

BRICKEARTH, AND ITS INFLUENCE ON THE CHARACTER OF SOILS, IN THE SOUTH-EAST NEW FOREST

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I. INTRODUCTION

BRICKEARTH is an indefinite geological term applied to loamy, superficial deposits of Quaternary age. Structureless deposits of brickearth are common in Southern and Eastern England and in most, particles in the size range $10\mu\text{m}$ to $200\mu\text{m}$ are dominant.

The Geological Survey maps a number of patches of brickearth in the south-western New Forest, most notably at Barton-on-Sea. Additional deposits of brickearth have been described from the New Forest (White 1915, Everard 1952, Lewin 1966a) and the author records several more in this paper for the south-east of the area.

The first aim of the work here recorded was to determine the extent of brickearth deposits in the south-east corner of the New Forest. Everard (1952) provides a very general map of brickearth distribution around Southampton Water which shows a large deposit at Fawley not recorded by the Geological Survey. As well as adding to the map of Everard an attempt was made to locate shallow deposits of brickearth, not mappable by the geologist, but which may make an important contribution to soils.

A further aim of the work was to try and determine the origin of the brickearth. Some brickearths have been described, especially from Kent (Pitcher *et al* 1954, Dines *et al* 1954), which have a particle size distribution which shows them to be true loesses, i.e. 50 per cent of the particles have diameters in the range $10\mu\text{m}$ to $50\mu\text{m}$ (Russell 1944, Pecsli 1968). Other brickearths are coarser, or less well sorted, and are considered to be loams which were transported to their final positions not by wind, but by water or solifluction (Godwin-Austen 1857, Prestwich 1865, White 1928, Zeuner 1949, Dines *et al* 1954). There was the possibility that a loess fraction might be isolated from some of the soils examined even if no loess deposit was apparent; this has been found to be the case in other areas (Perrin 1956, Avery *et al* 1959, Piggott 1962, Hodgson *et al* 1967).

The soil types developed on the brickearth, and the associated plateau gravel, of the south-east New Forest are described. The soil profiles are given series names after those originated by Kay (1939) in a survey of the comparable area of plateau gravel, brickearth and Tertiary rocks east of Southampton Water. These series have been mapped in other areas along the South Coast (Hodgson 1967), and although not used by Forestry Commission soil surveyors their applicability to the New Forest is pointed out by Birch (1964).

2. DESCRIPTION OF FIELD SITES AND SOIL PROFILES

A generalised map of brickearth distribution in the area is given (fig. 1) and the sites selected for detailed discussion may be located on this. These sites have been selected

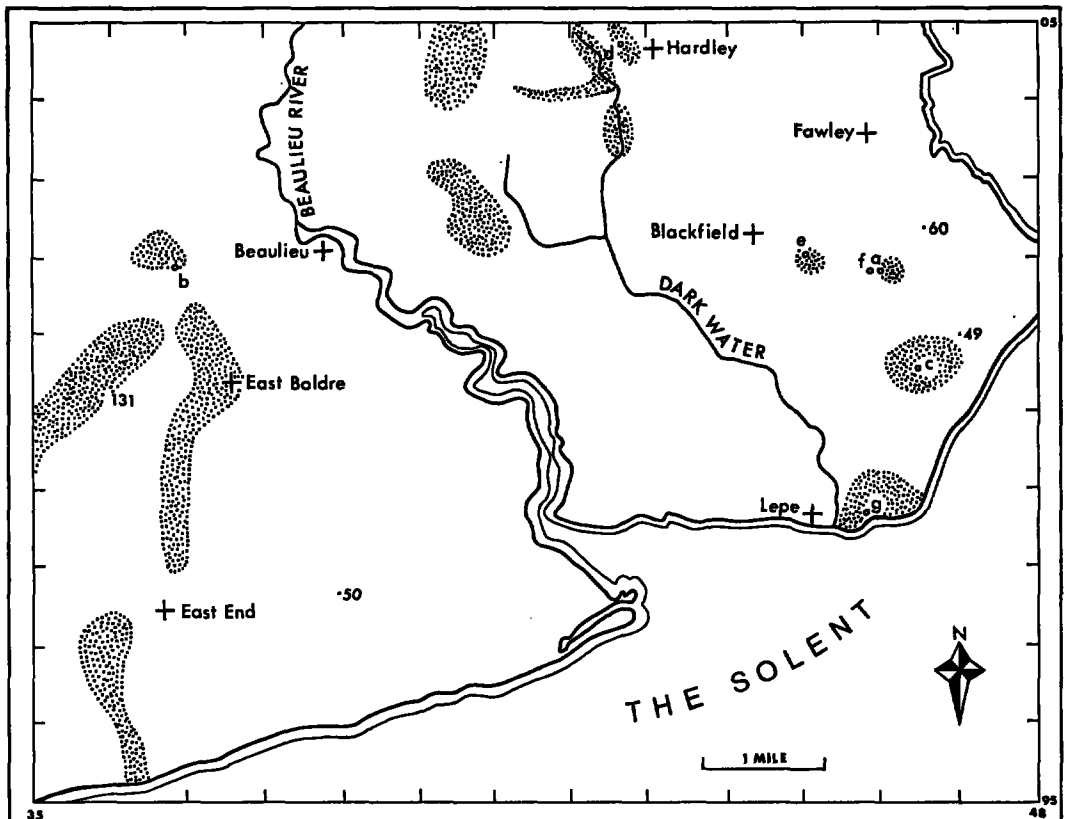
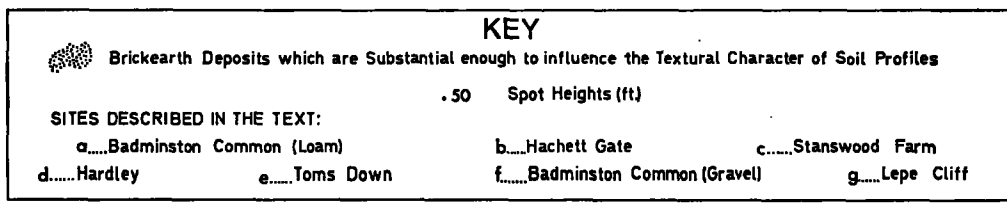


FIG.1: A GENERALIZED MAP OF BRICK-EARTH DEPOSITS
IN THE S.E. NEW FOREST



to provide an idea of the variability of the brickearth and its associated soils, whilst one of the sites on Badminton Common (O.S. Grid Reference 458015) is on plateau gravel and is described to provide a contrast with the brickearth sites. The brickearth sites described are at Badminton Common (459017), Stanswood Farm (464005), and Hatchet Gate (369018) and in the quarries at Hardley (425045) and Tom's Down (450020), and the cliff face east of Lepe (458985).

The brickearth soil at Badminton (459017) is on the north side of the Common within a previously unrecorded embanked enclosure.¹ This enclosure seems to correspond roughly with the well drained brown-earth soil developed on the brickearth, in contrast to the heavily podzolised soil on the gravel of the rest of the common. Below is given a profile description of the brickearth soil at Badminton. The profile nomenclature follows that currently used by the Soil Survey of Great Britain. Unless otherwise indicated the colours refer to air dry soil compared to Munsell Soil Colour standards.

Profile:	Badminton Common Brickearth.
Series:	Hamble Fine Sandy Loam series (well-drained brown earth of low base status).
Location:	Badminton Common, Nr. Fawley (SO 459017).
Elevation:	19.2 m. O.D. Slope: Level Drainage: Well drained.
Vegetation:	Scrub with a heath aspect.
Horizons:	
A	Very dark brown (10YR 2/2) loamy sand, slightly stony; structureless, with much humus intimately mixed; many roots; sharp boundary.
0-5 cm.	
E1b	Very dark greyish brown (10YR 3/2) loamy sand, increasing clay content with depth; slightly stony; friable, weakly structured; many roots; merging boundary.
5-30 cm.	
E2b	Dark greyish brown (10YR 4/2) loamy sand; very stony; weakly structured; narrow boundary.
30-40 cm.	
B1t	Dark brown (7.5YR 4/2) fine sandy loam with much gravel; weak structure; merging boundary.
40-65 cm.	
B2t	Dark yellowish brown (10YR 4/4) fine sandy loam; slightly stony; weak prismatic structure; merging boundary.
65-80 cm.	
B2t/C	Yellowish brown (10YR 5/4) fine sandy loam, slightly stony; weak prismatic structure.

Not all the brickearth soils in the south-east New Forest are well drained. Some are partially gleyed soils and similar soils are put by Kay (1939) into the Hook Fine Sandy Loam series. A partially gleyed brickearth soil can be seen in the area west of Hardley, and a 2 m. thickness of the parent material covering plateau gravel is exposed in a disused pit (425025). A profile description of the Hardley soil is given below as an example of a brickearth soil with signs of gleying.

¹ This enclosure does not appear on the nineteenth century maps of the Cadland Estate nor on the 1814 enclosure map for Eling and Fawley (Hampshire Record Office), and probably represents an undocu-

mented illegal eighteenth century encroachment onto what was then a Manorial Waste (C. Tubbs, private communication).

Profile:	Hardley.
Series:	Hook Fine Sandy Loam series (brown earth of low base status gleyed in B and C horizons).
Location:	West of Hardley (SU 425025).
Elevation:	33.5 m. O.D. Slope: 1°, aspect west. Drainage: slightly impeded.
Vegetation:	Old permanent pasture showing signs of reversion to heathland.
Horizons:	
A	Dark greyish brown (10YR 4/2), fine sandy loam; humose; structureless; merging boundary.
0-5 cm.	
E1b	Greyish brown (10YR 5/2) fine sandy loam; moderate crumb structure; merging boundary.
5-25 cm.	
E2b	Dark greyish brown (10YR 4/2) fine sandy loam; very stony; friable; the limit of most roots; narrow boundary.
34-45 cm.	
Bitg	Mottled dark brown (10YR 4/3) fine sandy loam; weak prismatic structure; slightly stony; mottling fades on exposure to air but in the field the mottles appear yellowish red (5YR 5/6) to dark grey (10YR 4/1); merging boundary.
45-50 cm.	
Bitg/C	Very pale brown (10YR 7/4) slightly stony fine sandy loam when dry: yellowish red (5YR 5/6) in the field mottled with reddish yellow (7.5YR 7/8) and dark grey (10YR 4/1). Moderate prismatic structure; narrow boundary with underlying sandy gravel.
50-150 cm.	

The brickearth from Tom's Down (450020, 18.3 m. O.D.) was from a quarry face. Its texture in the field appeared to be similar to that of the Hardley sample, i.e. more clayey than the Badminton brickearth. In the large quarry complex at Field's Heath and Tom's Down small pockets of brickearth may be seen in a number of places and the quarrymen described occasional banks of 'clay' (brickearth) running through the uppermost gravel layers.

The brickearth sample from east of Lepe (458985, 4.25 m. O.D.) was taken from a deposit of variable depth (up to 1 m.) which rests on gravel exposed in a cliff face approximately 5 m. high. The sample from Hatchet Gate (369018, 38.1 m. O.D.) came from the bottom of a soil pit (0.6 m.), which exposed a shallow moderately podzolised soil, under acid grassland. The pit was within the 18th century banked and ditched enclosure described by Tubbs and Jones (1964). This site is mapped as an area of Plateau Gravel underlain by Headon Beds by the Geological Survey; the apparently extensive brickearth deposit on this site is very different in colour (light olive brown, 2.5Y 5/4) if not in texture, from all other samples examined. The sample from Stanswood Farm (464005, 15.8 m. O.D.) is from the plough layer (Ap horizon) of an area where a thin layer of brickearth overlying gravel has been cultivated.

Detailed profile descriptions have been given of only two brickearth soils (Badminton and Hardley) since these are typical representatives of the two major brickearth soil series into which all other samples fall. The brickearth soil at Hatchet Gate showed signs of podzolisation but the soil was very far from the podzol found developed on gravel in this area. These gravel soils (Southampton Gravelly Sand series of Kay) are the commonest on superficial deposits in this area. As the map of brickearth distribution shows, this deposit, in contrast to the gravel, only covers a restricted area. The

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gravel podzol soil, the profile of which is detailed below, is from Badminton Common (458015) and a comparison of this profile and its related analytical data (see Section 4) with that for brickearth soils will indicate how much more favourable for plant growth are the brickearth soils.

Profile:	Badminton Common, Plateau Gravel. Series: Southampton Gravelly Sand series (strongly podzolised).
Location:	Badminton Common, near Fawley (SU 458015).
Elevation:	19.1 m. O.D. Slope: level Draining; slightly impeded in winter.
Vegetation:	Dry heathland vegetation.
Horizon:	
F 0-1 cm.	Black heath mor.
A	Dark reddish brown (5YR 2/2) coarse sand, slightly stony; high humus content; structureless; sharp boundary.
1-8 cm.	
E1a	Dark grey (5YR 4/1) coarse sand and gravel; structureless; moderate amount of humus; merging boundary.
8-20 cm.	
E2a	Grey (5YR 5/1) coarse sand and gravel; structureless; moderate amount of humus; merging boundary.
20-35 cm.	
Bh	Very dark greyish brown (10YR 3/2), coarse sand and gravel with occasional large cobbles; humose; undulating horizon of variable thickness; merging boundary.
35-40 cm.	
Bfe	Dark yellowish brown (10YR 4/4) coarse sand and gravel; slightly humose; weakly cemented; variable in thickness; merging boundary.
40-55 cm.	
Bfe/C	Strong brown (7.5YR 5/6) coarse sand and gravel, friable.

3. METHODS OF ANALYSIS

Standard methods were used for particle size and other laboratory analyses of brickearth parent material and profile samples. The particle size analysis of parent materials was by wet sieving followed by a pipette analysis (Loomis 1938), and of profile samples by wet sieving and the hydrometer method (Bouycous 1951). All samples for particle size analysis were dispersed with sodium hexametaphosphate. The pH of soil samples was determined on a suspension with a soil/liquid ratio of 2.5:1 using both water and 0.01 M CaCl_2 (Ryti 1965) to give a closer approximation to the field condition. The reported loss on ignition is the weight loss after two hours in a muffle furnace at 525° C. The total exchangeable cations were determined by the rapid method of Brown (1943) and are expressed as milliequivalents per 100 gm. of soil.

4. RESULTS OF LABORATORY ANALYSES

The details of the analytical work on the three profiles described in detail are given below (Table I). The texture classes in the table are those of the International Soil Science Society.

PROCEEDINGS FOR THE YEAR 1971

TABLE I: ANALYTICAL RESULTS FOR THE PROFILES AT BADMINSTON COMMON AND HARDLEY

PROFILE AND SERIES	Depth in cms.	% of gravel in total sample	ANALYSIS OF FINE EARTH (2 mm.)				Horizon	Loss on Ignition %	Total exchangeable cations	pH	
			Sand 2 mm. - 200 μ m.	Fine Sand 200 μ m. - 20 μ m.	Silt 20 μ m. - 2 μ m.	Clay 2 μ m. - 0				H ₂ O 1:2.5	M/100 CaCl ₂
Badminston Common	0-5	2.5	20.7	56.3	14.8	7.2	A	22.9	6.6	3.8	3.2
No. 1	5-15	4.0	19.4	64.8	14.2	1.6	E1b	11.4	4.2	3.9	3.4
Hamble	15-30	5.9	28.4	49.0	13.0	9.6	E1b	11.3	8.8	4.1	3.6
Fine Sandy	30-40	36.2	32.2	45.7	8.3	13.8	E2b	7.2	6.6	4.2	3.6
Loam	40-65	49.9	25.2	35.0	17.2	22.6	B1t	8.2	11.7	4.5	3.5
	65+	8.0	18.0	55.0	11.1	15.9	B1t/C	6.1	8.0	4.5	3.5
Badminston Common	1-8	5.7	53.5	42.0	4.2	0.6	A	55.5	4.9	3.3	2.8
No. 2	8-20	77.1	50.1	40.1	8.2	1.6	E1a	10.7	5.0	3.7	3.0
Southampton	20-30	81.5	50.2	36.0	9.2	4.6	E2a	6.2	6.4	4.0	3.0
Gravelly	30-35	79.5	45.9	39.7	9.2	5.2	E2a	3.6	8.1	4.1	3.3
Sand	35-40	61.0	50.1	40.5	7.4	2.0	Bh	8.3	7.2	4.4	3.6
	40-55	64.0	60.3	29.1	5.0	5.1	Bfe	3.6	7.0	4.5	3.6
	55+	50.0	74.7	13.4	4.8	7.1	Bfe/C	—	—	—	—
Hardley	0-5	4.2	15.3	40.7	25.4	18.6	A	10.27	9.2	5.4	4.6
Hook	5-35	1.5	20.9	47.4	13.1	18.6	E1b	7.68	10.0	4.9	4.1
Fine	35-45	21.6	17.4	60.2	10.8	11.6	E2b	6.5	8.8	3.8	4.7
Sandy Loam	45-50	11.2	16.5	54.7	13.6	15.2	B1tg	7.5	6.6	4.7	3.9
	50-150	1.7	8.8	46.4	18.5	26.3	B1tg/C	—	—	—	—

From profile morphology and field data it was possible to equate the soil types found in the S.E. New Forest with the series mapped by Kay (1939). However, detailed analyses of the profiles, for example the three tabulated above, show some contrasts with the equivalent data presented in Kay's report. The brickearth tends to be a very variable deposit, but in general in the area studied its main difference from the material analysed by Kay lies in its greater content of coarse sand (see figs. 1 and 2), and this is reflected throughout the profiles. A Hamble series profile like that on Badminston Common is therefore coarser in texture than the type profile and in consequence more acid and base poor. The same is true of the Hook series in the S.E. New Forest when compared to the equivalent series east of Southampton Water and in Sussex. Analyses of Plateau Gravel from the S.E. New Forest (fig. 2) show it to contain less coarse sand than Kay's samples.

Figs. 2 and 3 show cumulative frequency curves of particle size distribution for six samples of brickearth and one of gravel, including the parent materials of the three

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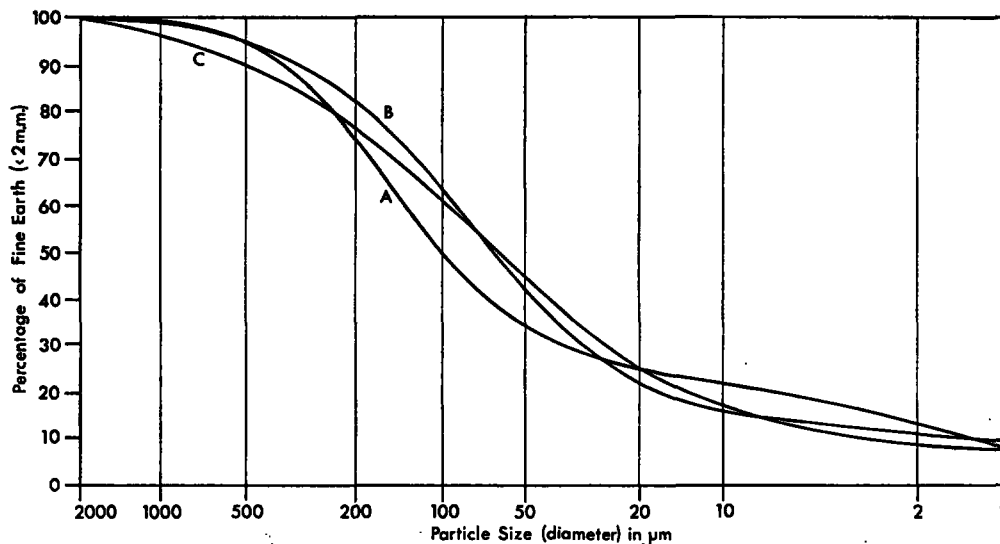


FIG.2: Cumulative Frequency Curves of the Particle Size of Brickearths from the S.E. New Forest

CURVE A.....BADMINSTON COMMON LOAM. CURVE B.....HATCHETT GATE BRICKEARTH.
CURVE C.....STANSWOOD FARM BRICKEARTH.

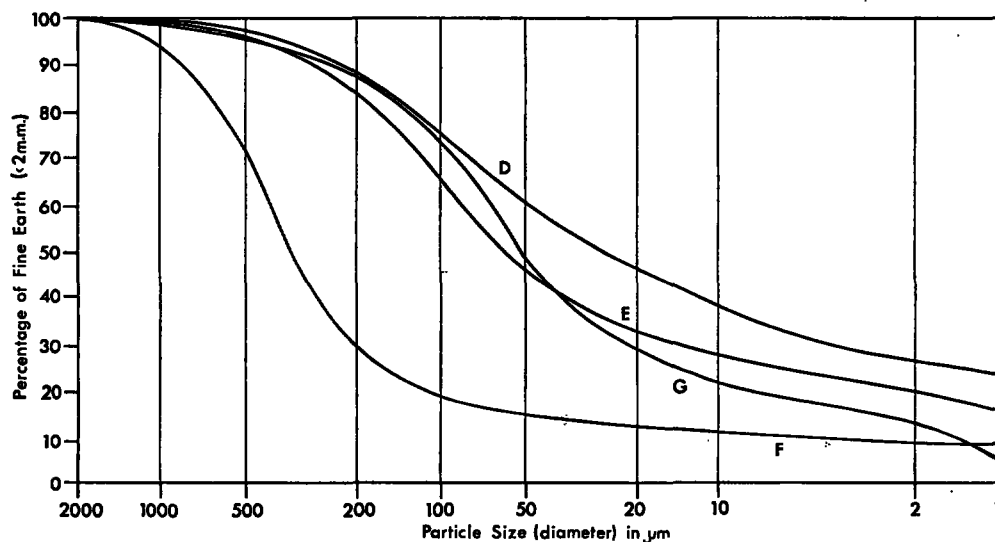


FIG.3: Cumulative Frequency Curves of the Particle Size of Brickearth and Gravel Deposits in the S.E. New Forest

CURVE D.....HARDLEY BRICKEARTH. CURVE E.....TOMS DOWN BRICKEARTH
CURVE F.....BADMINSTON COMMON GRAVEL. CURVE G.....LEPE CLIFF BRICKEARTH

profiles detailed above. The attributes of the curves are summarised in Table II. The obvious difference between gravel and brickearth fines (fig. 3) is that brickearth seldom has more than 20 per cent coarse sand, but gravel fines include 75 per cent coarse sand. As a broad generalisation, the curves for brickearth tend to be of two types. The curves for Badminton loam, Hatchet Gate and Stanswood Farm (fig. 2) illustrate the commonest textural type of brickearth, dominated by fine sand, low in silt and clay and moderately sorted. Brickearth of the type from Tom's Down and Hardley (fig. 3) is also dominated by fine sand but the modal class is towards the bottom of the fine sand range and clay is fairly high (20 per cent); this brickearth is poorly sorted and occasionally carries soils which are slightly gleyed (Hook Fine Sandy Loam series). The sample from Lepe (fig. 3) is rather better sorted than most brickearths from the area, but no samples examined have approached the cumulative frequency curve characteristic of loess (Zeuner 1949, West 1969). In summary it may be said that the brickearths of the S.E. New Forest are poorly sorted loams, often stony, with a mode at the finer end of the fine sand range and occasionally a high clay content; their cumulative frequency curves are those of floodloams (Zeuner 1949). Other brickearths from the New Forest have already been classified as floodloams (Chatwin 1948, Lewin 1966). The implication of these results is discussed below.

TABLE II: ATTRIBUTES OF FREQUENCY DISTRIBUTIONS OF SEDIMENT FINES (<2 mm.)

SAMPLE	md	Q1	Q3	so	sk
Badminton Common Brickearth	98 μ	190 μ	19 μ	3.16	0.375
Lepe Cliff Brickearth	50 μ	102 μ	16 μ	2.51	0.652
Tom's Down Brickearth	59 μ	140 μ	7 μ	4.47	0.281
Stanswood Farm (Ap)	62 μ	180 μ	23 μ	2.79	1.077
Hatchett Gate Brickearth	72 μ	155 μ	25 μ	2.49	0.747
Badminton Common Gravel	345 μ	560 μ	180 μ	1.76	0.846
Hardley Brickearth	30 μ	104 μ	1.5 μ	8.3	0.173

Md = Median Grain Size

Q1 = Upper Quartile (size with 75 per cent smaller)

Q3 = Lower Quartile (size with 25 per cent smaller)

So = Sorting coefficient $\sqrt{Q_3/Q_1}$

Sk = Skewness coefficient $Q_1.Q_3/Md^2$

5. DISCUSSION

The south-east New Forest is an area of Oligocene Headon Beds which are protected by large spreads of Plateau Gravel. Hence the two commonest soil series in the area are gravel-podzol soils, the Southampton Gravelly Sand and its cultivated equivalent the Warsash Gravelly Loam Sand both originally described by Kay (1939). However, Brickearth is more common than the Geological Survey maps indicate, but it generally occurs only as shallow sheets (e.g. at Lepe) often mixed with gravel by

cultivation, or if it is deeper than about one metre it is of very limited extent. The Brickearth soils are generally well drained but partially gleyed types (Hook Fine Sandy Loam series) were mapped; Kay (1939) attributes gleying in this series to a high water table in a topographically unfavourable site. However, in some cases in the New Forest (see for example the profile description and analytical data for the Hardley brickearth) drainage impedence due to a relatively high content (25 per cent) of fine clay in the parent material might be a contributing factor. All the brickearth examined contained some gravel, usually concentrated into layers, which if they become part of a soil profile contribute a marked feature to the profile morphology (see description of Hardley profile). The brickearth deposit at Lepe has stones spread throughout it, but since it is thin (about 1 m.) it is possible some of the stones have been incorporated from the gravel beneath by post-depositional disturbance. Another factor which may have influenced the character of the brickearth, especially in the thinner deposits, is the possibility of textural changes since deposition, due to weathering.

The texture and sorting of the brickearth imply it is a floodloam rather than a loessic deposit, but in the exposures examined there are no signs of bedding, although stony facies are common. In the quarry complex at Field's Heath and Tom's Down there is evidence that the brickearth represents channel infill. Both the Plateau Gravel and the Brickearth were deposited under conditions very different from those of the present, probably at a time when the conditions of deposition fluctuated rapidly. It is unlikely the deposits are all of the same age, and post-depositional disturbance and mixing have probably been common. The result is a lack of uniformity in the superficial deposits which is reflected in the nature of the soil profiles; it could be argued that the soil series used in this paper are far too broad considering this variability, and mapping at the level of the soil type or soil phase may be advisable.

The dating of the brickearth is problematical. Brickearth occurs generally in or on the uppermost layers of Plateau Gravel which are here in the form of terrace features (Everard 1954). Brickearth occurs on all the terraces from Everard's 15 ft. (4.6 m.) stage to the 150 ft. (45.7 m.) stage, but rarely above this level. Everard's stages can in part be correlated with interglacial and interstadial sea levels in other areas (Zeuner 1959). The Plateau Gravel of the southern New Forest is considered to be late Quaternary in age (Small 1964), and may be unrelated in age and origin to the erosion surfaces on which it rests. All that can be said of the brickearth is that it is later than the Plateau Gravel on which it lies. In some locations the brickearth has been disturbed by what were probably permafrost conditions under a periglacial climate. For example in the disused gravel pit west of Hardley (425025), involutions occur in the gravel and some gravel has been injected into the brickearth above. Lewin (1966a, 1966b) has noted other such features. The last period of cold continental climate which might have induced such disturbance features was in Zone III of the Late Weichselian (end of the last glaciation). Some of the brickearth must therefore predate that period.

6. CONCLUSIONS

This preliminary survey has established that brickearth is more common in the south-east New Forest than previously thought. The brickearth deposits are variable

in texture, irregular in topographic position, and discontinuous; in the south-east New Forest as elsewhere in south Hampshire, they probably represent a much re-worked sediment incorporating some loessic material but most recently water deposited under flood conditions. Brickearth is not an important parent material in the south-east New Forest but where it does occur it gives rise to fertile brown-earth, and thin spreads of the deposit have ameliorated the textural character of gravel soils in several cultivated areas bounding the Solent and Southampton Water.

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