been tentatively associated with early Mesolithic woodland disturbance, for example at Selmeston, Sussex (Scaife & Macphail, 1983) and at High Rocks, Kent (Macphail et al, 1987). It is therefore a possibility that, by disturbing the early Flandrian forest, the Mesolithic occupation at Warren Hill produced the fabric types described above. Alternatively, these could relate to Late Bronze Age clearances identified in the pollen record (Scaife AML report and pers comm.).

At a number of Mesolithic sites in Southern England it has been conjectured that human interference on poor soils produced localised acidification and podzolisation, for example, at the Sussex sites of Iping Common (Keef et al, 1965) and West Heath (Scaife & Macphail, 1983). These cases may therefore suggest that at Hengistbury Head localised podzolisation may have occurred on poor, coarse substrates, such as blown sand, although at Warren Hill there is no positive data to suggest this. On the other hand evidence from the Eastern Depression clearly indicates a probable Bronze Age date for the general podzolisation of the Headland.

Soil and vegetational history at Hengistbury Head

Although well south of the Devensian ice sheet the superficial deposits and Bracklesham Beds sediments at Hengistbury Head were strongly affected by periglacial conditions, mixing original sedimentary layers and producing a number of cryoturbated features including involutions and ice wedges, typical of those seen over a wide area of South-East England (Catt, 1979). The soils in which the prehistoric artefacts occur were however further reworked during the Late Glacial, with a trend towards better sorting of the upper sediments. For example, the well-drained conditions on the eastern slopes of Warren Hill and the Mesolithic site allowed strongly formed and continuous clay and silt link cappings (silt droplet fabric; Romans et al, 1966; Romans & Robertson, 1974) to develop under freeze-thaw conditions during the Late Devensian Interstadial (Zones 1b, Ic and II). Layering of this fabric could also relate to regular successive solifluction episodes. Similar fabrics of this date, but often reworked by later Zone III and Flandrian pedogenesis have been noted across the British Isles (Romans & Robertson, 1974). The sands of the Upper Palaeolithic occupation are better sorted than the purely soliflucted material, probably by local wind sorting (Collcutt pers comm and this volume).

As the freeze-thaw microfabrics are so well preserved by later soil burial from reworking by the harsh conditions of Zone III it is possible that the artefacts deposited by Upper Palaeolithic man at a level only now exposed by the development of the Eastern Depression, were similarly buried and little disturbed.

The Early Mesolithic flints at Warren Hill occur in very well sorted sands containing over 50% very fine sand and indicate a probable windblown origin. Such a deposit could relate to aeolian activity under periglacial conditions (Catt, 1979) at this site possibly during Zone III/Zone IV. The broad dating of the Early Mesolithic artefacts suggests the site may have been occupied at any time within Pre-Boreal or Boreal times, when such windblown sediments were undergoing primary pedogenesis in the form of decalcification and weathering (Ball, 1975; Macphail, 1987), allowing raw mineral soils to develop into brown soils. Deep sub-soil horizons at the site below the present day podzol contain microfabric evidence of Bw and Bt horizon (Avery, 1980) formation of brown sands (Dalrymple, 1962; Conacher & Dalrymple, 1977) and argillic brown sands (Sol lessive; Fedoroff, 1982).

In addition, the concentration of flint artefacts in the Ea2 horizon, besides relating to a possible deflation surface (lag deposit), may have occurred through earthworm working while the soil was still brown, thus necessarily pre-dating acidification. Other examples of pre-podzol earthworm working can be cited from Mesolithic sites at Oakhanger, Hampshire (Dimbleby in Rankine & Rankine, 1960), West Heath, Sussex (Drewett, 1978) and the Neolithic site of Rackham, Sussex (Dimbleby & Bradley, 1975). At Hengistbury Head, then, perhaps the soil acidification which occurred under oak woodland was initiated by the known primary Bronze Age clearance.

In the eastern Depression we know that an oak woodland regenerated in an area being progressively eroded as a larger valley (now removed by coastal cliff recession) advanced headwards, upslope. It is possible the peat in this valley head may have formed during the Atlantic period (Scaife, this volume). Whilst it may have been encouraged by the wet climate, its development was no doubt accelerated by primary forest clearance in the Bronze Age which further raised the water table in this already imperfectly drained area. Surface water flow at this time may even have accelerated the erosion of this depression removing Upper Palaeolithic artefacts in the area upslope from the present site.

Continued poor drainage and increasing acidity under the oak woodland cover produced gley podzols in this same area.

Fig. XX

Dates kyr bp	Pollen Zones	Soils	Archaeology
Late Devensian	I a, b, c	Solifluction & Freeze-thaw soil formation	Upper Palaeolithic occupation
11.8			
	II	"Sedimentary" burial of Zone I/II surfaces	
11.0			
	III	?Blown sand deposition across headland	
10.0 Early Flandrian	IV	Primary soil formation	Mesolithic occupation
9.6			
	V	Brown sand & argillic b.s. soil formation under developing forest	
	VI		
	VII	?Forest clearance, increased surface soil wetness (East Depression). Peat initiation.	
	VIII	Progressive soil acidification --> Podsolisation under Oak woodland regeneration.	Neolithic/Bronze Age artefacts
		Final woodland clearance; creation of <u>Calluna</u> heath; podsolisation continues.	Late Bronze Age/ Early Iron Age Bank & ditch

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Table 1.

Hengistbury Head: Grain Size

Sample	Soil	Clay	FZ	MZ	CZ	Silt	VFS	FS	MS	CS	VCS
	Profile 1	2	6	20	50	2-50	100	200	500	1000	2000um
6	bEa	No data	-	-	-	--	17	33	31	2	0
7	bBhs	8	0	6	3	9	18	32	30	3	0
8	bB(t)sg	8	0	4	5	9	25	28	27	3	0
	Profile 3										
18	lower Bsx/Bx	16	2	7	3	12	1	28	20	4	1
	Profile 4										
19	Ah/Ea	No data	-	-	-	--	40	32	15	3	1
20	Ea1	No data	-	-	-	--	40	37	14	3	0
21	Ea2	No data	-	-	-	--	53	37	5	1	0
22	Bh	1	1	3	2	6	55	35	4	1	0
23	Bhs	No data	-	-	-	--	55	37	1	0	0
24	B(t)sg	8	1	3	2	6	47	37	2	0	0

Table 2.

<u>Hengistbury Head: Chemistry</u>

Sample No.		pH	Org C	C	Pyro Fe	Al	Dith Fe	N	TTS No.
	Profile 1								
1	Ah	4.4							
2	dump Bsg/Bhs	4.7							
3	dump Ah/H	4.6							
4	bH	4.7	5.35	2.0	0.19	0.56	0	0.23	A
5	bAh	4.7		0.1	0.01	0.14	0	0.03	B
6	bEa	4.7		0.1	0.00	0.02	0.0	-	
7	bB(hs)	4.8		0.5	0.01	0.11	0.03	-	
8	bB(t)sg	4.8		0.1	0.02	0.10	0.09	-	C
	Profile 2								
9	Ah	4.8		0.6	0.13	0.04	0.02	0.12	
10	Ea	4.6		0.0	0.01	0.0	0.00	-	
11	Bhs	4.4		0.2	0.16	0.10	0.04	-	
12	Bhsg	4.8		0.7	0.20	0.18	0.37	-	
13	B(t)sg	5.1		0.1	0.06	0.08	0.16	-	D
	Profile 3								
14	Ea2	4.5	0.27	0.0	0.06	0.01	0.52		
15	Bh	3.8	-	1.6	1.19	0.15	0.57		E
16	Bhs	4.1	-	1.2	0.78	0.15	0.53		F
17	upper Bsx/Bx	4.5	0.22						
18	lower Bsx/Bx	4.9	0.17						G
	Profile 4								
19	Ah/Ea	4.5	1.33						
20	Ea	4.6	0.05						H
21	Ea2	4.6	0.07						I
22	Bh	5.1	0.69						J
23	Bh	5.5	0.74						
24	Btsg	5.2	0.07						K

NB Pyro. : Pyrophosphate Extractable (Avery and Bascombe, 1974)
Dith. : Dithionite Extractable

Appendix 1.

Soil Profile Description (Hodgson, 1974): Hengistbury Head (Figure 1)

Profile 1: Bank and Ditch Section (Plate 1)

Slope: 6' South.
Relief: centre of low ground in the Eastern Depression c. 30m from present-day cliff; both receiving and shedding site.
Vegetation: "wet" *Callunetum*.
Parent Material: (mainly) fine and medium sands derived from the Eocene Beds (sands, clays and gravels), Tertiary.
Altitude: c.14m OD.
Soil Type: (buried) typical gley-podsol (Avery, 1981).

Horizon, depth cm

Bank

L.F.H. 5-0	Wet Mor horizon; shallow litter of *Calluna* leaves and flower heads; includes c.20% sand; many medium and abundant fine roots.
Ah 0-20	Black to dark reddish brown (5YR 2.5/1-3/2) moderately weak fine and medium (bleached) sand; coarse angular blocky; few small stones (flints); very humose; may medium and fine roots; clear, irregular boundary.
Ea 20-(24)	Discontinuous reddish brown (5YR 4/3) loose to weak structureless sand; few small flints; moderately humose; few fine roots; broken, irregular boundary.
Bhsg/Ah (mixed dump) 20(24)-43	Mixed; common black (5YR 2.5/1) coarse blocky, moderately weak, very humose Ah, associated with areas of common fine and medium roots; common very dark grey (5YR 3/1) weak, humose Bhs material, (possibly also stained Ea); few yellowish red (5yr 5/.6) moderately firm "Bsg" nodules somewhat leached; at the base Ah material is present, the junction with the OGS possibly being a layer of inverted turves; sharp smooth boundary.

Old Ground Surface

bH 43-44(46)	Dark reddish brown (5YR 3/3) weak Mor (5% sand); medium blocky, stone free; very humose ("peaty"); few fine roots; clear smooth boundary.
bAh 44(46)-56	Very dark grey (5YR 3/1) weak fine and medium sand; coarse blocky; few small flints; humose; very few fine roots; wavy boundary.
bEa Light 56-61	Reddish brown (5YR 5/3) loose to weak structureless fine and medium sand (Table 1) with reddish brown (5YR

5/3) humic stains; few stones; no roots; clear, irregular boundary.

bBhs 61-66(96)	Dark reddish grey (5YR 4/2) weak fine and medium loamy sand (Table 1); weakly massive; few small flints; moderately humose; clear very irregular (patches of "clayey" involutions?) boundary.
bB(t)sg 66(96)-106+	Pinkish grey (7.5YR 6/2) sand and reddish yellow (7.5YR 7/8) sandy loam (bulk analysis as loamy sand; Table 1); weak; reddish yellow areas moderately plastic; massive/ poorly developed medium prisms; clay coatings present; "inclusions" of common small to very large flints; few pores; common "old" medium roots with associated "washed in" humus.

<u>Profile 2: Palaeolithic Site, Thermoluminescence</u>

<u>Section</u>: Mace-Campbell (Plate 6).
<u>Slope</u>: 4' South.
<u>Relief</u>: low ground in Eastern Depression c.3-4 metres from present-day cliff; both receiving and shedding site.
<u>Vegetation</u>: "wet" <u>Callunetum</u>.
<u>Parent Material</u>: (as Profile 1)
<u>Altitude</u>: c.13m OD.
<u>Soil Type</u>: Typical (nodular) gley-podsol.

Horizon, depth cm

Superficial cover of <u>Calluna</u> turf and 8 cms of bleached blown and colluvial sand.

Ah 0-7	Dark reddish brown (5Yr 2.5/2) and reddish grey (5YR 5/2) weak sand; medium angular blocky; few small stones (flints); humose; common fine and very fine roots; clear, wavy boundary.
Ea 7-20	Reddish grey (5YR 5/2) very weak sand; structureless; few small flints; few fine roots; clear, wavy boundary.
Bhs 20-46(55)	Mainly dark reddish brown (5YR 3/2) with patches of black (5YR 2.5/1) moderately weak sand; massive; few small flints; (few strong brown Bsg nodules at 30 cm depth); few fine roots; generally, clear irregular boundary.
B(t)sg 46(55sg)-80	Pale brown (10YR6/3) and brownish yellow (10YR6/8) weak sand (also areas of sandy loam); massive with weakly prismatic structure; few small flints; possible clay coatings in areas of finer soil.

Profile 3: Old Quarries (southern end) (Quarry section) (Plate 1)

Slope: 2' North East.
Relief: gently sloping ground between Warren Hill and the Eastern Depression, c.30 metres from present cliff.
Vegetation: "dry" Callunetum.
Parent Material: Sands and gravels derived from the Eocene Beds.
Altitude: c.18m OD.
Soil Type: humo-ferric podsol.

Horizon, depth cm

L.F.H.	Highly rooted, black very humose; bleached sand.
Ah/Ea 0-51	Dark grey (5YR 4/1) and light reddish brown (5YR 6/3) very weak sand; weakly blocky to structureless; few small flints; moderately humose; many medium and fine roots; clear, irregular boundary.
Ea2 51-70	Reddish brown (5YR 5/4) moderately firm sand; structureless to massive; very few flints; low humus; rare medium roots; clear to sharp, irregular boundary.
Bh 70-74	Very dark grey (5YR 3/1) firm sand; massive; many small to large flints; few medium roots; very humose; clear, irregular boundary.
Bhs 74-97(105)	Dark reddish brown (5YR 3/3) very firm sand; massive; many small to large flints; rare roots; moderately humose; gradual, irregular boundary.
Bsx/Bx 97(105)-140	Strong brown (7.5YR 4/6) firm sandy loam (Table 1); massive; many small to large flints; rare roots; becoming more brown (7.5YR 5/4) with depth; dark red (2.5YR 3/6) iron pans isolating greyish zones - convolutions and lenses.
C 140+	Cryoturbated Pleistocene Head.

Profile 4: Mesolithic Site (Plate 14)

Slope: 5' South.
Relief: plateau edge area of Warren Hill, c.3 metres from present-day cliff; mainly shedding site.
Vegetation: "dry" Callunetum.
Parent Material: very fine and fine sands, derived from Eocene Beds.
Altitude: c.30m OD.
Soil Type: humo-ferric podsol.

Horizon, depth cm

30-40 cm of "recent" moderately humic "grey" blown sand, with few thin "turf" lines.

Ah & Ea 0-23(25)	Very dark grey (5YR 3/1) moderately weak very fine and fine sand (Table 1); generally structureless; few small and medium flints; moderately humic; rootless; gradual irregular boundary.
Ea1 23(25) -58	Mainly pinkish grey (5YR 7/2) with few very dark grey (5YR 3/1) and very few reddish brown (5YR 4/4) moderately weak sand (Table 1); structureless; stone-free in upper part, becoming moderately stoney with medium flints; very low humus; gradual,irregular boundary.
Ea2 58- 69(82)	Pinkish grey (5YR 7/2) loose very fine and fine sand (Table 1); stone-free, contains (50%) coarse very firm Bh mottles; broken, clear boundary.
Bh 69-82	Dark reddish brown (5YR 2.3/2) very firm sand (as Ea2); massive; very humose; clear, irregular boundary.
Bhs 82-102	Reddish grey (5YR 5/2) in upper part, and yellowish red (5YR 4/6) very firm sand; massive; stone-free; repeating thin Bh pans; gradual and clear,irregular boundary.
Btsg 102- 125+	Mainly light yellowish brown (10YR 6/4) moderately firm sand with strong brown (7.5YR 5/8) firm sandy loam (both bulked as loamy sand, Table 1), and pinkish grey (7.5YR 7/2) "clay" bands; massive/weakly developed medium prisms; possible old roots; clay coatings present in finer areas.

Appendix 2

No. Thin Section Description (Bullock, et al. 1985; Courty, et al. in press): Hengistbury Head

A. Profile 1. bH (43-44(46)); sample 43-45 cm (Plates 2, 3)

Structure: poor coarse angular blocky; very weakly platy, 'intergrain channel structure' of closely packed organic matter, the continuity of which is broken by numerous (biological) channels. Porosity: 15-20%, very dominant channels, dominantly vertical; dominant coarse meso-channels, frequent fine macro-channels; moderately serrate. Mineral: 15%; moderately sorted; coarse/fine, 95:5. Coarse: very dominant sub-angular and angular medium and fine sand-size quartz; frequent silt-size. Fine: very few very fine quartz and mica (set in organic matrix). Organic: 85%. Coarse: frequent very dark brown humified lignified (vertical) root tissue - anisotropic. Very few pale yellow, birefringent, probable anisotropic. Very few pale yellow, birefringent, probable parenchymatic tissue; rare charcoal. Fine: very dominant pale brown and brown, highly humified amphorous organic matter; mainly coprogenic origin - see below (also peaty dopplerite?); moderate flourescence. Few single, grouped probable fungal cells; also pollen present (flourescent illumination), probable oak pollen (ref. thin sections). Groundmass: open porphyric, undifferentiated b-fabric. Pedofeatures: Excrements, few aged dissagregating moderately thin probable Enchytraeidae and coallescing very thin probable Oribatid mites into coarse (meso) bodies. (identification from Babel, 1975; Bal, 1982). These occur in passage and channel features, and are organic and more dark brown than surrounding organic matter matrix. Also few aged (pale brown) excrements infilling "old passage" features. (More dark brown ones may derive from fauna perforating from dumped humus layers in bank - though no fresh droppings are present). Fabric: dominant mixing of pale brown and brown organic fabrics (probably by fauna); also common perforations - medium (meso) passage features (faunal channels). Depletion quartz grains leached of mineral coatings, i.e. they are 'bleached'.

Interpretation This H (or almost Oh; Avery, 1980) horizon consists very dominantly of highly humified (as shown by U V illumination), amphorpus organic matter with an exceedingly high pollen content (see also Scaife, this volume) and although including coprogenic remains is mainly amphorous because of "melting" through compression and wet conditions (Fisher and Macphail, 1985). It is infact rather peat-like. The material has been moderately biologically worked - being perforated by both faunal and root channels. It appears to be a wet copromor developed under oak woodland (Scaife, pers comm) allowing some biological activity. Rare excrements are present but the overall character is of an H horizon. The lack of charcoal in this horizon suggests little human interference on this specific site during the time of Mor development.

B. bAh (44(46)-56 cm); sample 45-50 cm

Structure: poor coarse angular blocky; areas of both (open) intergrain microaggregate and (dense) intergrain channel microstructure (biological channels). Porosity: 20-25% increasing with depth dominant complex packing voids; frequent (decreasing with depth) moderately serrate coarse meso-channels. Mineral: 40% C/F (as above) poorly sorted (see Table 1). Coarse: dominant fine and very fine sand-size, sub-angular and angular quartz; very few coarse and frequent silt-size quartz; rare flint. Fine: as bH. Organic: 60% (decreasing with depth). Coarse: rare root tissue (as above); rare charcoal. Fine: very dominant brown and dark brown (PPL), reddish brown (RL), anisotropic, highly humified amphorous organic matter: very few fungal remains. Grondmass mainly prophyric with increasing areas of enaulic (with depth) - quartz grains set in organic matrix which with depth becomes more open and quartz grains are separated by organic aggregates; undifferentiated b-fabric. Pedofeatures. Excrements: very few dissagregated very thin, probably of Enchytraeidae (Babel, 1975; Bal, 1982). Fabric: very few medium few fine meso-passage features (Faunal) generally; coarse (2cm) intrusions of H, but with dominant very fine quartz, contain frequent medium meso-passage features. Depletion: quartz grains are free of mineral coatings.

Interpretation The bAh horizon differs from the bH by containing increasing amounts of mineral material with depth. Faunal and root channels are also moderately well-developed. It is a typically leached Ah horizon but again biological levels are moderately high. quantities of fine charcoal increase with depth, suggesting an earlier human impact, which subsequently decreased.

C. bB(t)sg(66(96)-10+); sample 81-87 cm (Plates 4,5)

Structure: massive; massive grain structure. Porosity: (15%) dominant complex packing voids; few medium (meso) moderately serrate channels. Mineral: (very dominant) C:F 90:10. Coarse: poorly sorted; very dominant very fine, fine and medium sand (Table 1) size quartz. Few silt-size quartz; few flint, rare weathered glauconite grains generally sub-rounded to sub-angular. Fine: few brownish to very dark brown/black (see amorphous); pale brown to orange (RL) low birefringence to opaque. Organic: coarse; very few in situ lignified root remains;. fine very low quantities associated with amorphous coatings; rare charcoal. Groundmass: prophyric; ("silasepic"), mainly undifferentiated b-fabric. Pedofeatures, Textural: occasionally moderately "dusty" clay coatings; often latterly 'ferruginised' or degraded; clay coatings also around mineral grains; moderately birefringent. Depletion: common depleted areas (pale in field) thinner ferruginous/clay coatings - more open fabric. Amorphous: common coarse mottles (orange in field) of densely cemented mineral grains by dominantly ferruginous (very dark brown to black; orange in reflected light) amorphous material - also infilling void spaces - in places impregnating an earlier clay fabric. Fabric: 'silt' bands relating to parent material layers.

Interpretation The main fabric is that of a gleyed illuvial horizon of a podzol. Minor quantities of a clay fabric relate to the original fine character (including silts) of the parent material (Table 1) and textural pedofeatures formed by an earlier phase of clay translocation (lessivage). These clay coatings have suffered both degredation (chemical leachates) and 'ferruginisation' (by illuvial sesquioxides and also by hydromorphic iron), but appear to be moderately coarse grained or dusty, possibly suggesting that they were mainly translocated and deposited under a disturbed woodland. The process of clay translocation ceased as the profile continued to acidify and a Mor horizon developed under the continued oak woodland cover - with or without the affects of minor clearance - until the process of podzolisation became dominant. It is probable that the soil has always been wet but a post-burial rise in water-table (after woodland clearance - Scaife, pers comm) may account for the hydromorphic features affecting a previous 'argillic' horizon formed under possibly drier conditions. However, it is worth noting that only few channels were seen at this depth suggesting only moderate biological penetration.

Profile 2

D. B(t)sg (4-6(55)-8-t cm); sample 49-53

Structure: massive, massive grain structure; Porosity: (15-20%) dominant complex packing voids, few medium (meso) moderately serrate channels. Mineral: coarse, fine (85:15). Coarse and Fine: (as profile 1 B(t)sg). Dominant dark fine material. Organic: rare charcoal, fine organic material not obvious, ferruginised root pseudomorphs. Groundmass: porphyric, dominant undifferentiated b-fabric, minor 'silasepic'. Pedofeatures, Textural: occasional clay coatings - low birefringence, slightly dusty sometimes later phase of clay illuviation is ferruginous, degraded coatings also present. Depletion: (as Profile 1, B(t)sg). Amorphous: common impregnation of fine fabric by mainly amorphous ferruginous material, also complete amorphous infills of sesquioxidic/ferruginous material in voids, opaque and orange (RL), very weak birefringent fabrics of earlier clay fabrics present. Fabric: (as Profile 1, B(t)sg), Moderately cemented silt layers occasionally occur.

Interpretation: This horizon is closely comparable to the B(t)sg horizon of Profile 1; and is again a gleyed podzolic subsoil with a previous history of clay translocation which has been almost obliterated by later and still extant podzolisation and hydromorphism. It may be noted however that this horizon, downslope of Profile 1, has been more strongly affected by the deposition of hydromorphic iron. Silt layer separations may well be of periglacial freeze-thaw origin, but their character is not diagnostic of any particular conditions or period (see G).

Profile 3

E. Bh (70-74 cm); sample 70-74 cm

Structure: massive, varies from massive to bridged and coated grain microstructure. Porosity: (15%) complex packing voids. Mineral: C: F 80:20. Coarse: moderately to poorly sorted; dominant very fine, fine and medium sand-size quartz; very few coarse sand, frequent silt; very few flint; glauconite, opaques; feldspar present; rare mica. Fine: all as amorphous pedofeatures. Organic: root channels contain much fungal material, see amorphous pedofeatures; frequent very dark brown/blackish micro-aggregate (polymorphic), as clumps - very dark brown under RL. Groundmass: chito-gefuric, undifferentiated b-fabric. Pedofeatures, Textural: rare ferri-clay coatings. Amorphous: see organic matter - for dark polymorphic which relate in some part to movement of "Ah" polymorphic material via roots. Rest of coatings, which are very dominant are finely fractured, brownish, opaque; and blackish to dark golden brown (RL) - the dominance of the blackish organo-sesquioxidic amorphous features show this is a Bh horizon (Macphail 1983b). Few ferruginous infills (pan) and sesquioxidic impregnations are present, but the overall fabric is one of mainly brownish (PPL) weakly polymorphic infills and coatings, progressing to monomorphic.

Interpretation: This is a typical Bh horizon fabric of a humo-ferric podzol of southern England. Large amounts of very dark (in RL), probably humic amorphous organo-sesquioxidic polymorphic and monomorphic pedofeatures occur. The strong cementation of this horizon results from progressive stabilisation of the illuvial sesquioxides and organic matter as a monomorphic fabric. The mineral grains are moderately to poorly sorted and thus appear more closely related to the Eocene parent material than to a windblown derivative (as at Profile 4, for example).

F. Bhs (74-97 cm); sample 74-86 cm (Plates 8, 9)

Structure: massive, very tight bridged and coated microstructure. Porosity: (15-20%) complex packing voids; rare (2 examples in uppermost part) medium (800 um) channels (part infilled - see organic matter, amorphous). Mineral: C: F, 70:30. Coarse: moderately to poorly sorted; dominant very fine, fine, and medium subrounded and subangular quartz frequent silt; few flint; very few weathered and little weathered glauconite, mica and feldspar present; very few coarse sand and small stones (flints); possibly rounded "clay soil" fragments. Fine: two fine fabrics present, very dominant (a) see amorphous; (b) very dark brownish; dark gold or black (RL). Organic Coarse: very few fungal bodies - sometimes ferruginised. Fine: in upper part channel infill of dark brownish/black; black (RL) polymorphic organic matter. Groundmass: a) chito-gefuric to porphyric, undifferentiated b-fabric; b) porphyric, low birefringent speckled fabric. Pedofeatures, Textural: in b) common (probably relic) reddish limpid clay coatings on grains and in voids - seem disrupted and are now ferruginised. Amorphous: very abundant brown, dark brown; mainly golden brown (RL), finely fractured monomorphic organo-sesquioxidic coatings and infills. Rare ferruginous (sesquioxidic) cementation of mineral grains, and void infills. Fabric: many relic zones of fabric (b) - usually cemented areas of low birefringent clay (and silt) with heavily ferruginised argillic features - possibly relating to 'papule-like', slightly disrupted argillic features present in the Bhs/Bsg(t) horizon of Profile 3.

Interpretation: Typical cemented Bhs horizon with a dominant 'aged' monomorphic microfabric, probably containing less humic acid and organic matter overall in comparison to the sesquioxidic content, compared with the Bh horizon above (Table 2). This horizon also contains small areas of relic brown argillic soil fabric, which is obscured by illuvial materials. Thus, this horizon has been incompletely leached by the process of podzolisation, and illuviation is now 'protecting' the earliest fabric. The latter includes both evidence of earlier clay translocation and possibly also palaeo-argillic material in part disrupted, as described from Profile 4, Btsg horizon.

G. Bsx/Bx (97-<105>-140 cm; sample, 125-130 cm) (Plates 10-13)

structure: minor platy within massive; loose embedded microstructure - minor channel microstructure. Porosity: (10%) dominant fine (250 um) vugs, generally smooth-walled; frequent very fine (50 um), moderately elongate channels. Mineral: C: F 75:25. Coarse: very dominant unsorted small stone size, to silt-size quartz; rounded and sub-angular; frequent, commonly very coarse or stone-size flint, very few glauconite, mica and feldspar. Fine: yellowish brown to very dark yellowish brown; pale to very dark orange; speckled; very low birefringence. Organic: rare ferruginised 'fungal' spores. Pedofeatures, Textural: very dominant. Very abundant well-developed silt pans (droplets), caps and link cappings. From 200-1,000 um thick; generally horizontal; well-developed; pans averaging 1 mm apart. Pans and caps are made up of coarse silt set in fine silt clay matrix with enough orientation to make them moderately birefringent. Much of rest of fabric, and on the silt pans are many dusty to very dusty and commonly microlaminated clay coatings and infills. Often near opaque clay coatings are succeeded by more birefringent but dusty clay coatings; limpid phases also present. Depletion: very abundant depleted areas of pale dirty brown fine fabric (pale mottles). Amorphous: very abundant very dark brown to blackish areas cemented by ferruginous materials (orange mottles). Fabric: strong lamina fabric differences are caused by the silt pans.

Interpretation: This subsoil horizon is weakly affected by up to the present-day podzolic illuviation. It has also been strongly influenced by hydromorphism which characterises these subsoil levels at Hengistbury Head. The most important features, however, are textural and relate to an earlier history of cryogenic activity. This gave rise to a platy and compacted structure by the formation of silt pans (droplets), caps and link caps. They form (Romans, et al 1980) "in dispersed soil on freely draining sites where a frozen surface crust developed in winter and a dry layer was formed over winter between the frozen crust and underlying frozen subsoil by migration of water towards the cold surfaces. In spring most of the water content of the frozen surface layer was rapidly removed by lateral drainage and drying winds and eventually the final basal layer melted to produce muddy drops which drained rapidly on to dry soil below, leaving the characteristic form of the silt droplet in the soil fabric". These periglacial features have been preserved because they are too deep to be affected by pre-podzol worm working. The well-defined and strongly developed nature of these features suggest that they formed earlier than Zone III. As no rounded silt granules or "twisted" pans occur it is suggested that they were also unaffected by Zone III conditions (Romans and Robertson, 1974; Romans, pers comm; see Discussion). The slaking of the soil contemporary with silt pedofeature formation also resulted in very coarse grained clay and fine silt illuviation. However, these features may relate to wetting, during the progressive burial by solifluction material - each phase contemporary with silt pan formation.

The fabric as a whole is also affected by minor secondary clay translocation which is of probable Holocene date, as noted at all the soil profiles across the Head.

Profile 4

H. Ea1 (23(25)-58cms) sample 27-34cm (Plate 15)

Structure structureless; single grain microstructure with patches of intergrain microaggregate. Porosity (35%) very dominant simple packing voids; very few highly serrate coarse channels. Mineral (dominant) C:F; almost 100:0; Coarse well sorted; very dominant very fine and fine sand size quartz; very few silt, few medium sand grains dominantly subangular - subrounded; c.5% flint, one ironstone fragment. Fine no fine material. Organic frequent patches of organic Ah; Coarse very few root fragments Fine (in patches) frequent fine (40-60um) microaggregates of amorphous organic matter-dark brown to opaque; brownish in RL. Groundmass monic, minor intergrain microaggreate; undifferentiated b-fabric. Pedofeatures Depletion: very dominant clean mineral grains. Fabric patches of "organic Ah" fabric.

Interpretation: This is a typical highly leached sandy (Table 1) Ea horizon of a well-drained podzol. Mineral material is well sorted, and includes anomalous little weathered glauconite and ironstone nodules, indicating windblown additions. Except for intrusions of Ah material from above, this horizon is strongly homogeneous throughout, and no Mesolithic "surfaces" were apparent.

I. Ea2 (58-69(82)cms); sample 60-73cms (Plate 16)

Structure structureless; single grain microstructure. Porosity (30%) very dominant simple packing voids; very few coarse (meso) - c 500um channels, highly serrate "open" walls. Mineral (dominant) C:F; 100:0 Coarse very well sorted; very dominant very fine and fine sand size quartz; few medium; subangular - subrounded; few flint, very few opaques other minerals. Fine absent. Organic very few amorphous organic matter coatings. Groundmass monic. Pedofeatures Depletion: very dominant clean sand grains.

Interpretation: Very similar to the Ea1 horizon above, this eluvial horizon is very well sorted, and shows little variety throughout. Unlike the Ea1 horizon above it contains no intergranular organic matter, although there are possible very thin organic coatings on the mineral grains.

J. Bh (69-82cm); sample 72-77 cm (Plate 17)

Structure massive; bridged and coated grain (pellicular) microstructure. Porosity (25%) very dominant complex packing voids. Mineral (dominant) C:F 100:0 Coarse well sorted; very dominant very fine and fine sand size quartz; subangular-subrounded; few flints; Fine absent. Organic Coarse generally absent; Fine organic matter is very dominantly brownish; very dark brown to black (RL); amorphous material; isotic (see Amorphous). Groundmass chitono-gefuric with minor prophyric; undifferentiated b-fabric. Pedofeatures: Amorphous; very dominant: most mineral grains are coated with amorphous organic matter this dominantly monomorphic material also bridges grains and forms unlayered infills. The character of these amorphous coating and infills suggests they may differ from the coatings in E and F which tended to be more black because of their sesquioxidic content; coatings are probably rather low in sesquioxides (ignited profile).

Interpretation: This illuvial horizon is formed in the very well sorted sand (Table 1) described from the Ea2 horizon above. The mineral material is cemented by predominantly illuvial organic matter producing a Bh horizon. According to micromorphological tests (eg. UV.; Van Vliet et al 1983) the amorphous monomorpic coatings are possibly dominated by organic matter (see Profile 3, Bh and Bhs horizons, for more typical Bh fabrics) which is unusual in English podzols which are dominantly humo-ferric podzols (Mackney, 1970: Macphail, 1979). This may relate to flushing by lateral soil water movement above the ironstone/ironpans present in the parent material.

K. Btsg (102-125+ cm); sample 109-114 cm (Plate 18,19)

Structure massive, with underlying subangular blocky; mainly massive microstructure, minor pellicular grain (less cemented) microstructure. Porosity (10% overall, <10% in cemented areas). Complex packing voids in open areas; elsewhere very few smooth walled fine (meso) 150 um channels. Mineral (very dominant); C:F; 65:35 moderately well sorted; very dominant very fine and fine sand-size quartz; subangular-subrounded; few flint; Fine dirty brown (with relic fine organic fraction) dark reddish brown to very dark reddish brown; orange to dark brown (RL); very low to no birefringence; fine fabric comprises mainly ferruginised fine microaggregate (2-3 um) fabric (see textural and amorphous). Organic not apparent generally - possibly minor monomorphic coatings. Groundmass very dominantly porphyric, frequent chito-gefuric; grains single spaced in dense embedding clay / ferruginous / sesquioxidic matrix; speckled fabric to undifferentiated b-fabric. Pedofeatures, Textural, very abundant (most of fine fraction) clay grain coatings and void infills - fewer void coatings; coatings post-date microaggregate fine fabric, are microlaminated, and often heavily ferruginised; clay coatings are are poorly birefringent and are moderately dusty in general; although possible earlier phases are more limpid and birefringent. There are also disrupted textural features (papules). These are broken, or slightly out of in situ position; limpid, very dark red and usually very poorly birefringent. Amorphous; very abundant amorphous sesquioxidic impregneation of the fine fabric and textural pedofeatures - often as mottles or bands; the latter follows relic bio-channel porosity.

Interpretation. The effect of depth is to protect this relic argillic brown sand from podzolic leachates. Ferruginisation of the peds also preserved the interior fabric in contrast to paler, more open fabric areas - from leaching and "depletion" by hydromorphism. This subsoil horizon exhibits characteristics of a brown argillic sand formed by brown soil weathering and clay translocation of Holocene date, which occurred prior to the podzolisation and minor hydromorphism now dominating the soil profile as a whole. Possibly limpid translocation was succeeded by a longer period of dusty clay translocation.

An earlier fabric can also be recognised. Limpid, but very red (probably ferruginous, but not related to present-day hydromorphism) clay grain and void coatings predate the brown soil/argillic soil fabric, but appear moderately disrupted. These latter features may relate to a phase of argillic horizon formation, pre-dating the last glacial period ("palaeo-argillic", Avery 1980) and were moderately disturbed prior to Holocene pedogenesis (see Profile 4, Bsx/Bx horizon).

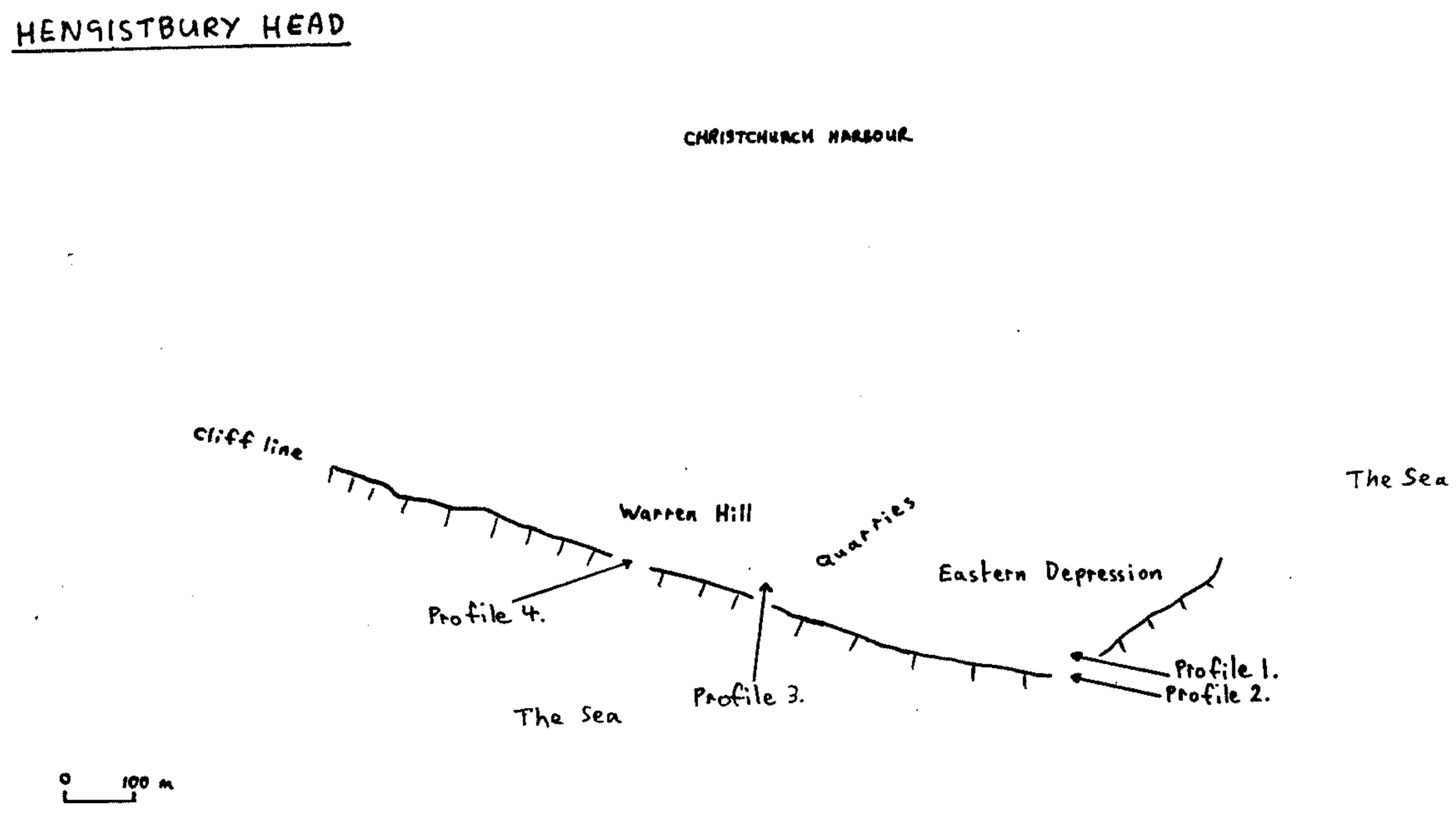


Fig. 1. Location of Soil Profiles

Fig. 2. Hengistbury Head: Sample location.

Profile 1.

Horizon	Thin section	C14	Bulk sample
Ah			x 1
BANK: dump Bsg/Bhs			x 2
BANK: dump Ah/H			x 3
bH	A	< 3350 ± 90 yrs. bp >	x 4
bAh	B		x 5
bEa			x 6
bB(hs)			x 7
bB(t)sg	C		x 8

Profile 2

Horizon	Thin section	C14	Bulk sample
recent sand			
Ah			x 9
Ea			x 10
Bhs			x 11
Bhsg			x 12
B(t)sg	D		x 13

Profile 3

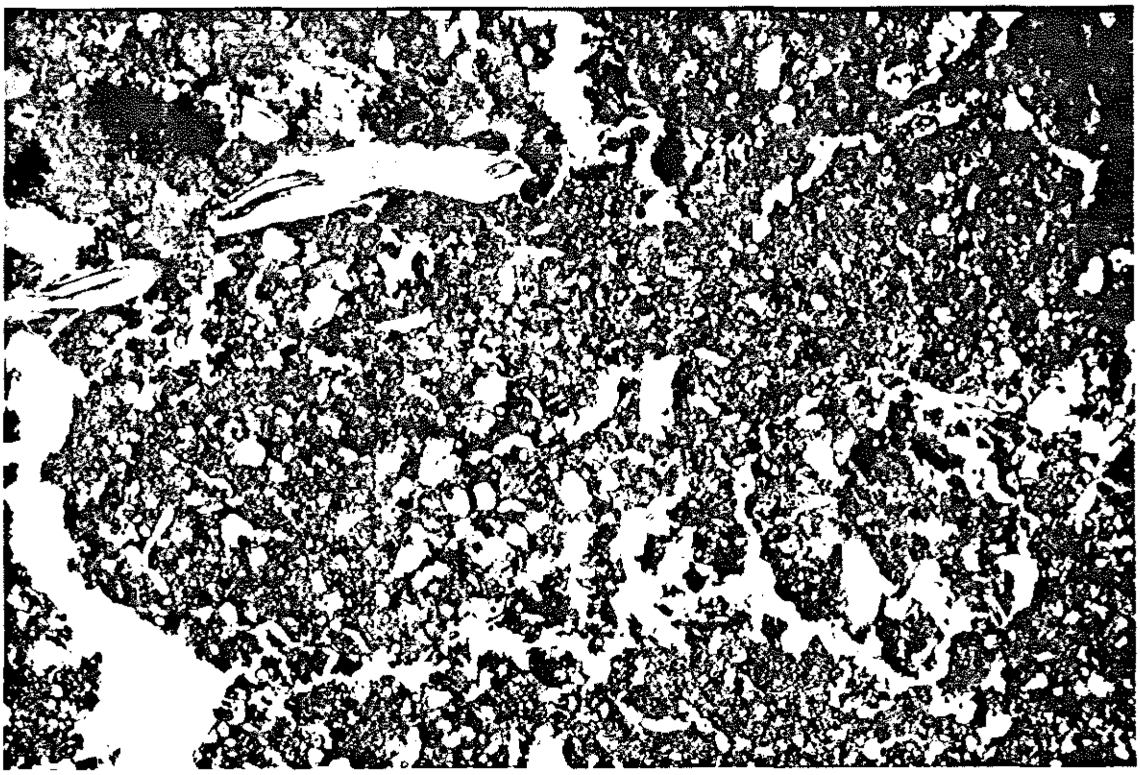
Horizon	Thin section	C14	Bulk sample
recent sand			
Ea 2			x 14
Bh	E		x 15
Bhs	F	< 1700 ± 90 yrs. bp >	x 16
upper Bsx/Bx			x 17
lower Bsx/Bx	G		x 18

Profile 4

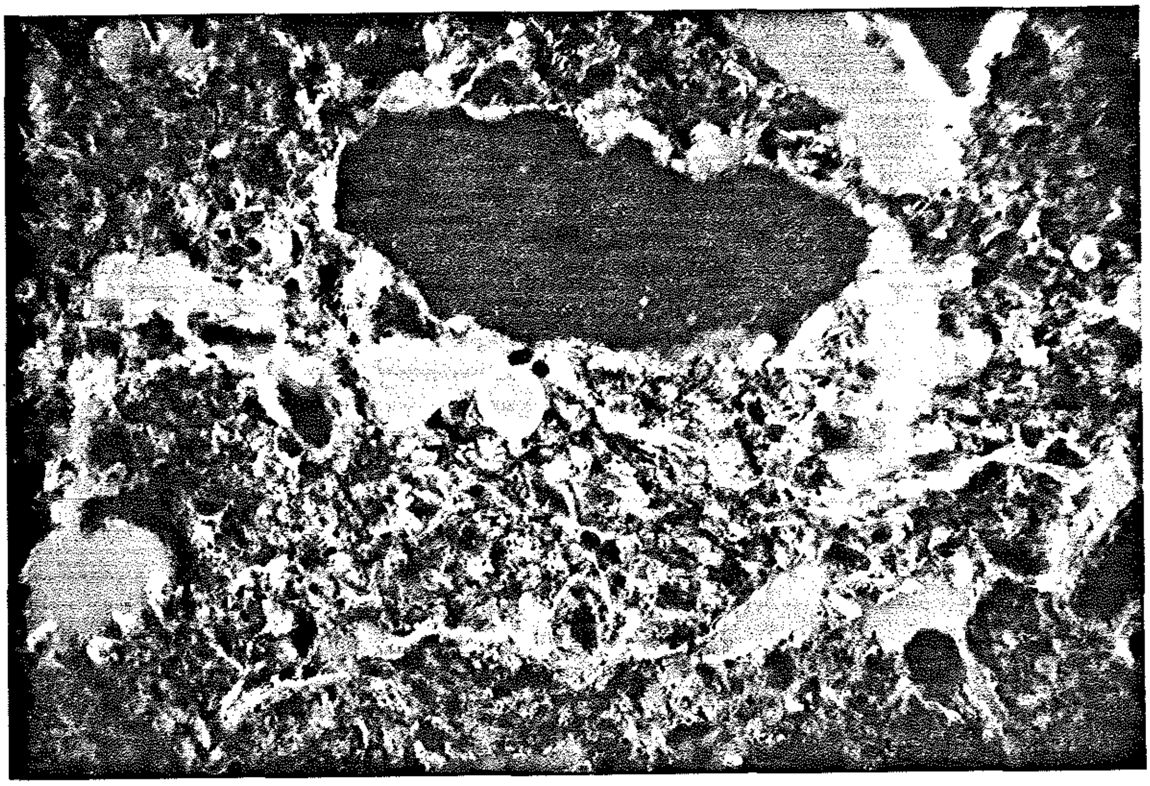
Horizon	Thin section	C14	Bulk sample
recent sand			
Ah/Ea			x 19
Ea1.	H		x 20
Ea2	I		x 21
Bh	J		x 22
Bhs			x 23
Btsg	K		x 24

Key: □ – thin section
x – bulk sample
< > – C^{14} sample

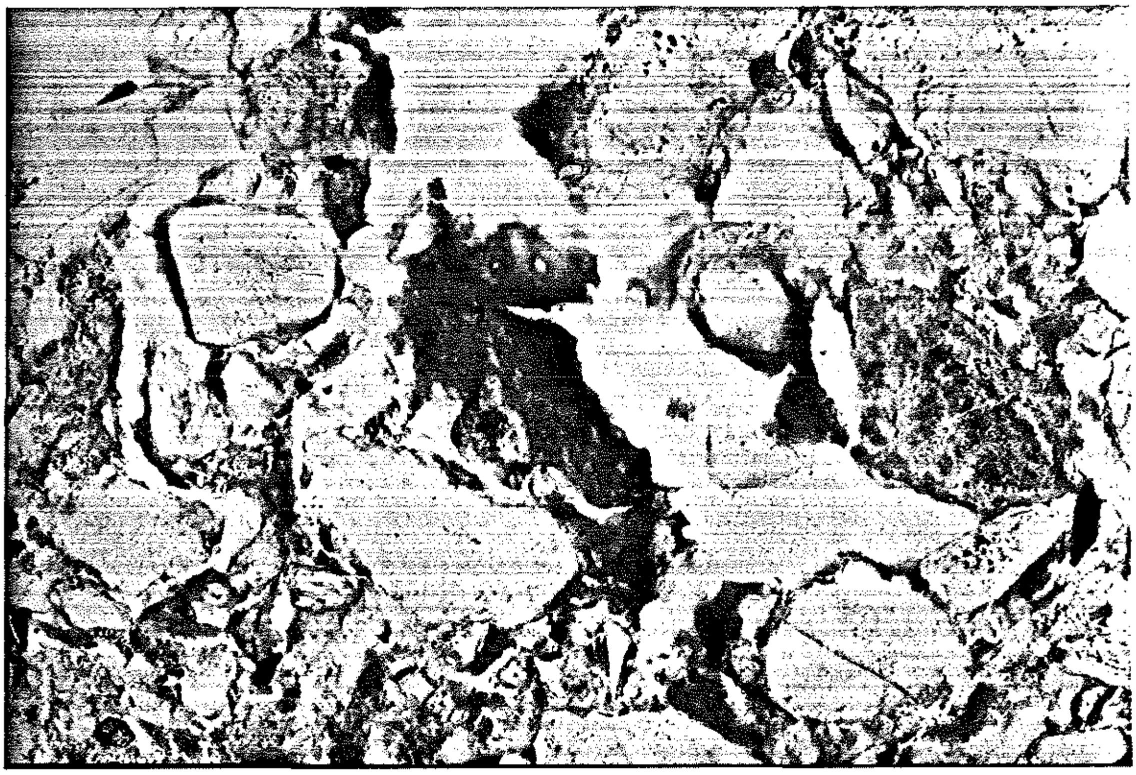
1. Field; Profile 1, Eastern Depression; typical gley podzol beneath Late Bronze Age/Early Iron Age bank; pollen sample column and thin sections A/B and C; buried H horizon dated as 3350 ± 90 yrs bp (HAR 6186).



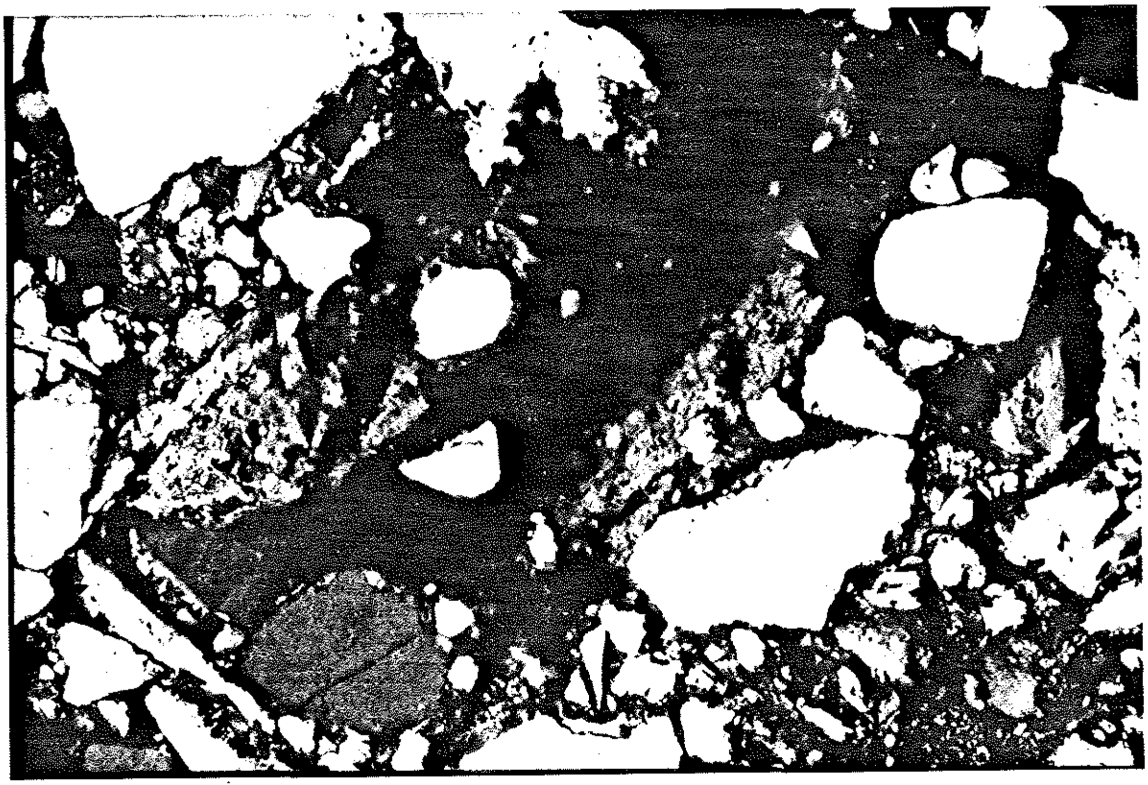
2. Photomicrograph; as 1; buried H horizon; dominantly amorphous organic matter, here displaying evidence of biological perforation. Plane polarised Light (PPL), frame length is 5.225mm.



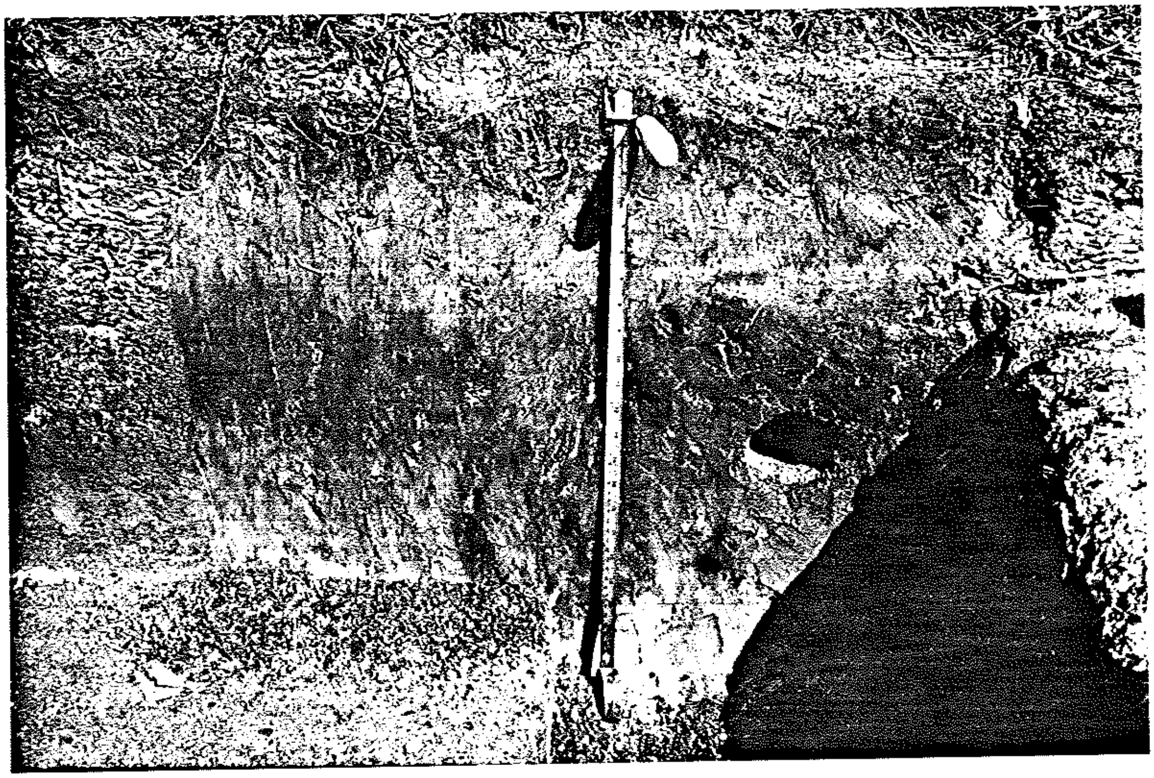
3. As 2; note under Ultra Violet Light (UV) strongly absorbent (black) amorphous organic matter, with high amounts of residual pollen being strongly flourescent. UV (INA, Grignon), frame length is c. 500 um.



4. Buried B(t)sg horizon; fabric of sand grains and highly ferruginised relic argillic soil, showing history of clay translocaton succeeded by podzolisation and hydromorphism. PPL, frame length is 1.38 mm.

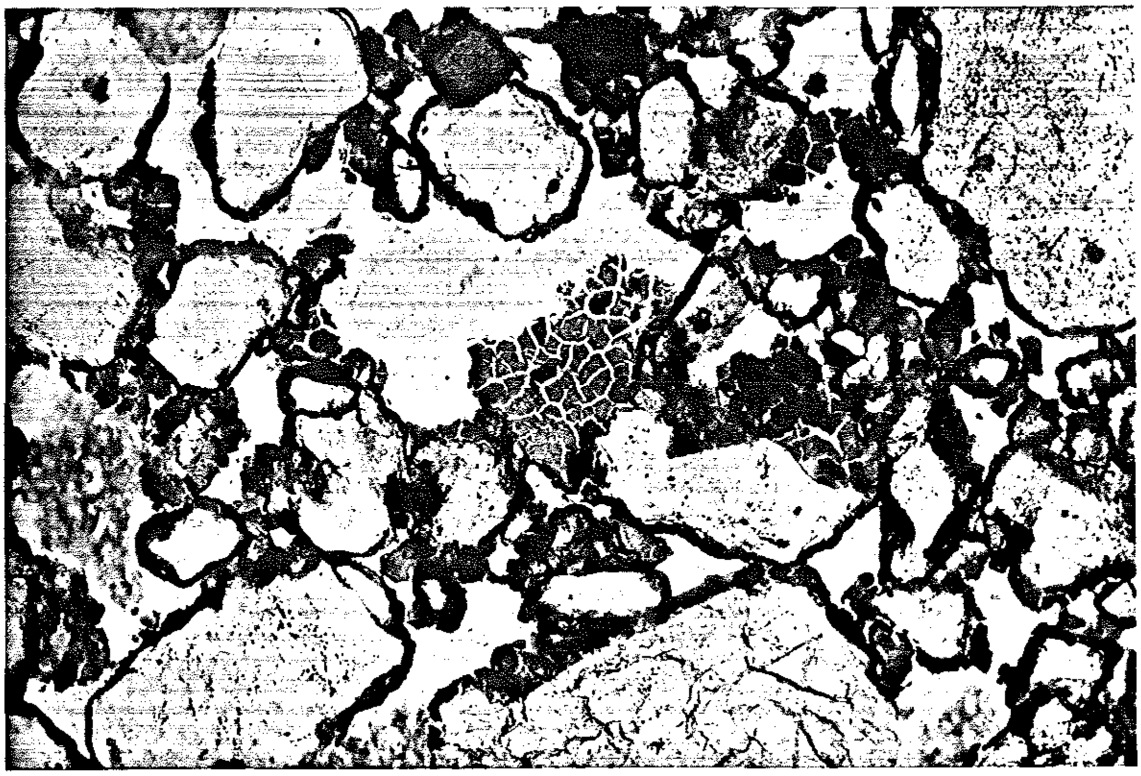


5. As 4, Crossed Polarised Light (XPL) showing degraded nature (poor birefringence) of clay coatings which have undergone acid attack and iron impregnation (plate reversed).

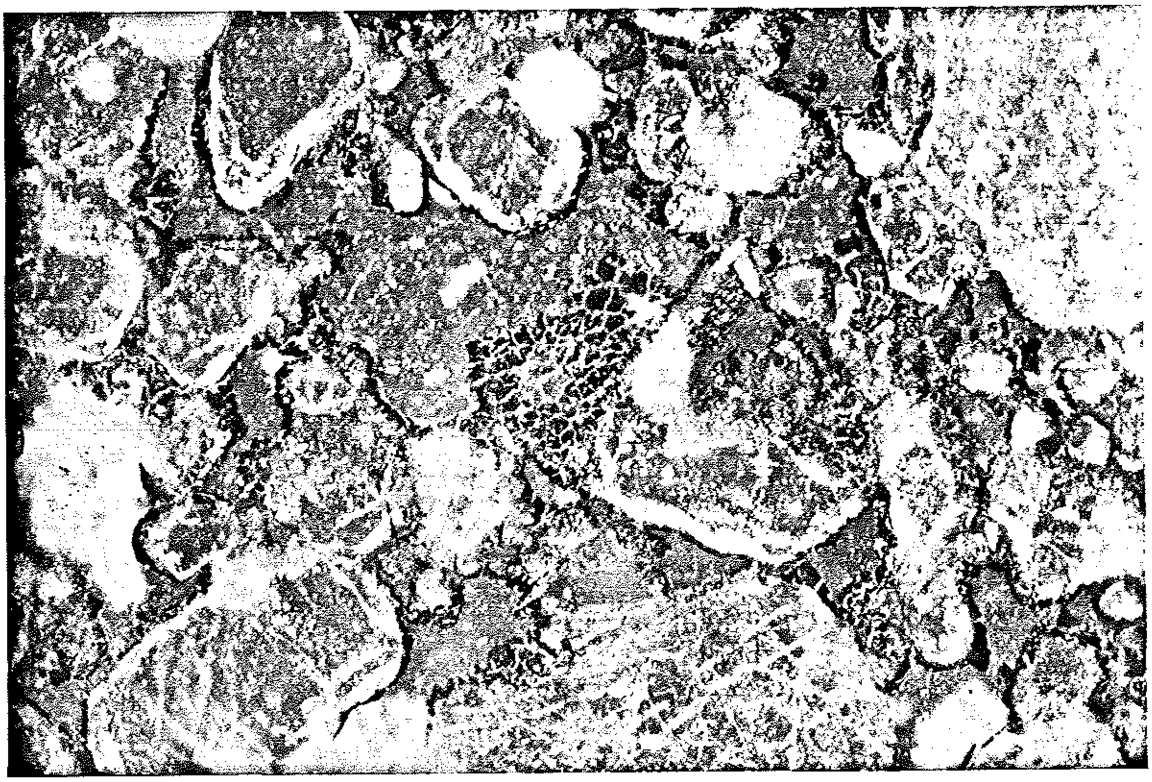


6. Field; Profile 2, Mace/Campbell Upper Palaeolithic site in the Eastern Depression; typical (nodular) gley podzol; note layer of recent sand and humic lenses by trowel; and in the subsoil the horizontal auger hole for the thermoluminescence capsule which measured the annual dose as influenced by soil water, as a control for the TL dating of the Upper Palaeolithic burned flints here.

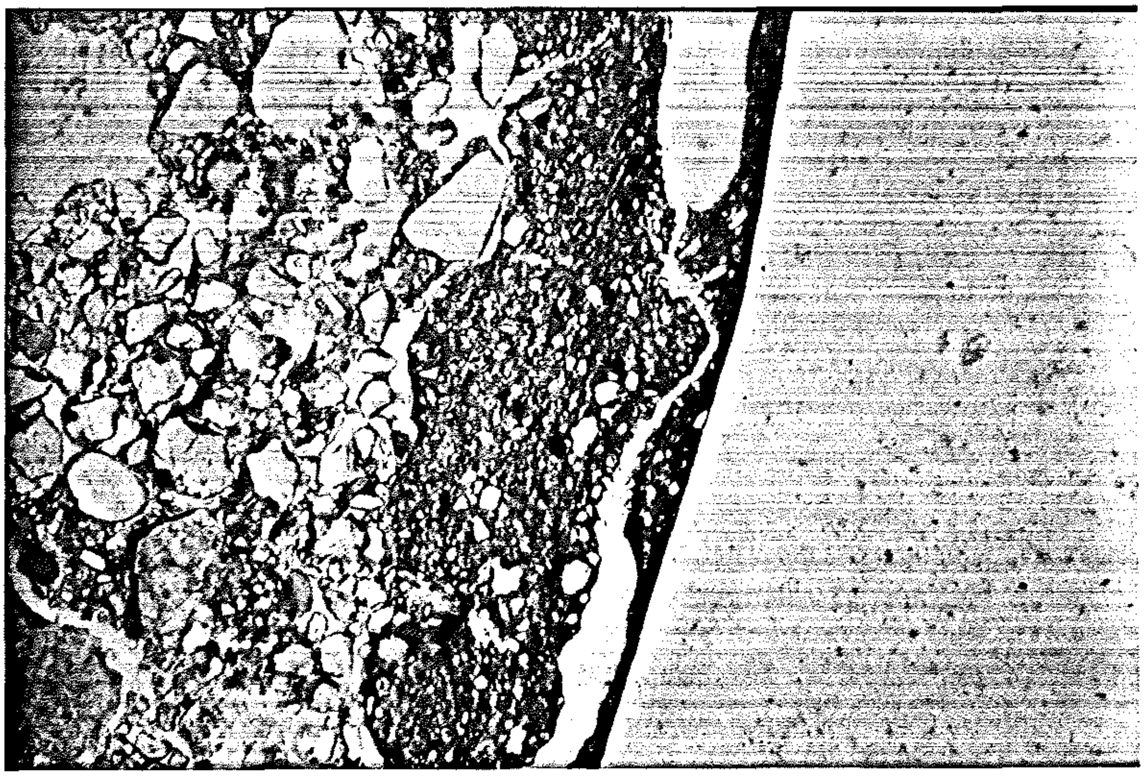
7. Field; Profile 3; Transverse Quarry; truncated humo-ferric podzol covered by recent blown sand developed on poorly sorted gravelly head which features freeze/thaw soil structures.



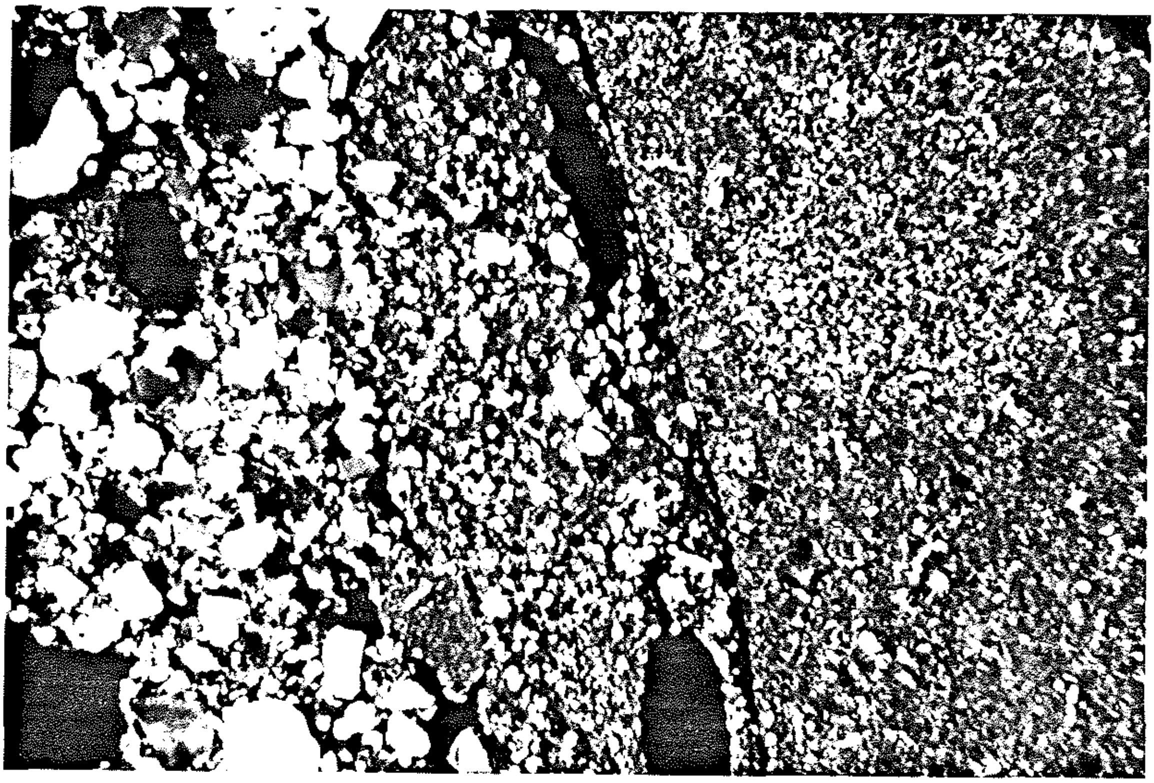
8. Photomicrograph; Bhs horizon; note mainly monomorphic organo-sesquioxidic infills and coatings of this cemented illuvial horizon; the contained organic matter produced a mean residence C14 date of 1700 ± 90 yrs bp (HAR - 6185) indicating a Bronze Age period for the initiation of major podzolisation here. PPL, frame length is 1.348 mm.



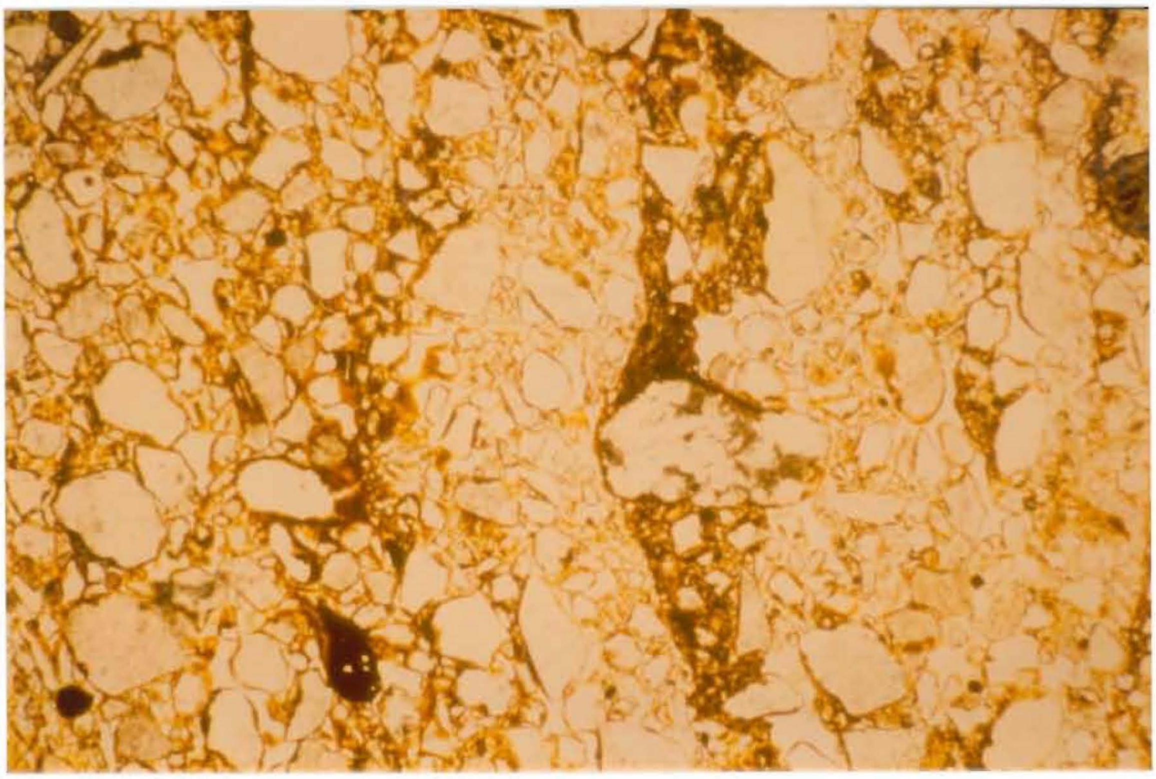
9. As 8; Oblique Incident Light (OIL); colours may suggest primary organo-sesquioscidic (orange) illuviation followed by mainly organic (black) illuviation, which shrunk and cracked as it aged (de Coninck, 1980).



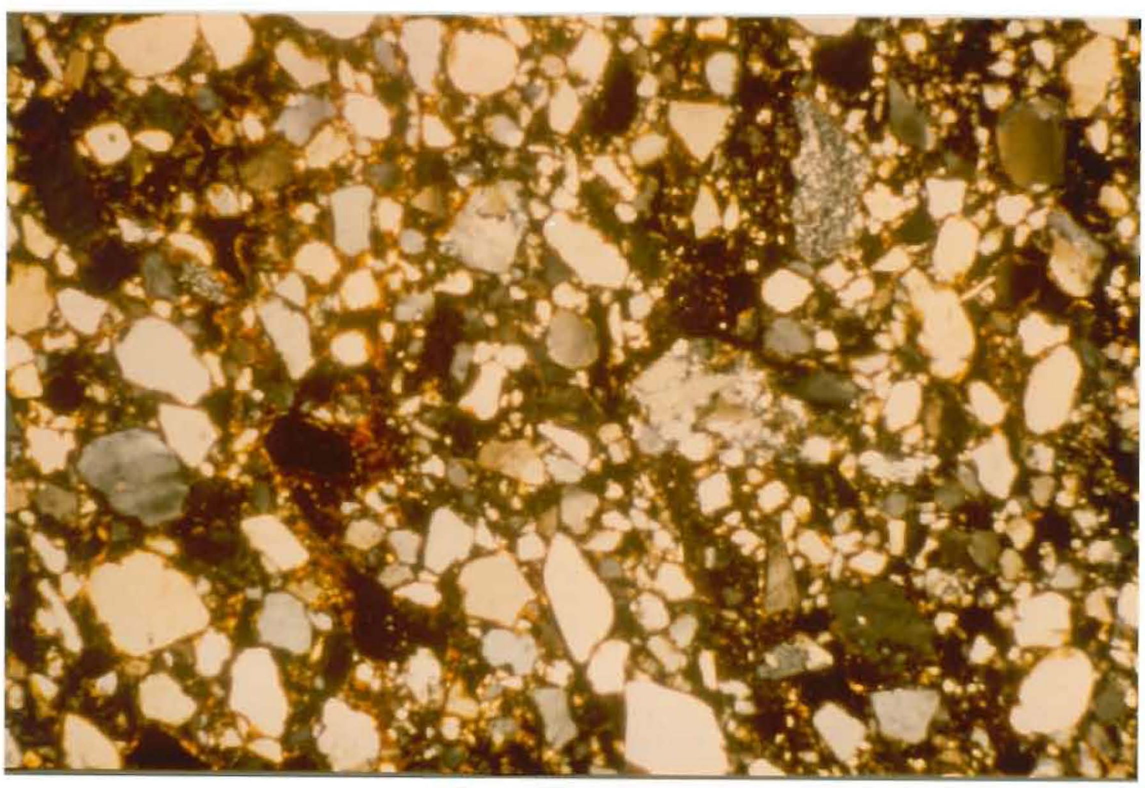
10. Bsx/Bx horizon; detail of strongly formed silt and clay capping of a large flint; followed by dusty clay; a feature typical of freeze/thaw soils. PPL, frame length is 1.348 mm.



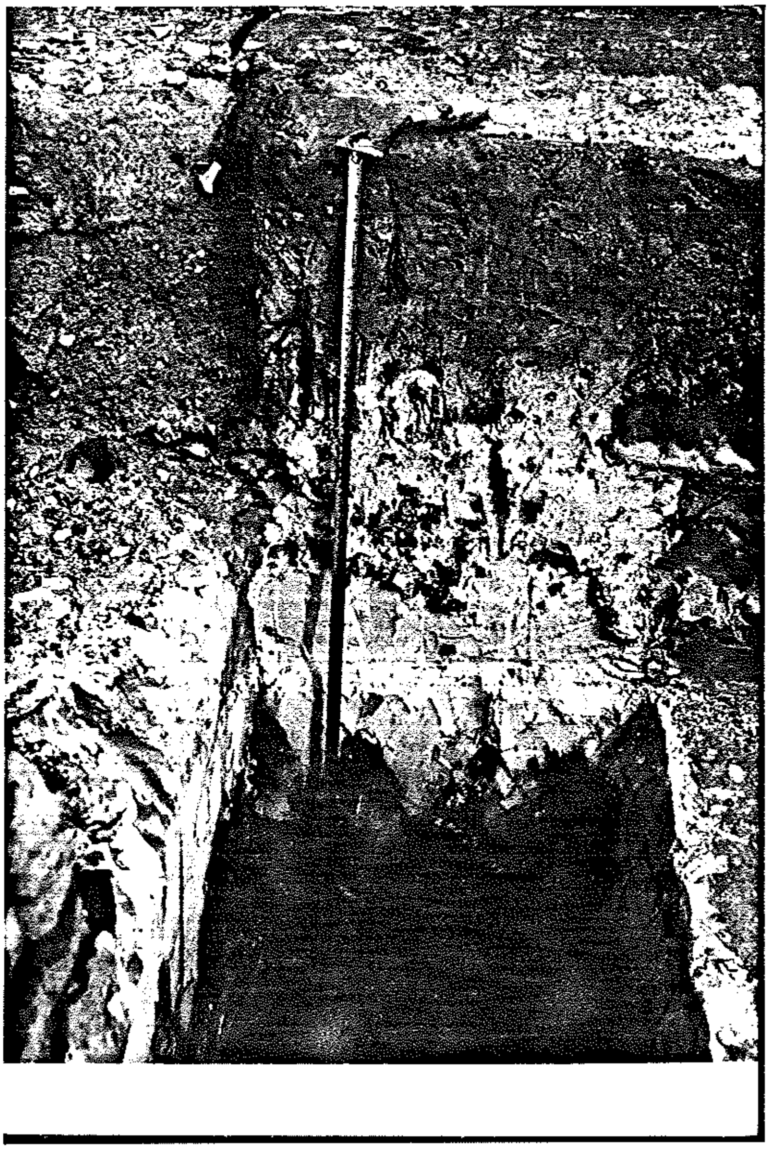
11. As 10, XPL; note moderate birefringence produced by deposition of poorly sorted mineral material (plate reversed).



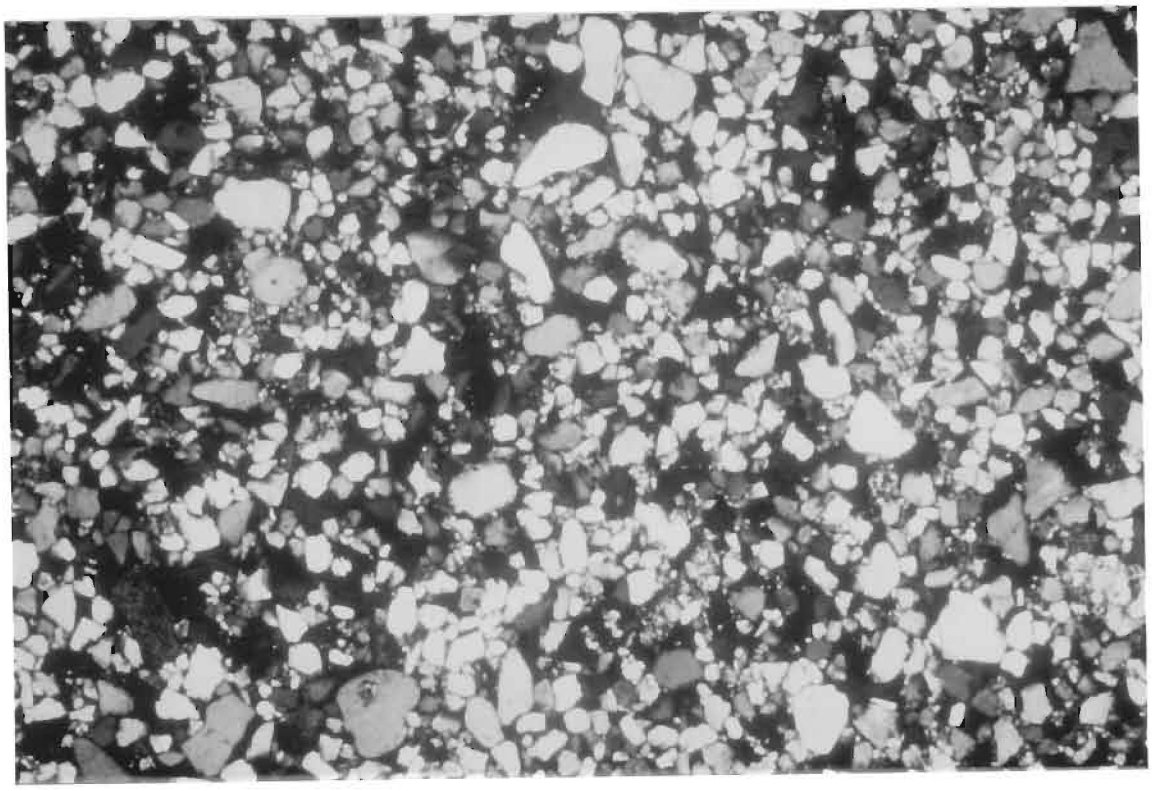
12. As 10; area of repeated well formed link cappings separated by moderately clean soil, indicating soil was very dry when silt droplet formed during spring melting (see text). PPL, frame length is 5.225 mm.



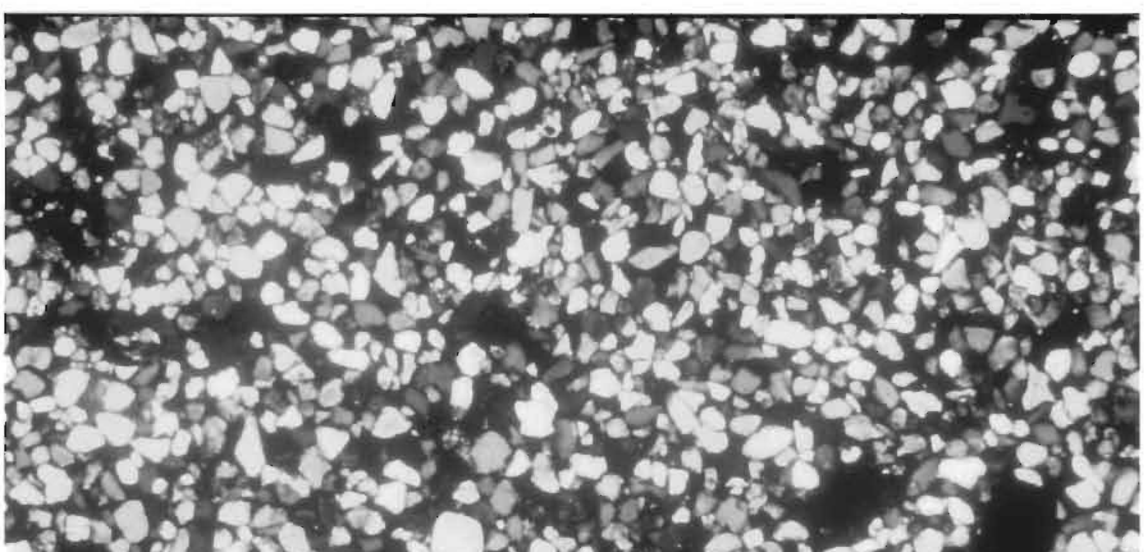
13. As 12, XPL; these textural features are poorly birefringent in part due to absorbed hydromorphic iron.



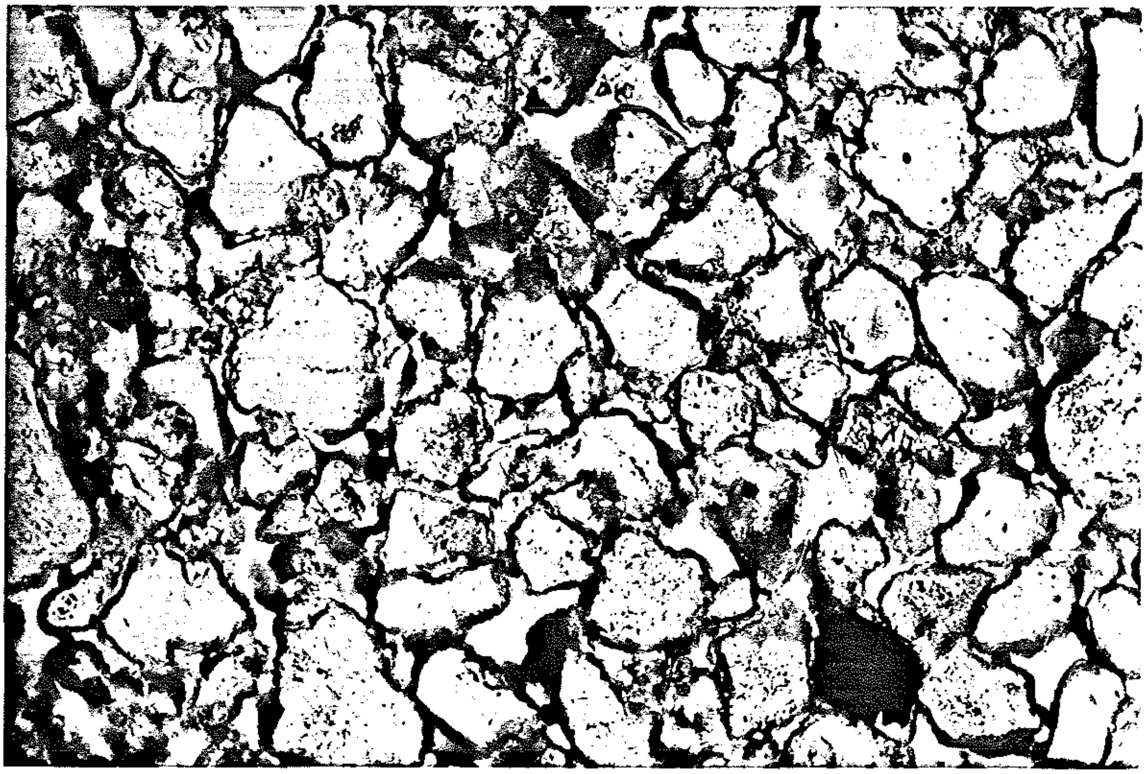
14. Field, Profile 4; Warren Hill, Powell Early Mesolithic Site; note most recent disturbed blown sand has been removed; stone line may approximate to phase(s) of deflation.



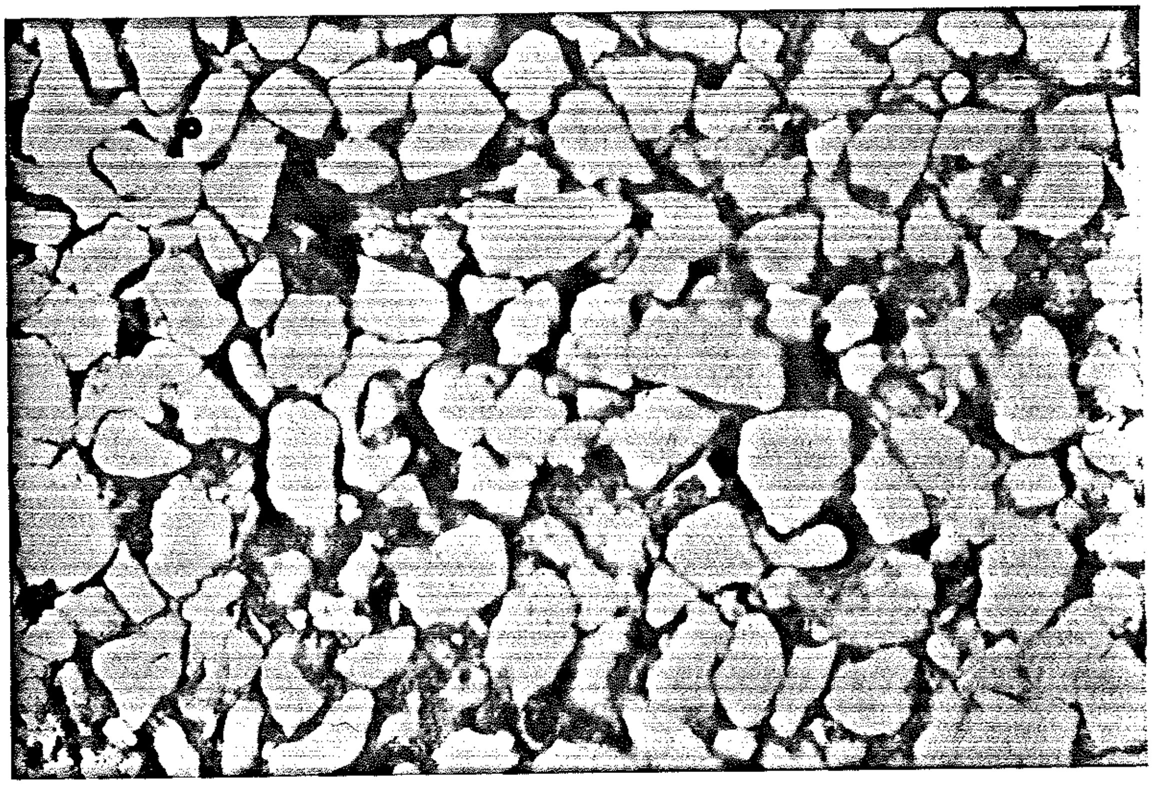
15. Photomicrograph; Ea1 horizon; moderately well sorted clean, mainly quartz sand. XPL, frame length is 5.225mm.



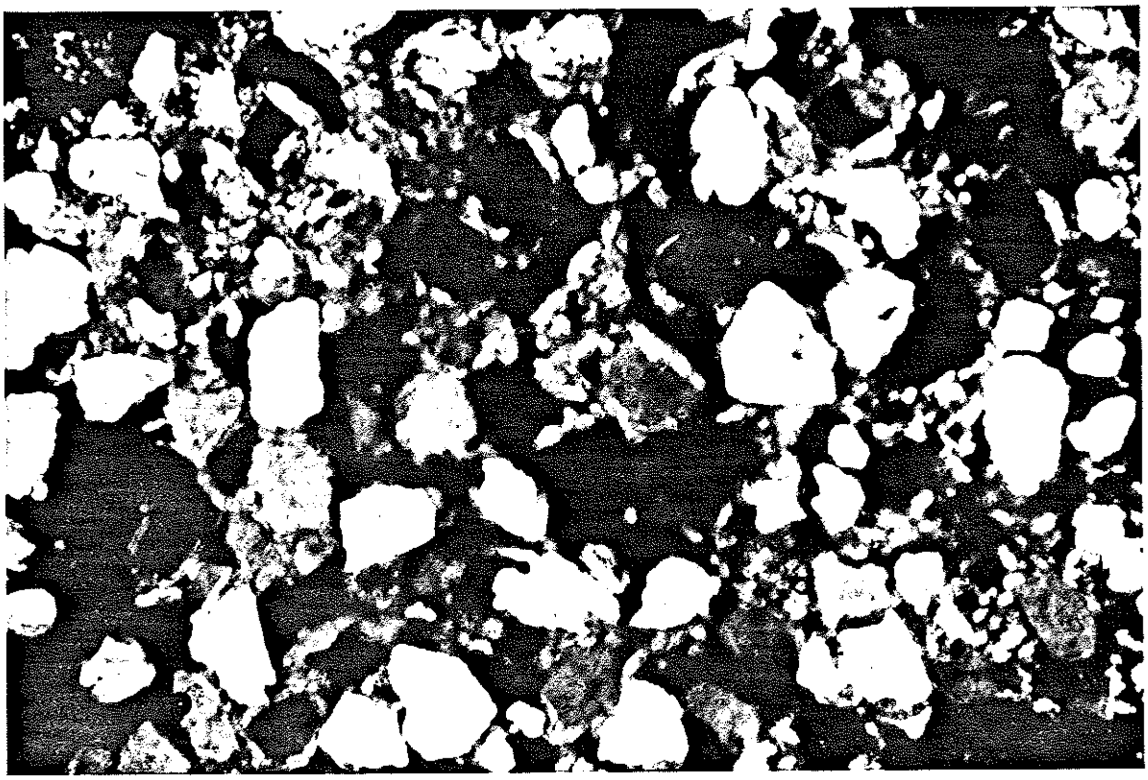
16. Ea2 horizon; well sorted very fine and fine quartz sand. XPL, frame length is 5.225 mm.



17. Bh horizon; mainly pale brown organic grain coatings on quartz grains. PPL, frame length is 1.348 mm



18. Btsg horizon; area within cemented relic ped; quartz grains with intergranular infill of fine micro-aggregate (Bw) soil and clay coatings of this relic argillic subsoil. PPL, frame length is 1.348 mm.



19. As 18, XPL; note high birefringence of clay coatings here little affected by hydromorphic and podzolic sesquioxidic illuviation (plate reversed).