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Ancient Monuments Laboratory
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SOIL REPORT ON THE MID-SAXON FLOOR AND DARK EARTH AT JUBILEE HALL, COVENT GARDEN, LONDON.

R I Macphail BSc MSc PhD

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Summary

The Mid-Saxon brickearth floor contained possible carnivorous type coprolites, and in addition seemed to have been affected by organo-phospatic solutions from ash from the hearth and also possibly from cess. Vivianite occured. (Some features, however, may post-date the burial of the site). Perhaps after abandonment an omnivorous type coprolite was deposited on the floor surface, possibly just prior to the collapse of the building when the daub walls were affected by fire. Typical Dark Earth fabrics may result more from the activity of Enchytraeidae than from earthworms.

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R.I. Macphail 1986

Introduction

During May 1985 the Inner London Archaeological Unit excavated Saxon remains at Jubliee Hall (director, Bob Whytehead). The archaeology was of particular interest because a hearth and associated floor related to rare 8th century Mid-Saxon (c. 720 AD) occupation (Whytehead, 1985; pers. comm.).

The natural substrate on the site comprised brickearth over sands and gravels. The section studied (Section 2) featured a brickearth clay floor (a variety of contexts) immediately overlain by "Pale Dark Earth" (context 61) which merged into Dark Earth proper (context 60). These layers were investigated by micromorphology and the analysis of organic carbon and calcium carbonate (Avery and Bascomb, 1974; Bullock et al 1985; Courty et al in press).

Results and Discussion

These are presented in detail in Table 1 and in the Micromorphological Description and Interpretation. Briefly the investigation shows that a Mid-Saxon, rather pure brickearth (Table 1) floor seems to have had probable "carnivorous" type coprolites incorporated into it during its use. The floor was also affected by water containing organophosphatic solutions from the hearth and these produced a form of ironpaning, and possibly with soluble coprolitic material or cess also produced amorphous iron nodules and infills (see Plates 1, 2), featuring vivianite ($Fe_3 (PO_4)_2 . 8H_2O$).

On the surface of the floor an "omnivorous" type coprolite occurs beneath what may be interpreted as a collapse of "daub wall" material. Ash over the coprolite

suggest fire accompanied the collapse. The "wall" material included very pure brickearth together with brickearth mixed with organic matter (Table 1) - some form of clay wall daub (Plates 1, 2). Burning of this material reddened layers of the daub (Plates 3, 4). This horizon which was called "Pale Dark Earth" in the field was in places re-worked by soil fauna. Probable Enchytraeidae produced organo-mineral micro-aggregates, typical of Dark Earth (see Plates, 11, 12) (Macphail, 1981, 1983), whereas earthworms produced casts of rather "pale" soil because the "digestible", organic matter had been removed leaving just the charcoal (Plates 5, 6, 7, 8, 9, 10). The analysis of the Dark Earth here (Plates 12, 13) and elsewhere (Macphail and Courty, 1985), suggests that this finding indicates the role of earthworms in Dark Earth formation to have been over-stressed, whereas Enchytraeidae may have been overlooked. The Dark Earth at Jubilee Hall again seems to have developed from re-worked, insubstantial buildings (Macphail and Courty, 1985), leading to a finely calcitic fabric (Plate 13) being developed.

Acknowledgements

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Table 1. Jubilee Hall, Analytical Data.

Horizon	% Organic Carbon	% Calcium Carbonate
Dark Earth	1.1	2.2
Brickearth collapse/ Pale Dark Earth	1.2	0.9
Brickearth floor	0.5	trace

Micromorphological Description - Jubilee Hall

Thin Section A ([1] Dark Earth) 0-55cms. (Plates 11, 12 and 13)

Structure very weakly prismatic; micro-aggregate microstructure. Porosity 35%; very dominant, open-walled, medium vughs; few medium open-walled, dominantly vertical, channels.

Mineral. Coarse/Fine limit 10um. Course/Fine 50:50. Coarse unsorted; dominant silt size, very fine, fine, medium sand-size quartz; few coarse quartz; frequent medium, coarse, very coarse and gravel size flint; few fine to very coarse opaques, glauconite etc; rare feldspar, limestone. Common daub, burned daub, brickearth fragments (see Fine); rare probable oyster shell fragments - disintergrating; frequent coarse to fine, bone, rare weathered, biogenic calcite sometimes burned.

Fine heterogenous; a) dominant (micro-aggregate) very dark brown, blackish; heavily dotted (PPL); low birefringence; dark brownish, black specks (charcoal) in OIL (biologically worked dark earth). b) few pale brown, speckled (PPL), moderate birefringence; pale orange in OIL (calcitic mortar/plaster; ashey fabric). c) frequent, very dark brown, blackish, heavily dotted (PPL); very low birefringence; very dark brown in OIL (slaked daub fabric, sometimes blackened or reddened by burning). d) few yellowish-brown to dark brown (PPL), generally low to moderate birefringence; blackish, dark brownish and reddish in OIL (Brickearth fragments, mainly burned).

Organic. Coarse bone as above; few charcoal. Fine very abundant, charred organic matter, obscurring most of fine fabric; humifying organic matter; rare plytoliths.

Ground mass porphyric, (closely embedded), weak to moderate crystallitic b-fabric.

Pedo features. Excrements very dominant, thin organo-mineral, probable Enctrachaeids; rare mamilated fragments (possibly relic), rare biogenic calcite ?Arionid.

Textural. Common intercalations of fine fabric in daub (unworked biologically, perhaps because baked by burning). Fabric heterogeneous mix of anthropogenic fabric, commonly reworked biologically.

Amorphous. Few yellowish-brown fragments of ? organo-phosphatic and iron character ? See sample 2.

Thin Section B [2] Pale Dark Earth biologically worked "?collapse" and [3] Brickearth "collapse?" and [4] floor)

2 = 42 - 46(50) cm. (Plates 5, 6, 7, 8, 9, 10)

3 = 46(50) - 50 cm. (" 3, 4)

4 = 50 - 55 cm. (" 1, 2)

Structure 3 and 4, massive with massive microstructure; 2, massive and sub-angular blocky, with massive, vughy, micro-aggregate and total excremental microstructures.

Porosity 3 and 4, 10-15%; 2, 30%. 3 and 4, very dominant, moderately smooth walled, medium vughs, few fine channels. 2, common, medium to coarse, moderately smooth walled vughs; frequent, very coarse, moderately smooth walled channels (earthworm).

Mineral. C:F 60:40 generally. Coarse very similar to sample 1, but:- very abundant silt-size quartz (Brickearth), frequent gravel size flint; frequent burned and unburned bone. Large amount of inclusions, including Brickearth floor and burned and indurated areas. Rest of description is divided into 3 levels.

4 - "Brickearth floor":- Organic. Coarse, many large fragments of reddish-brown, ferruginised bone - cooked - digested?; occasional wood charcoal. Fine. Many organic fragments - charred grass, humified grass; rare phytoliths. Abundant, yellow, yellowish-brown to dark brown amorphous, organic matter as concretions, organic (?root) pseudomorphs, and as septaric and concentric nodules; generally non-birefringent, yellow or brown in OIL; occasionally associated or includes blue/green vivianite crystals. Many relate to decalcified ashy areas where only phosphate staining and minor clay coating formation left, others are probably coprolitic. These features are complex, some presumed to be some form of organo-phosphate - probably mainly derived from ash; although some may be influenced by cess. Others appear to be coprolite fragments. Fabric mineral "background" is predominantly Brickearth with minor organic mixing. Other features are "iron panning" or staining of layers of Brickearth, and brown amorph ous infills - iron and manganiferous hydromorphic impregnation - seems to decrease away from hearth direction. There could be some association with amorphous organo-phosphatic features as described above, which also occur elsewhere in this layer as nodules.

3 - "Brickearth colapse?":- This layer of mainly Brickearth has been strongly perforated by biological (earthworm) activity. Includes gravel, coarse charcoal etc; many fine charred and humified often "grassy" organic matter; therefore deposit orginating from "mixed" Brickearth daub, plaster etc. Organo-phosphatic infills also occur in small amounts.

4 - "Pale Dark Earth":- This is a very complicated layer which includes Brickearth fabric, many inclusions, and two main types of biological working.

Excrements. Many excellent, coarse, mammilated mineral earthworm excrements occur as "loose" infills of coarse channels. These can be differentiated from the general fabric by being very pale brown, dotted (PPL), very low birefringent, and grey to very pale yellow OIL. They contain abundant, fine organic mater, which is predominantly black - presumably charred - with extremely little yellowish-brown organic matter present. The coarsest mineral inclusions are fine sand (c. $\lesssim$ 500um). Surrounding soil is less well sorted (including all the inclusions - bone, shell, burned daub, stained Brickearth, Brickearth etc), and much darker because it contains very abundant, fine organic matter much of which is yellowish-brown and amorphous (ie fresh, "edible", organic matter is present).

Also present are many thin organo-mineral excrements, probably Enchytraeids - wire worms, which have not digested all the organic matter.

Interpretation The mid-Saxon floor is made up of brickearth. This constructional material, which was commonly used for "clay" floors and "clay" walls in Roman times had been previously studied from both City and Southwark sites (Macphail, AMLR , 1984,; Macphail and Courty, 1985), and from destruction levels at Colchester (Macphail, AMLR 21, 1986). It is also being currently investigaed from the COSE and 28 Park St. sites in Southwark. Although a large proportion of the brickearth material at Jubilee Hall is from uncontaminated Brickearth - ie a geological clay loam deposit generally low in organic matter (Plates 1, 2) - much has been mixed with organic matter. This suggests some re-use.

The brickearth layer may not just be a floor which is contemporary to the hearth in this part of the site. Close inspection seems to suggest that there may be

"two" layers; the floor itself and an overlying brickearth deposit which could be a building collapse deposit including brickearth daub.

The Floor: In the floor, which is made up of both pure and contaminated brickearth, inclusions such as coarse flints, coprolites (see below) and large fragments of (partially digested) ferruginised bone occur. The floor was also affected by hydromorphic (gleying) iron and manganese staining (impregnation) or ironpan formation - probably contemporary to the site because it is fractured. This discontinuous pan is also possibly more strongly developed towards the hearth. Localised near-surface wetting and even slaking of dirt floors is a common phenomenon (Courty et al in prep), and this pan formation here probably relates both to wetting and the influence of "organo-phosphatic" solutions derived from hearth ash residues - the latter enhancing bio-chemical effects of hydromorphism and ferruginous impregnation elsewhere.

In addition, there are nodular infills 1-3mm in size, yellow with dark brown to black edges, amorphous, non-birefringent and yellow and brown in reflected light. These also sometimes contain the blue/green iron-phosphate mineral vivianite which, although a mineral common to fen soils, has clear associations with anthropogenic deposits (Keeley and Macphail, 1981; Macphail, 1983). There are two probable interpretations of these nodules. They can be the result of a combination of hydromorphism (mobilising iron in the reduced state), and water containing organo-phosphates from dissolved wood ash from the nearby hearth. In fact, because of some obviously impregnated outer margins, this effect must be at least contributary. Secondly, they can be coprolitic in origin. Some are definitely coprolites (from reference thin sections, Macphail, Potterne AML report in prep; Courty et al in prep) on the grounds of morphology, with discrete, dark brown margins and possibly pseudo-morphic bone fabrics; whereas others are more nodular and possibly represent an organo-phosphatic residue (in a ferruginous environment) - ferruginisation also effecting bone fragments.

The high quantity of amorphous material, the lack of phytoliths and plant inclusions, but the presence of bone with "digested" margins and possible "pseudomorphic bone" all indicate that these coprolites are from carnivores. It is a possibility that these are from mainly meat-eating humans, as opposed to dog, because the latter tend to scavenge and their coprolites may have an "omnivorous" content. Such amorphous yellow ("amber") coprolites have been associated with such pure carnivores as hyenas (Goldberg, 1979). However, without access to Ultra Violet Light or X-ray analysis it is difficult to be more precise over the chemistry of these features, for instance to suggest any nitrogenous content - only a faint possibility in this well-weathered environment.

The collapse: At approximately the junction between the floor and the "collapse" one area contains much coprolitic material. Here, however, although amorphous organic matter predominates, there are a few phytoliths and frequent plant fragments suggesting an omniverous origin. It seems to have been deposited in a semi-liquid state, as some of the surrounding soil became impregnated. The coprolite is then directly succeeded by what may be interpreted as "collapse" or "destruction" deposits. These look very similar to the Brickearth floor at the field level, because they are essentially of the same mineral origin - ie brickearth. Here, however, the brickearth, although containing "pure" fragments, is mainly mixed with organic matter (Plates 1, 2) - phytoliths; fine, often charred, organic matter; and coarse plant remains and plant pseudomorphic porosity, all suggesting a daub or "clay wall" origin. Fragments of decalcifying "plaster" also occur, but of course these may be secondary. Within the "collapse", and for example overlying the "surface" coprolite are small areas of ash (calcite crystals) associated with organic rich daub fabrics. Also in this part of the thin section are thin layers of charcoal, burned "brickearth" with charcoal and ash (Plates 3, 4). Some burning may therefore be associated with

the collapse/destruction of this building. Further coprolititc material and organo-phosphatic/vivianite deposition also characterise this deposit.

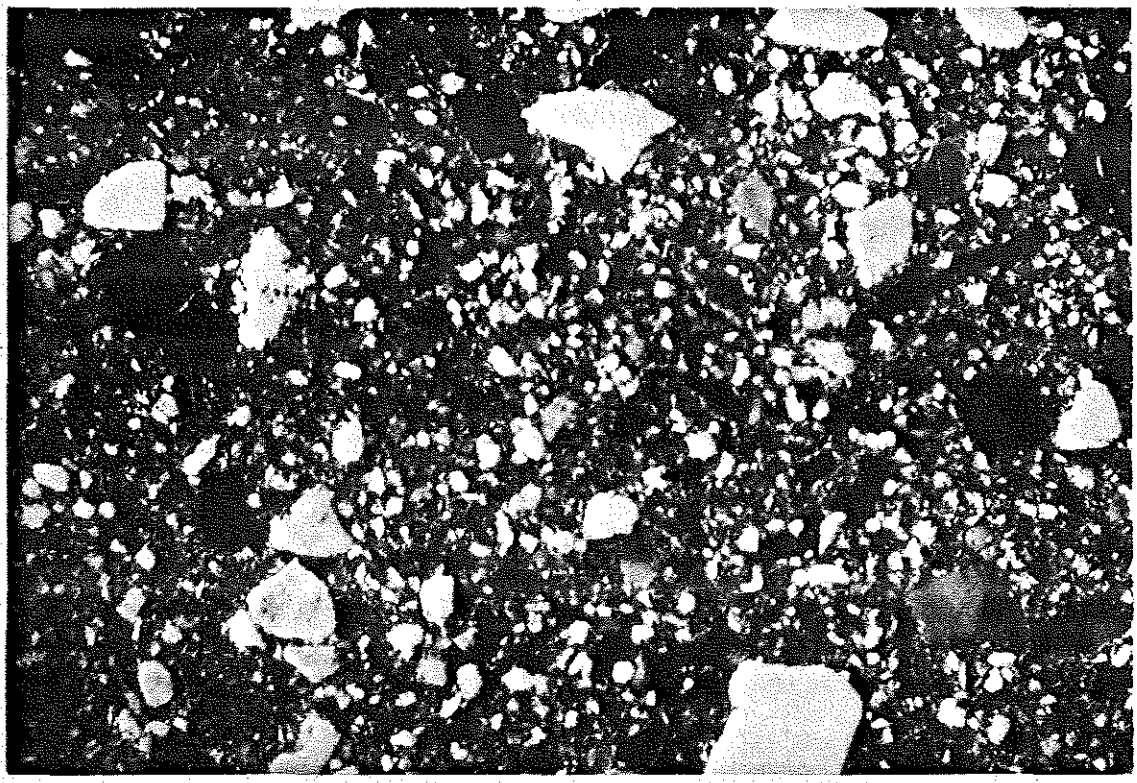
Post-depositional events; accretion of Dark Earth

It appears that the loose "collapse" deposit ("pale Dark Earth" in the field) was moderately well perforated by fauna, although the brickearth floor, probably because it is more dense and rather "sterile", was much less biologically worked. Two main types of faunal working can be recognised and it is important to differentiate these. Frequently, dark organo-mineral excrements probably relate to Enchytraeidae (wire worms) which are known to produce stable soil aggregates and occur in hundreds of thousands in the top few centimetres of natural soils (Albrecht et al in press). In addition, Arionidae (slugs) were also present chewing over decaying organic matter, as evidenced by their (now decalcifying) calcite granules. Enchytraeidae and Arionidae, however, were less efficient in re-working the deposit in comparison to earthworms which produced very coarse channels and mammilated casts or excrements from the anthropogenic mixture of brickearth mineral, organic matter and charred organic matter. Detailed studies of these excrements and surrounding "pale Dark Earth" of the "collapse" and re-worked "collapse" show (Plates 5, 6, 7, 8, 9, 10) similar sorting and birefringence. The excrements, however, are much more grey in colour (ie paler), because although they still contain much charred organic matter as in the juxtaposed sediment, all of the "digestible" organic matter has been removed. This characteristic is typical of casts (Kretzschmar, in press).

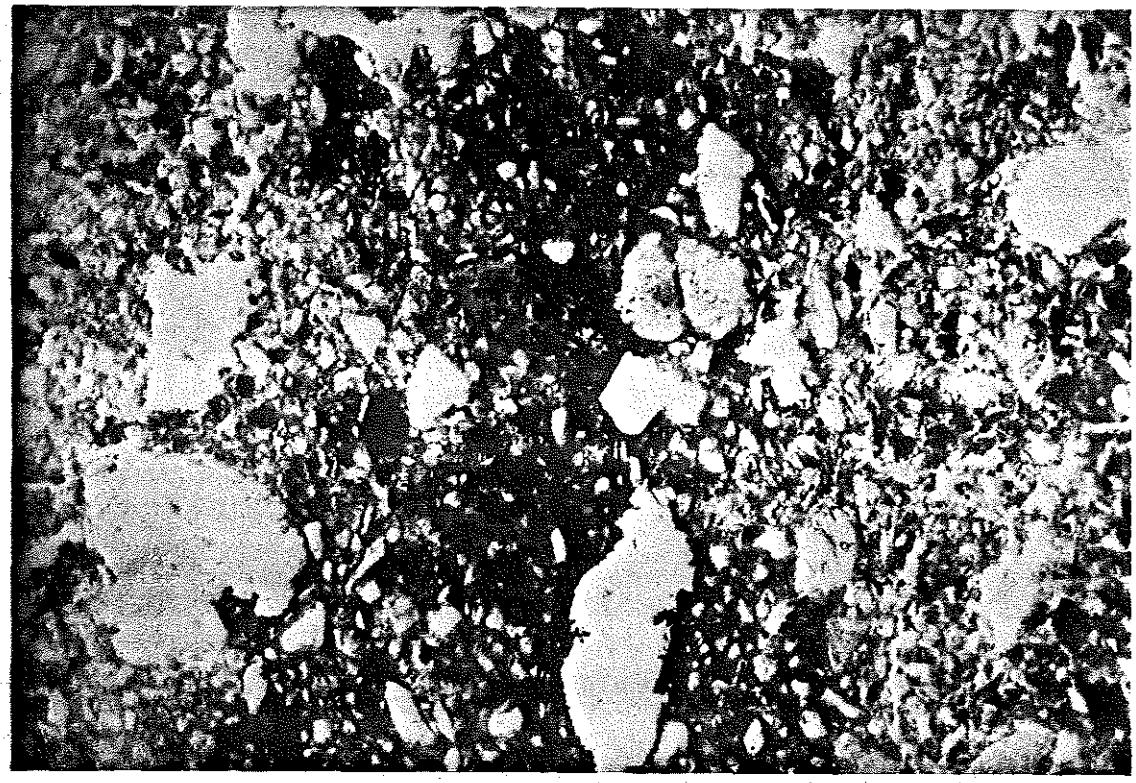
It is very important to note that in the Dark Earth deposit, sampled some 50cms above the base of the floor, the fabric appears to be purely that of micro-aggregates (Plates 11, 12) - typical of Dark Earth (Macphail, 1981, 1983; Macphail and Courty, 1985), and seemingly very probably the result of

Enchytraeidae. Therefore this clear evidence suggests the impact of earthworms on Dark Earth deposits may have been over-emphasised in the past. The origin of Dark Earth, Although still under study (Macphail, COSE and 28 Park St. AML reports in prep) relates in part to the destruction of insubstantial buildings (Macphail and Courty, 1985) and again the fine calcium carbonate (Table 1) present within the mattrix at Jubilee Hall (Plate 13) is a typical result.

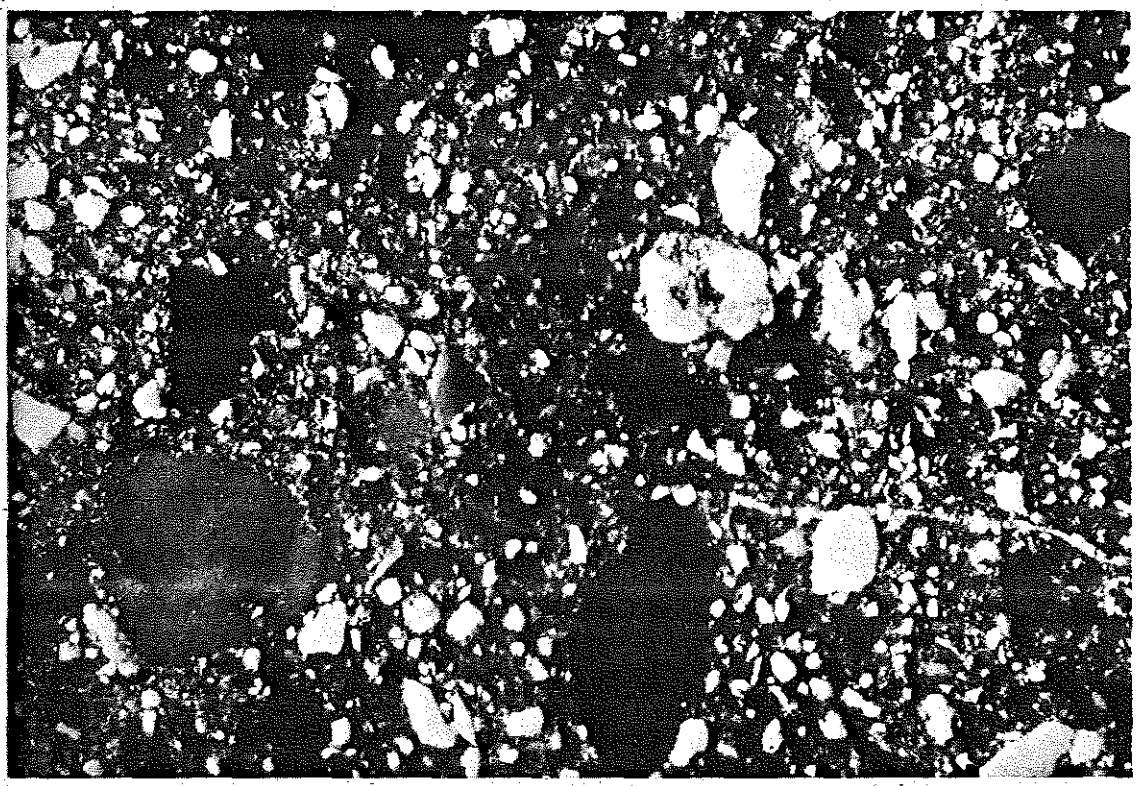
1. Photomicrograph: brickearth collapse; in centre very pure brickearth; surrounding it is "brickearth daub" contaminated by mixed-in organic matter and charcoal. Note brown infill of amorphous organic matter related to mobile organo-phosphatic solutions (vivianite is present) from coprolites or ash breakdown. PPL (Plane polarised light), frame length is 3.35mm.



2. As 1. XPL (crossed polarised light).

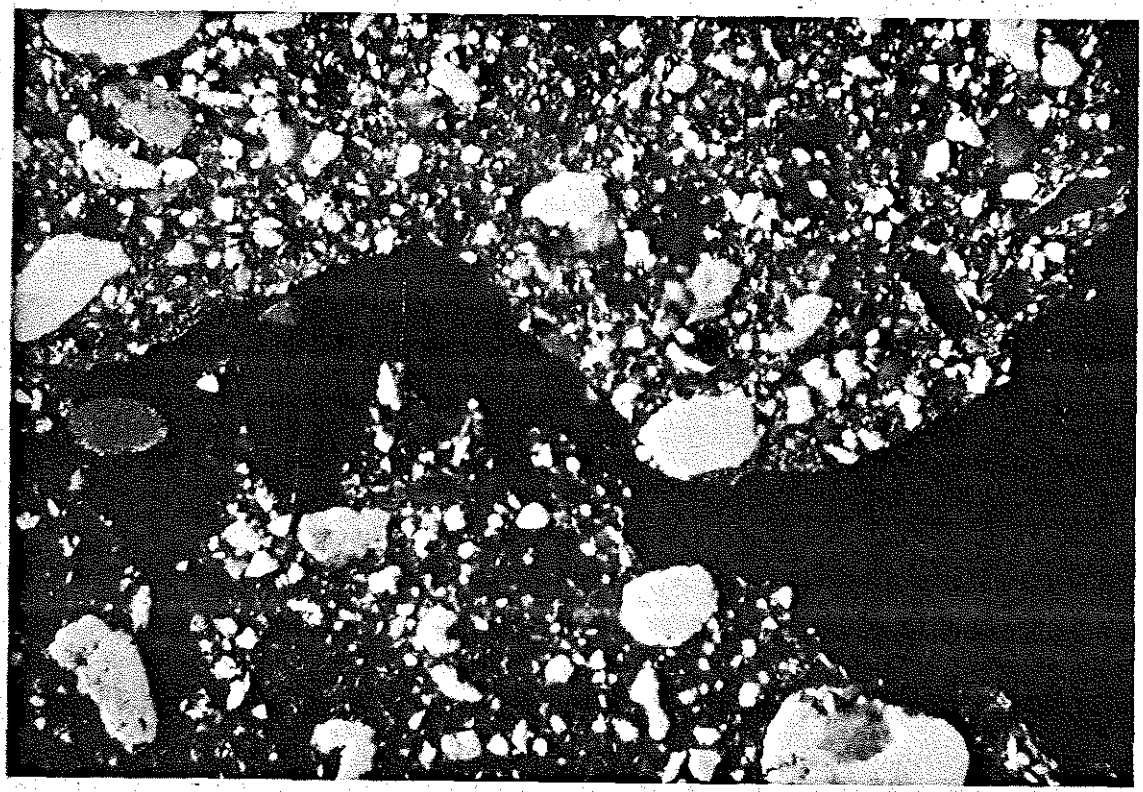


3. Brickearth collapse; layers of brickearth mixed with organic matter as a daub, part of which has been burned with associated wood; a fabric containing relic charcoal and calcitic ash has been reddened by heating as a result. PPL, frame length is 3.35mm.



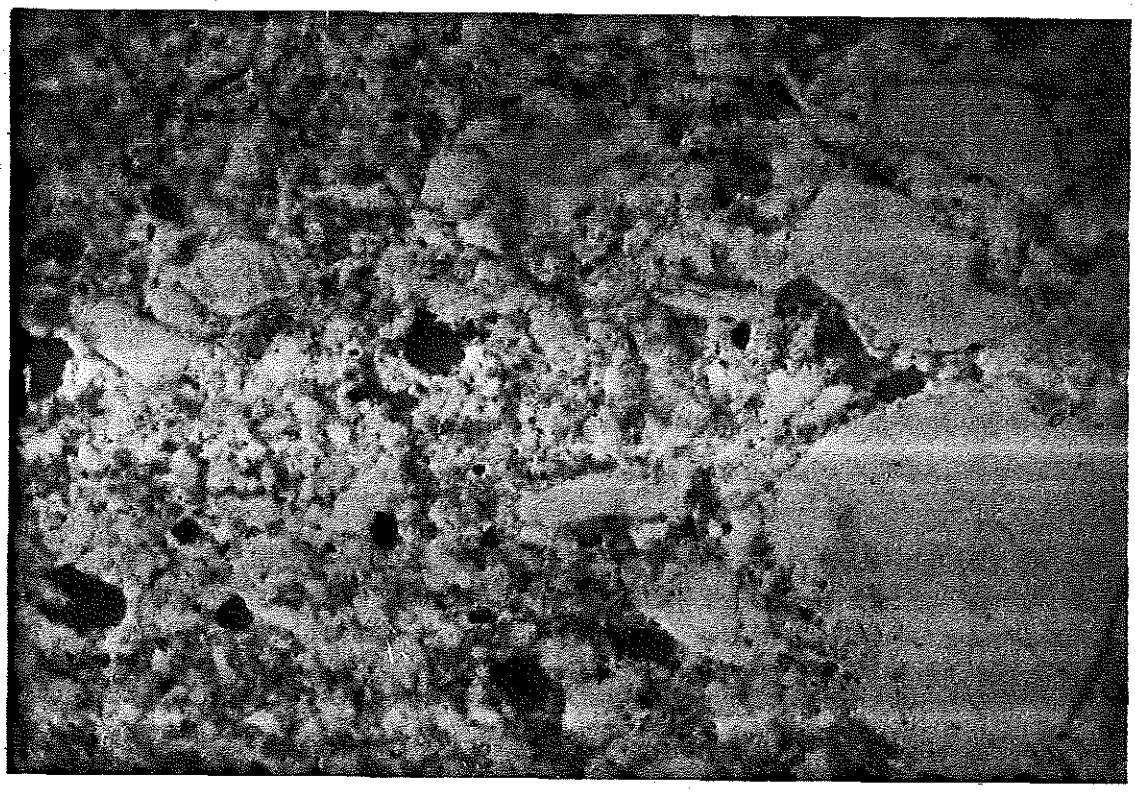
4. As 3, XPL.

5. Brickearth collapse/Pale Dark Earth; mammilated earthworm excrements surrounded by general Dark Earth fabric (see Plates 11, 12); note pale colour of excrements relating to loss of "digestible" organic matter. PPL, length of frame is 3.35mm.

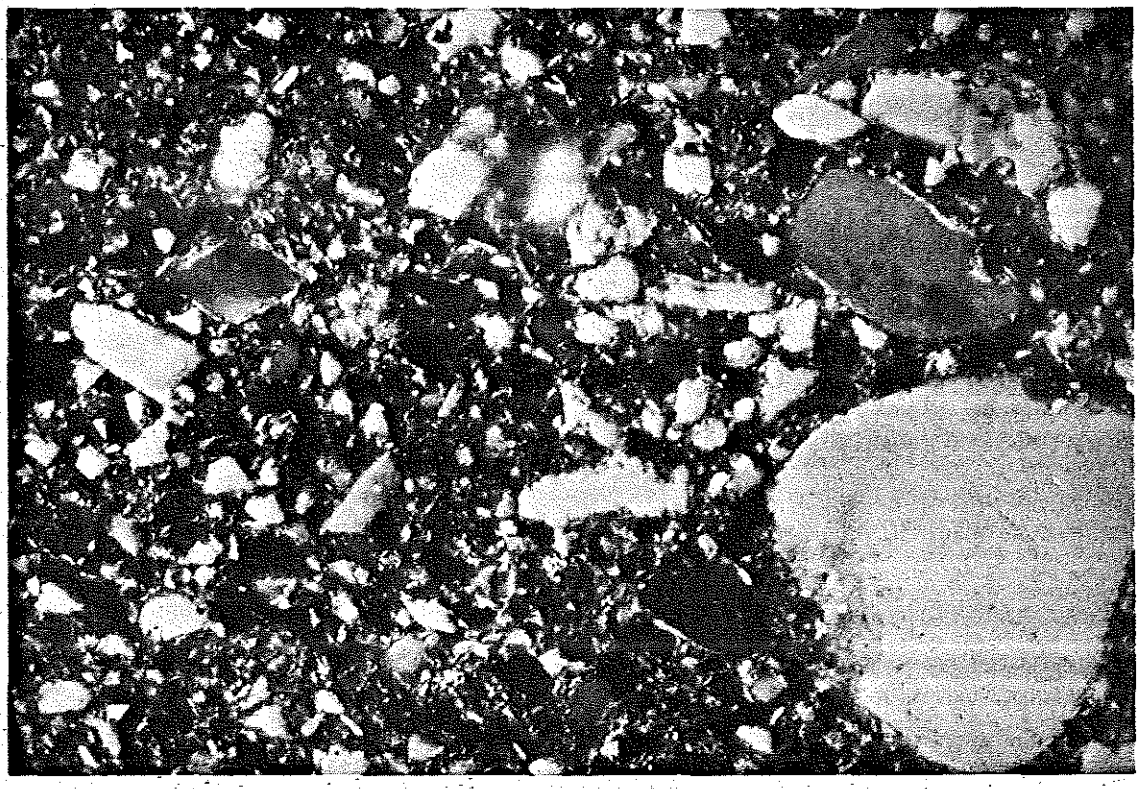


6. As 5, XPL; note similar sorting and birefringence, although the latter is somewhat masked by organic matter in the Dark Earth

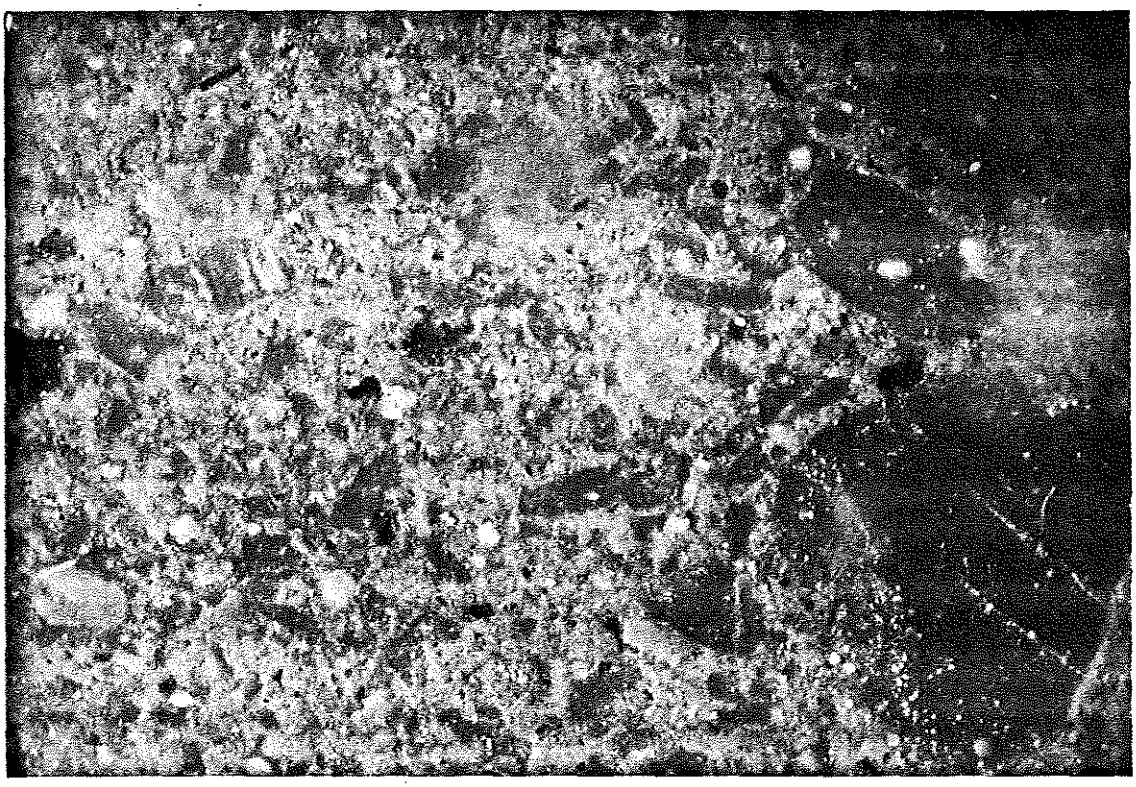
7. As 5, OIL (Oblique incident light); note paler colour of the excrement because of lower organic content.



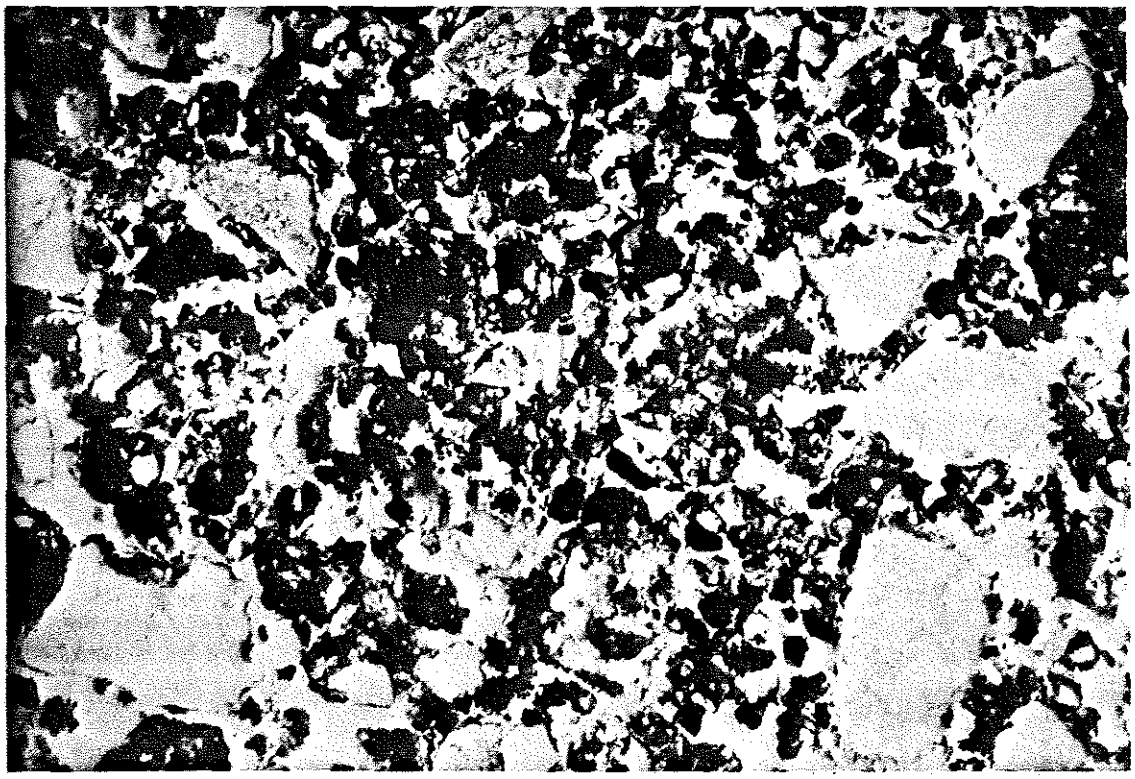
8. As 5; detail of excrement showing that common, fine organic fragments still occur. PPL, length of frame is .33mm.



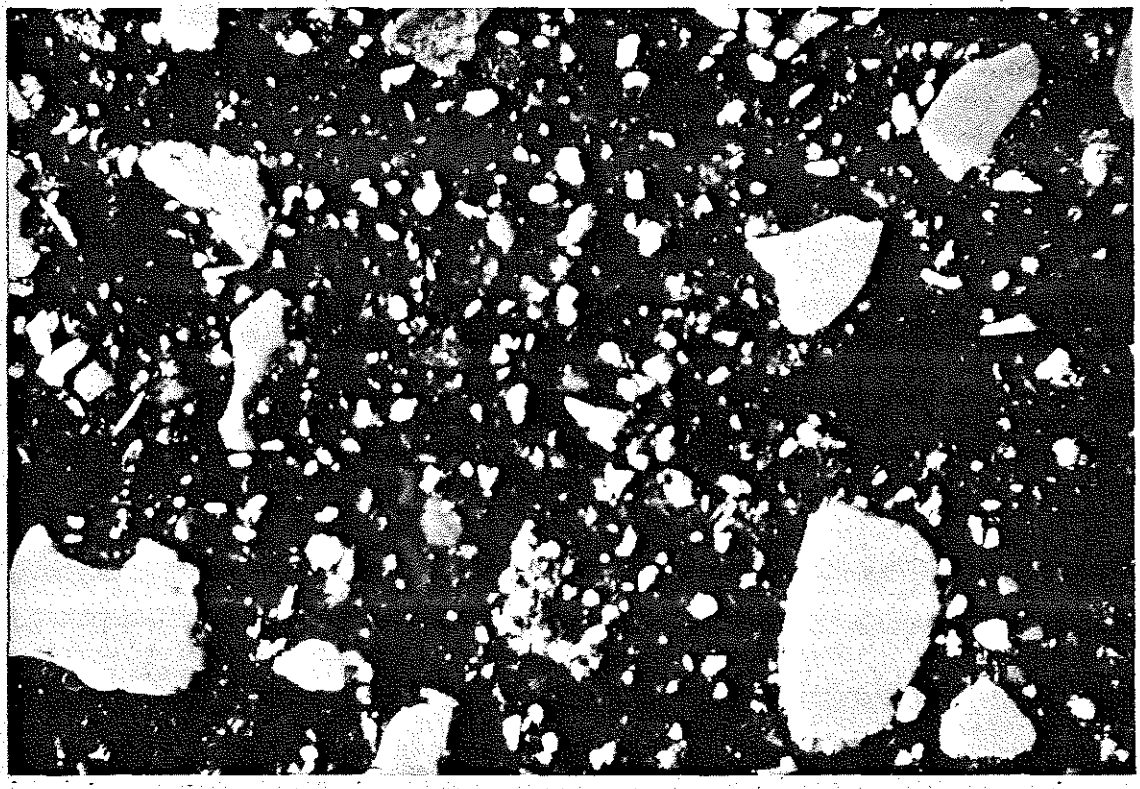
9. As 8, XPL, note birefringence pattern (very similar to natural brickearth).



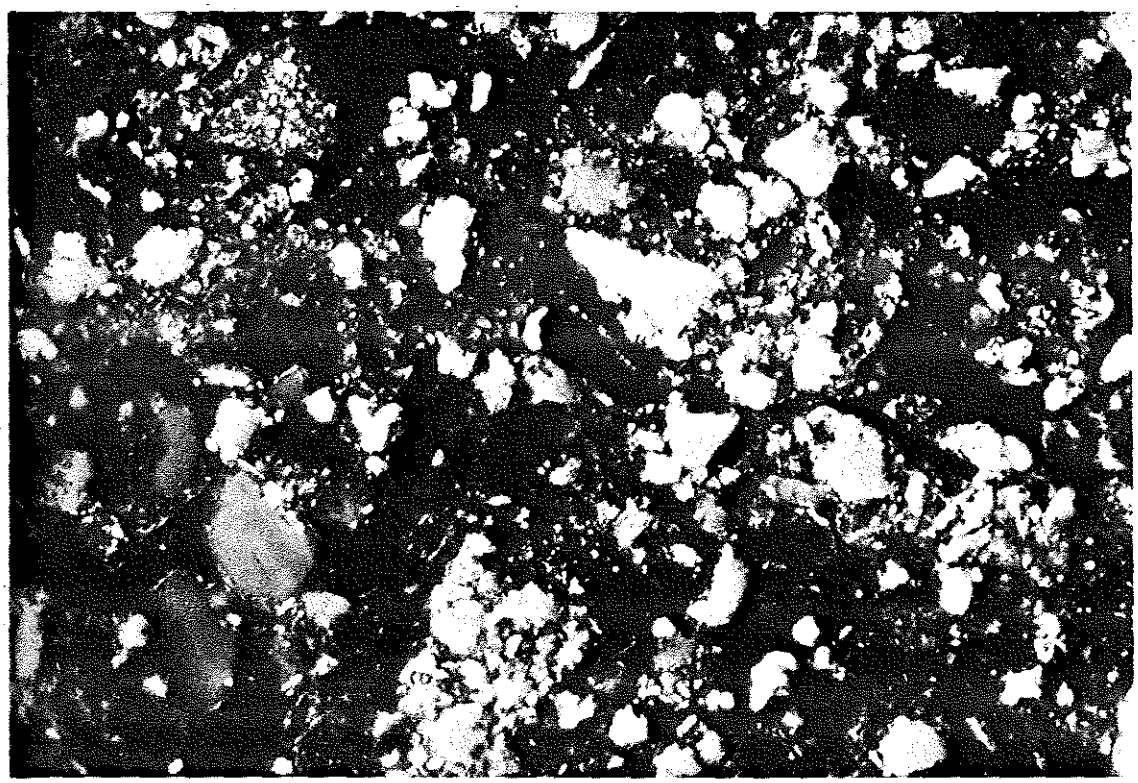
10. As 8, OIL; note only indigestible, fine charcoal remains.



11. Dark Earth; fabric dominated by typical organo-mineral micro-aggregates of presumed Enchytraeidae origin. PPL, length of frame is 3.35mm.



12. As 11, XPL; note background crystallitic b-fabric.



13. As 11, detail showing fine birefringence of calcitic material (ash, plaster, mortar origin) typical of Dark Earth. XPL, length of frame is .33mm.