Natural Environment Research Council
British Geological Survey
Geology of Sheets SY 99 NE and SE
and parts of SY 99 NW and SW
Corfe Mullen - Lytchett Minster, Dorset
Part of 1:50 000 sheet 329 (Bournemouth)

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with contributions by
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and J. D. Cornwell (Geophysics)

Bibliographical reference
BRISTOW, C.R. and FRESHNEY, E.C. 1986
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(Corfe Mullen-Lytchett Minster, Dorset)

Geological report for DOE: Land Use Planning
(Exeter: British Geological Survey)

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Production of this report was funded by the
Department of the Environment

The views expressed in this report are not
necessarily those of the Department of the Environment

SUMMARY

Some 55 km^2 of the Corfe Mullen - Lytchett Minster area have been geologically surveyed at the 1:10,000 scale. As a result, the detailed stratigraphical sequence established in the Poole Formation during 1984 has been followed westwards; additionally, sand members within the London Clay have been recognized and mapped over a wide area. Gentle E-W flexures which are superimposed on the regional dip of 1°SE, probably overlie faults of pre-Aptian age (mid-Cretaceous). Dinoflagellate floras collected from the clays of the Poole Formation and London Clay allow the various stratal units to be placed within the known dinoflagellate zonal sequence. Landslips developed on the clays of the Reading Formation, and solution-collapse hollows developed over the Chalk have been identified at a number of sites. Many of the clays of the London Clay and Poole Formation have been exploited for bricks, tiles and pottery, but most pits are now disused and mostly backfilled. In addition, extensive reclamation of low-lying ground and tidal flats has occurred. A map showing the extent and nature of the Made Ground is included. Summaries of grading data for sand samples collected in the field are presented graphically. River Terrace Deposits occur at various levels; except in the extreme south and north they have been either built over, or exploited, or are of too limited extent or thickness to form significant resources. An account of the hydrogeology of the district is included. The application of geophysical techniques, principally using the EM 31 and 34 to measure ground conductivity as an aid to geological mapping, is discussed in Appendix 1. A glossary of technical terms appears at the end of the report.

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EXPLANATION OF PLATES

1. INTRODUCTION

The original geological survey of the area comprising Sheets SY 99 NE and SE and parts of sheets SY 99 NW and SW was made by H W Bristow and J Trimmer at the one-inch to one mile scale (1:63 360) as parts of Old Series Geological sheets 15 and 16, published in 1856 and 1855 respectively. The drift deposits were not represented on these maps. Clement Reid resurveyed the area on the six-inch to one mile scale (1:10 560) in 1894 and his results were incorporated in New Series One-Inch Geological Sheet 329 (Bournemouth), published in 1895 in both Solid and Drift editions, and in the accompanying memoir (Reid, 1898). A second edition of this memoir was produced by H J O White, and was published in 1917. White re-examined much of the ground, but the published maps remained unaltered. In 1976, the Bournemouth (329) Sheet was republished without revision at the 1:50 000 scale. In 1983 the Institute of Geological Sciences (now the British Geological Survey) was commissioned by the Department of the Environment (contract PECD7/1/0103-149/82) to provide new 1:10 000 geological maps of the Poole-Bournemouth area. This contract comprises the survey of ten 1:10 000 sheets, and parts of four others (Figure 1), over three years, to form a basis for the planning of urban and industrial development, and the safeguarding of mineral and water resources. The first phase of the contract was completed in 1983 and the results were incorporated in the four 1:10 000 sheets which comprise SZ 19, published in 1984, and the accompanying Open File Report by Freshney, Bristow and Williams (1984). During 1984, the second phase of the contract was completed and the four constituent

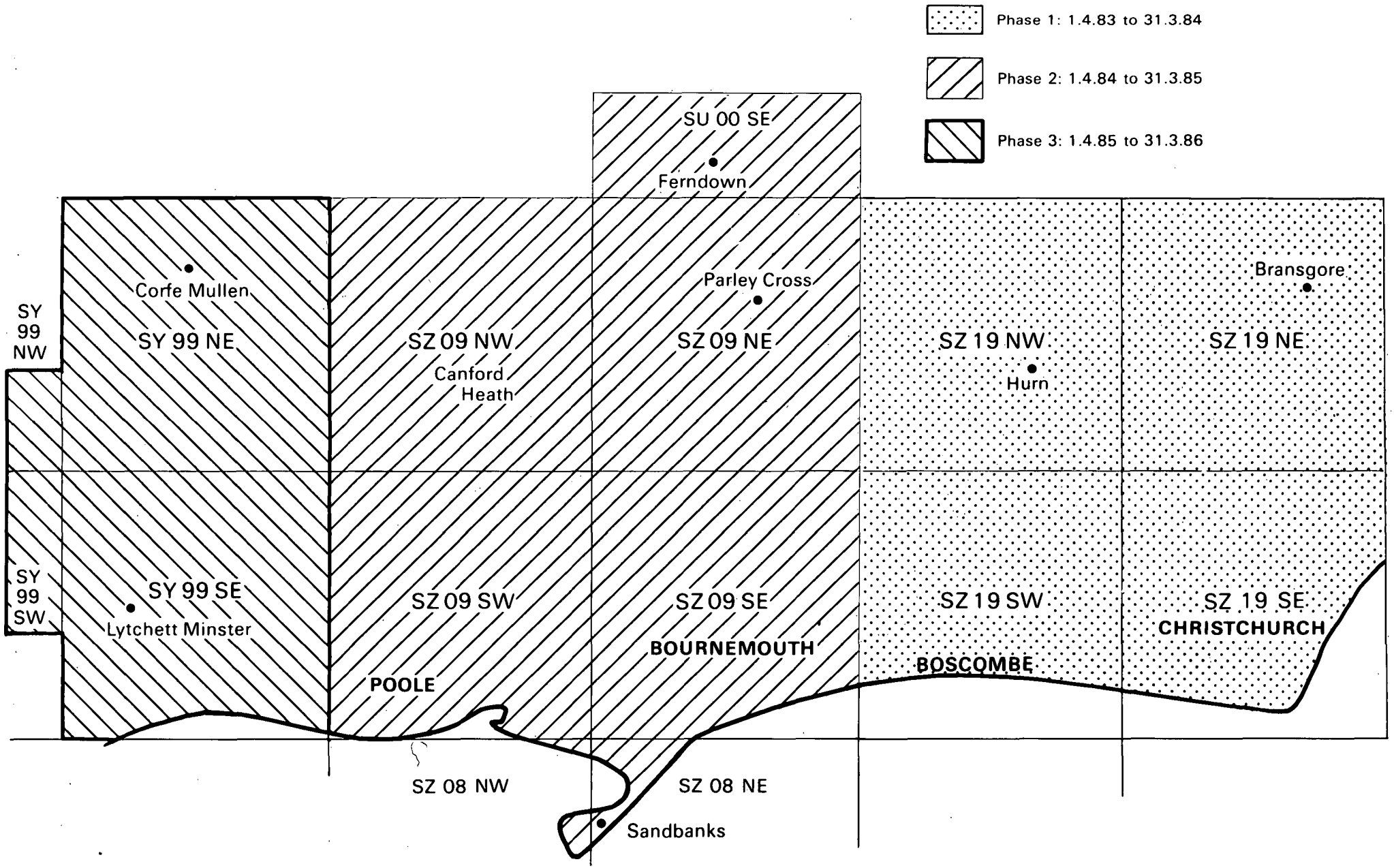


Fig. 1 Index map showing the area covered by the Poole-Bournemouth project and this Report.

quadrants comprising SZ 09 together with parts of sheets SZ 08 NW and SU 00 SE were published in 1985, together with an Open File Report (Freshney, Bristow and Williams, 1985). Mapping of the third and final phase of the contract, consisting of SY 99 NE and SE and parts of SY 99 NW and SW was carried out as follows in 1985 under the direction of R. W. Gallois, Programme Manager:

SY 99 NE C R Bristow
SY 99 NW C R Bristow
SY 99 SW C R Bristow
SY 99 SE E C Freshney

Dr R Harland, Mr C.J. Wood and Mr D.K Graham have provided palaeontological reports respectively on dinoflagellates,Tertiary and Quaternary molluscs encountered during the present survey.

Dr.J.D.Cornwell has provided an account of trial traverses of an EM31 ground conductivity meter as an aid to mapping a mixed sand/clay succession.

The authors thank Poole and Wimborne borough councils and Dorset County Council and their officers for their cooperation in providing borehole and other sub-surface information from their records. Thanks are also due to numerous landowners for access to their ground. Mrs Hemsley of the Beacon Hill Brick Co. Ltd, and Messrs A.Smith and G. Barrington of Pilkington and Carters Tiles, kindly provided details of their respective companies products.

The northern part of the area described in this report is drained by the River Stour and its tributaries. In the south, the smaller Sherford River and its dominantly north bank tributaries reaches the sea in Lytchett Bay. The watershed between these two rivers, which locally rises to over 90m,

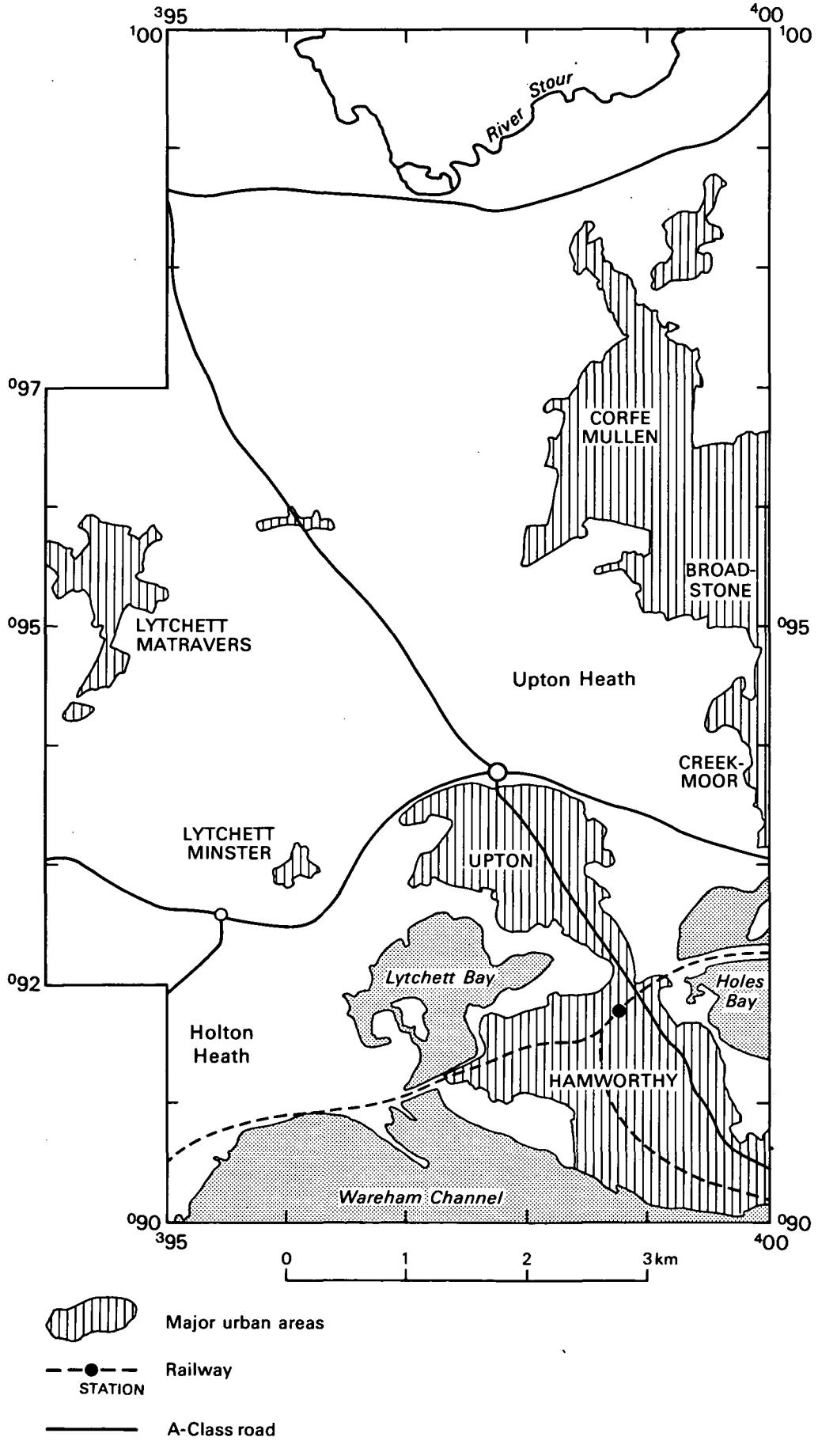


Fig. 2. Location map showing major urban areas and main communication routes in the Corfe Mullen-Lytchett Minster area.

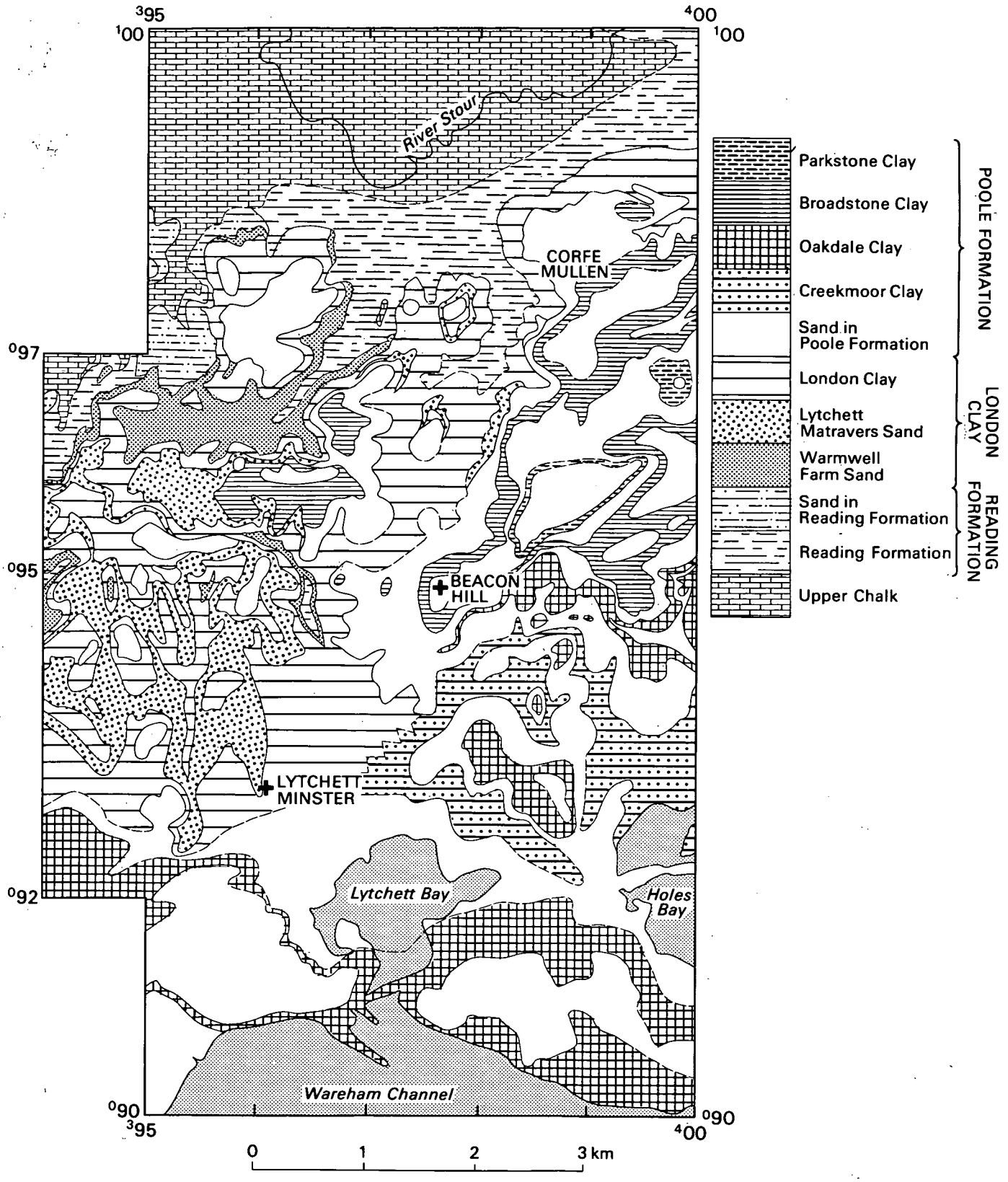


Fig. 3. Sketch-map of the solid geology of the Corfe Mullen-Lytchett Minster area

crosses the district from Lytchett Matravers, eastwards through Beacon Hill to Broadstone.

The urban areas of Hamworthy, Upton, Broadstone and Corfe Mullen occur on the eastern border of the district. The smaller villages of Lytchett Minster, Lytchett Matravers and Sturminster Marshall lie in the western part (Fig. 2).

Chalk crops out north of the River Stour and on the sides of some of the tributary valleys south of the Stour in the north-western part of the district. The Reading Formation occupies a narrow tract in the north-west and in the bottom of three small inliers in the south. The London Clay extends in an arc south-westwards from Lambs Green to Lytchett Minster (Fig. 3). The overlying Poole Formation occupies about 50% of the project area in the southern and eastern parts.

The principal drift deposits are the river terrace deposits which form a stepped suite principally in the north and east (Fig.8). The floodplain of the River Stour is floored by Alluvium which gives rise to rich pasture lands.

The geological succession present in the district is shown below in Table 1. Estimated thicknesses are given in metres where known. Abbreviated logs of selected boreholes are given on the maps and in Appendix 1.

Table 1. Geological succession in the Corfe Mullen-Lytchett Minster area.

DRIFT DEPOSITS

Quaternary	Landslip
	Alluvium
	Marine or Estuarine Alluvium
	River Terrace Deposits
	Marine Beach Deposits
	Head

SOLID FORMATIONS

System	Group	Formation	Named Member	Thickness	
		Branksome Sand		10	
	Bournemouth Group	Poole Formation	Parkstone Clay	2 to 5)	
			Broadstone Clay	2 to 7)	
			Oakdale Clay	8 to 10)	80
			Creekmoor Clay	6 to 18)	
Palaeogene		London Clay	Lytchett Matravers Sand	0 to 7	20 to 40
			Warmwell Farm Sand	0 to 15	
		Reading Formation		20	
Cretaceous		Upper Chalk		50 proved	

SOLID

The oldest solid rocks in the present district comprise the highest beds of the Cretaceous Upper Chalk. The Chalk is smooth, white and massively bedded with flints at various levels. The Chalk crops out, or has a subdrift crop, only in the north-west; it underlies the Tertiary rocks over the rest of the district. The Reading Formation consists principally of clay, commonly plastic and reddened. Coarse-grained sand is developed at various localities; in places the Reading Formation consists entirely of sand. The basal bed of the Reading Formation

BOURNEMOUTH GROUP

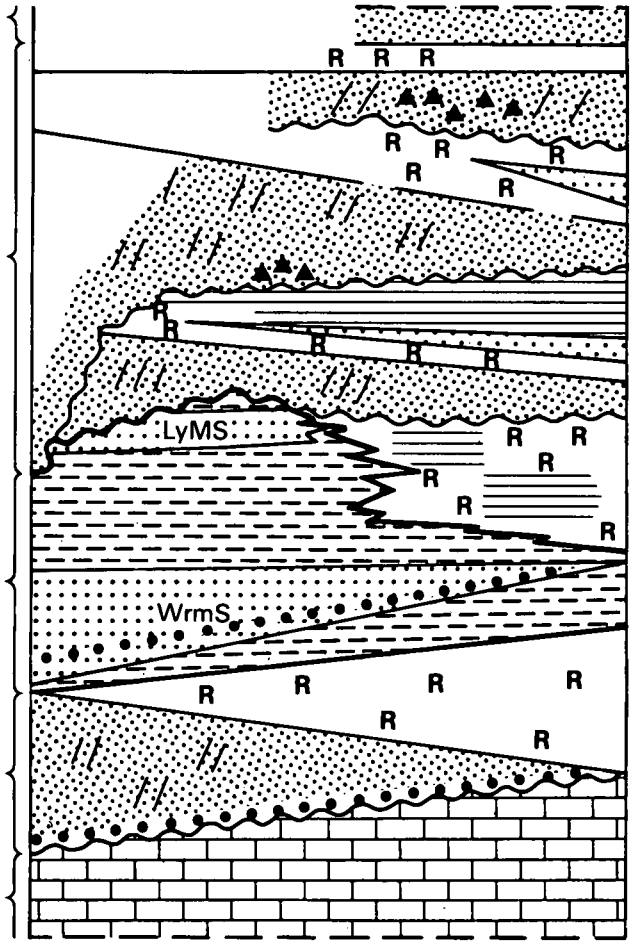
BRANKSOME SAND
Fine-grained sands with sandy clay and clay-clast conglomerates. Channelling into bed below.

POOLE FORMATION
Very coarse- to medium-grained sands with strong cross-bedding arranged in fining-upward units separated by four clay members.

LONDON CLAY
Olive grey sandy to very sandy bioturbated clays and clayey fine-grained sands with some lateritic layers and occasional rounded flint pebble bands. Shelly fossils in some areas.

READING FORMATION
Grey, usually red-stained silty clay. This passes, particularly in the west, into cross-bedded coarse-grained sand. At the base there is a glauconitic sandy clay containing flint pebbles and cobbles.

UPPER CHALK
Rubbly chalk with scattered flints.



PARKSTONE CLAY
Orange and grey very silty clay.

BROADSTONE CLAY
Grey, red-stained silty and sandy clay with an impersistent medium-grained sand unit.

OAKDALE CLAY
Carbonaceous brown, commonly laminated, sandy clays and clayey silts with a patchy development of red staining which is commonest in the lower part. An impersistent fine-grained sand also occurs.

CREEKMOOR CLAY
Mainly grey red-stained silty and sandy clays with some areas of brown roughly laminated sandy clays. This clay passes west into olive grey bioturbated clays of the London Clay.

LYCHETT MATRAVERS SAND (LyMS)
Fine-grained sands and ferruginous sandstones with some clayey fine-grained sands.

WARMWELL FARM SAND (WrmS)
Fine-grained to very fine-grained sand with some lateritic cementation. One or more flint pebble beds occurs at or near the base.

POOLE FORMATION

LONDON CLAY

READING FORMATION

KEY

- Fine- to medium-grained well sorted sand
- Very coarse- to medium-grained sand
- ▲ ▲ ▲ Clay-clast conglomerate
- Clay, undifferentiated. Mainly palaeosols
- Greyish brown clays with silt and sand laminae
- Bioturbated silty to sandy clays
- Chalk
- • • • • Pebble beds
- /// Cross-bedding
- R R R R Red staining

Fig. 4 Generalized stratigraphy of the Reading Formation, London Clay and Bournemouth Group.

consists of clayey pebbly sand, with many of the pebbles having a glauconite coating. The London Clay comprises silty clays and fine-grained sand. Over much of the district the beds of sand are thick enough to map separately; they occur at two levels, the basal Warmwell Farm Sand and the higher Lytchett Matravers Sand. At the base, one or more pebble beds are commonly present and locally these are accompanied by glauconite and molluscs. The youngest solid rocks of the district are those of the Poole Formation and Branksome Sand. Deposits of the former consist of medium- to coarse- or very coarse-grained sand interbedded with laterally persistent clay beds, some of which are named and can be mapped over extensive areas. These clays have been extensively worked for pottery clays in the past. The Branksome Sand consists of thinly bedded, fine-grained sand with interbeds of sandy clay.

2. SOLID FORMATIONS

CRETACEOUS

UPPER CHALK

Chalk occurs at depth under the whole of the present district, but crops out, or has a subdrift crop, only in the north-west near Combe Almer and north of the River Stour. An extensive subcrop occur beneath the Alluvium and River Terrace Deposits of the Stour. There is a general south-eastwards and southerly fall across the whole district in the Chalk surface of between 0.5° and 1°.

Only poor sections in weathered rubbly Chalk with scattered flints have been seen in the present district; most drillers' logs record 'Chalk and flint', or 'soft, crumbly or putty chalk with flints'. From a consideration of nearby exposures it is probable that the Chalk of the present district belongs to the Belemnitella mucronata Zone of the Upper Chalk (White, 1917).

The maximum thickness of Chalk penetrated in the district is 191m near the Corfe Mullen Pumping Station [9705 9845][1]. At Shapwick [ST 9429 0135],1.3km N. of the district 341m of Chalk were proved beneath River Terrace Deposits, of which 243m belongs to the Upper Chalk. To this can be added about 80m of Upper Chalk which occurs at outcrop to give a total thickness of about 320m for the Upper Chalk.

Details

The largest outcrop of Upper Chalk occurs north of the River Stour [970 999]. A small pit [9704 9985] formerly existed in

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1 Grid References are prefixed by the SY unless otherwise stated

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this outcrop, but no section remains. Firm white chalk can usually be augered close to the surface in this area.

About 12 pits existed in the Combe Almer area, but all are overgrown and sections are limited to poor exposures up to 1m high of rubbly, unfossiliferous, white chalk with scattered flints. The majority of these pits must have exposed the junction with the Reading Formation, but no sectionis now visible.

White (1917) described a section in a small pit [971 974] 200m E of Henbury Plantation. There, the upper part of the Chalk is hardened, iron-stained and with a bored surface. The borings vary from 0.25 to 2mm in diameter and are filled with sand. This pit has now been back-filled with lime from the waterworks.

PALAEOGENE

READING FORMATION

The Reading Formation underlies much of the present district, but crops out, or has a sub-drift crop, only in the north-west between Lytchett Matravers [940 960] and Lambs Green [SZ 000 990]. Three small inliers occur in the bottom of valleys south and south-east of Lytchett Matravers.

The basal bed of the Reading Formation consists of a lithologically distinctive, glauconitic sand or sandy clay with flint pebbles and cobbles.

Over much of its outcrop, the Reading Formation is dominantly a clay. Characteristically, and particularly in the eastern part of the outcrop, it consists of brick-red, mottled red and grey, and mottled red, yellow and grey clays. Locally, and especially in the higher strata in the west, the clays are silty and mottled orange and grey and are similar to clays in the London Clay. Beds of fine- to coarse-grained sands are also common in the western part of the district. These sands may be developed both at the base [945 970] and at the top [9545 9745] of the Reading Formation. In places [951 972 and 955 980], the whole of the formation is represented by sand. Cross-bedding has been recorded in the sands (White, 1917, p.11). Apart from in the basal bed, no pebbles have been found within the sands of the present district. Both the clays and the sands probably have a combined maximum thickness of 20m. In the Beacon Hill Borehole [9761 9446] the Reading Formation is about 11m thick.

Grain-size-analyses of samples from the present district are included in Figs. 6 and 7.

Buurman (1980), from his study of the Reading Beds of the Isle of Wight, concluded that the Reading Formation had formed in a fluvio-marine environment. The sedimentary features indicated to him periods of sedimentation, alternating with periods of emergence followed by soil formation under a climate with a fairly high annual temperature and a dry season.

Details

Two small inliers [940 949 and 9465 9475] of the Reading Formation occur south of Lytchett Matravers; a third inlier is present in the valley bottom near Lytchett Heath. The outcrops are largely obscured by downwashed sands which are related to springs issuing from the base of the London Clay. It is assumed from these springs that the Reading Formation consists dominantly of clay at both localities.

Augering in the stream bed [9644 9460] 300m SE of Lytchett Heath Farm, showed the presence of stiff grey red-stained clays.

North-west of Lytchett Matravers, the dominant lithology is mottled red and grey, or orange and grey, silty clay with local developments of fine- to coarse-grained sand. About 1.3 km NW of Lytchett Matravers crossroads there is a thick development of dominantly medium-grained, but with some fine- and coarse-grained, sand [940 966]. North of this sand, the basal beds of the Reading Formation consist of 0.6m of sandy clay with a glauconitic base, resting on Chalk [9401 9672]. At another place [9420 9657], 0.6m of mottled orange and grey clay rests on 0.2m of glauconitic sand, which in turn rests on Chalk. On the opposite side of the valley to the last exposure, a small section [9437 9664] in the basal beds revealed 0.1m of mottled orange and

grey silty clay overlying 0.3m of weakly glauconitic sand, resting on Chalk. A similar sequence was noted 120m to the N. [9440 9677]. The basal beds north-east of Lower Loop Farm are overlain by some 2 to 4m of fine-grained sand. White (1917, p.11) noted that south-east of Combe Almer Farm the sands are ferruginously cemented and were worked for building stone. The sands are succeeded by dominantly red, or mottled red, yellow and grey clays. East of the shallow valley north-east of Lower Loop Farm, the glauconitic basal bed is succeeded upwards by 2 to 5m of mottled orange and grey silty clay which in turn is overlain by coarse-grained sand. This sand forms the bulk of the outcrop [952 970] south of Combe Almer. White (1917, p.11) noted a 6-m-section [953 970] south of Combe Almer in strongly cross-bedded, fine- and coarse-grained sands. On the west side of the pit, a lenticle of laminated, pale grey silty clay, about 1.5m thick, was seen to overlie the sands. North of the large dry valley at Combe Almer, the basal glauconitic bed can be found at several points. At two localities [9515 9772 and 9536 9819], glauconite-coated pebbles are common on the surface. This basal bed is succeeded by up to 10m of sands which locally [eg 9504 9803] are very coarse-grained. Yellow-brown sandy clay overlies the sands hereabouts [950 978 and 9515 9808].

In an old chalk pit [9531 9753] west of Heron Grove, 0.6m of red clay overlies 0.1m of glauconitic clay, which in turn rests on Chalk. Higher strata consist of about 10m of red and grey clay, and yellow and brown sandy clay which in turn are overlain by fine- to medium-grained, cross-bedded buff sand up to 1.5m thick. Continuing northwards, the lower clay disappears and the

Reading Formation is represented by 20m of fine- and medium-grained sands. The sands die out abruptly east of Henbury Park [9600 9825]. Significant beds of sand are not found in the Reading Formation east of Henbury, apart from in an inlier [967 970] in the bottom of the valley south-east of Henbury Plantation, where fine- to coarse-grained sands occur. A section [9659 9684] in the sands of the inlier exposes about 1m of fine-grained sand. Small, well-rounded pebbles are common in the disturbed top 15cm of the section. These may have come from a pebble bed within the Reading Formation, or possibly from the Warmwell Farm Sand at the base of the London Clay. Higher strata hereabouts consist of mottled red and grey, and orange and grey clay.

White (1917, p.11) noted the "Bottom bed" resting on hardened Chalk in Chalk Pit Copse [9705 9735].

Red clay has been dug from two old pits [9640 9844 and 9665 9840] east of Henbury Manor. In the Knoll Manor Clay Pit [974 978], the junction between the London Clay and Reading Formation is exposed. More than 10m of purple and red clays, and mottled grey-green and red clays are seen beneath the London Clay. From here eastwards, red, and mottled red and grey, clay is the dominant lithology, although mottled orange and grey silty clay and clayey silt occur east and south of Knoll Clump [9818 9745 and 9805 9700]. An old railway cutting [978 983 - 9815 9815] still exposes poor sections in mottled red and grey clay. Similar mottled red and grey clay occurs beneath the glauconitic basal bed of the London Clay in an old pit [9890 9865] west of Candys Farm.

A borehole [9937 9890] at the sewage works proved, beneath 5.18m of drift, 1.07m of stiff brown and blue, laminated, silty, clay, overlying 0.76m of greyish blue silty fine-grained sand which in turn rests on 1.22m of brown and blue-grey with some red-brown, silty clay.

The most easterly point in the district where the Reading Formation was proved was in a borehole [9995 9913] for the Wimborne By-pass. There, the following succession was proved:

	Thickness (m)	Depth (m)
River Terrace Deposits	6.1	6.1
Reading Formation		
Clay, silty, laminated light brown, red-brown and light grey	0.2	6.3
Clay, silty, very stiff, laminated brown mottled grey and dark red	1.0	7.3
Sand, fine-grained, silty	0.3	7.6
Clay, silty with layers of silt and siltstone, brown mottled grey, very stiff	2.6	10.2

LONDON CLAY

London Clay crops out, or occurs at depth, about 75% of the Corfe Mullen-Lytchett Minster district. The formation crops out over a wide area in the Lytchett Matravers - Lytchett Minster area. From there, the outcrop narrows and swings north-eastwards and follows a sinuous course to Lambs Green in the north-eastern part of the district (Fig. 3).

The base of the London Clay is well defined in the north by a highly glauconitic, clayey, locally shelly, pebbly sand up to 2m thick. In the south-west, neither shelly nor strongly

glauconitic beds have been recognized, but pebble beds developed at more than one level occur within the basal fine-grained sand which may be up to 6m thick. This sand, here named the Warmwell Farm Sand, is well developed in the tract south-west from Henbury Plantation [966 980]. The member takes its name from the exposures in the lanes and banks near Warmwell Farm [949 964].

The sands vary from very fine- to fine-grained, and are locally clayey, (Figs.6 and 7). Pebble beds composed of very well rounded black flints occur at at least two levels. White (1917) recorded the presence of quartz pebbles. Most pebbles are between 1 and 2 cm across, but some are up to 10cm across. The pebble beds vary from sands containing stringers of scattered pebbles to matrix-supported pebble beds up to 0.6m thick; most beds are less than 10 cm thick.

The Warmwell Farm Sand almost everywhere forms a prominent scarp, up to 6m high, generally with powerful springs issuing from its base. At outcrop, the sand is up to 6m thick, but in the Holton Heath borehole [9548 9087] in the south, it appears to be 15m thick.

At two localities [9589 9532 and 9647 9450] in the southern part of the district, clay of London Clay lithology has been recognized in an inlier beneath the Warmwell Farm Sand. At the first locality, grey-brown micaceous fine-grained sandy clay was augered in the bottom of a valley. At the second locality lower down the valley, olive-grey, extremely silty clay with glauconite was encountered. In the absence of boreholes, the extent of this lower clay which has only been recognized in this inlier is unknown.

The Warmwell Farm Sand is succeeded by extremely silty and sandy clays with clayey fine- to very fine-grained silty sands; locally, mainly at the top of the unit, slightly coarser-grained sands occur. The sandier parts of the succession probably form the tops of coarsening upward sequences which comprise the London Clay. At the surface, the clay is weathered to a characteristic mottled orange and grey; locally, mottled red, yellow and grey clays have been augered. A characteristic feature of the formation in this district is an abundance of hard brittle 1-2cm thick ferruginously cemented layers (?laterites). At the base of the clays, a breccia, up to 10cm thick, composed of tabular siltstone and fine-grained sandstone clasts with scattered rounded flints, up to 10cm thick, is locally present. Fossils have been found at one locality [9645 9702] in this basal breccia.

The clay above the Warmwell Farm Sand is up to 8m thick and is overlain by the Lytchett Matravers Sand. The name is taken from the village of Lytchett Matravers near which there are extensive outcrops of fine-grained sand similar to the Warmwell Farm Sand; it is commonly ferruginously cemented and is locally hard enough to have been worked as building stone (White, 1917, pp.16-17). No pebble bed has been noted in this sand. The sand forms extensive flats around Lytchett Matravers and has a sharp feature break, locally associated with springs, at its lower boundary. The maximum thickness is about 5m.

Northwards, the Lytchett Matravers Sand either dies out as a mappable unit, or is cut out beneath the unconformable Poole Formation.

The clay overlying the Lytchett Matravers Sand is similar to the clay above the Warmwell Farm Sand. It has been worked for bricks and pipes near Lytchett Matravers. It probably has a maximum thickness of 10m.

The bioturbated clays of the London Clay east of Lytchett Minster appear to pass rapidly eastward into poorly laminated clays, the Creekmoor Clay of the Poole Formation.

Dinoflagellate cysts from the London Clay indicate an age range from the ?meckelfeldensis Zone at the base in the Knoll Manor clay pit [974 970], to the simile Zone at the top of the London Clay in the Henbury sand and gravel [963 973] pit. Younger strata are preserved at depth in the southern part of the area, as the varielongitudum Zone has been recognized at the top of the London Clay in the Beacon Hill Borehole [9761 9446].

The London Clay, despite the variation in the width of outcrop, maintains a fairly uniform thickness of about 20m. There is some local variation in thickness due to overstep by the Poole Formation. In the Lytchett Minster area, the thickness of the London Clay is about 30m. In the Beacon Hill Borehole [976 9446], the London Clay is up to 40m thick.

The bioturbated nature of the clays, the presence of coarsening-upward sequences with transgressive flint-pebble horizons, and the occurrence of dinoflagellate floras, suggests that the formation is nearshore marine, with the salinity being brackish. The abundance of lateritic layers and local stiff red mottled clays in the sediments indicates periodic emergence with the development of lateritic palaesols. These features indicate that the London Clay of this area was deposited

in a marginal marine environment, with transitions to estuarine and fluivatile conditons taking place over distances of probably less than one kilometre.

Details

Warmwell Farm Sand and overlying clay

The base of the Warmwell Farm Sand is clearly defined by springs and a sharp feature at the base of 5- to 6-m-high escarpment to the north-west of Lytchett Matravers. A section [9387 9606]in the sunken lane 130m W of the present district, shows:

	Thickness (m)
Sand, fine-grained, clayey	0.4
Pebble bed of small (up to 2cm) matrix-supported, well rounded flints	0.1
Clay, silty mottled orange and grey, and clayey fine-grained sand	0.3
Sand, fine-grained, orange and buff	2.2

A composite section [9470 9662] in the road bank 200m ESE of Higher Loop Farm reveals:

	Thickness (m)
Clay, very silty, mottled orange and grey and fine-grained sandy clay	1.8
Warmwell Farm Sand	
Sand, fine-grained with a lateritic top; pebble bed of scattered small (up to 2.5cm) rounded flint pebbles in middle of unit	0.8
Clay, sandy, coarse-grained, passing up into a clayey fine-grained sand; pebble bed (pebbles up to 8cm across) 0.3m from base of section	1.0

About 350m NE, there is an old quarry [950 968] in which is exposed 1.8m of horizontally bedded fine-grained sand. White (1917, pp.17-18) recorded the following section at this locality:

	Thickness (m)
Sand, fine-grained, with bands of grey laminated loam; thin seams of ironstone	c.1.6
Pebble beds, two, separated by loamy sand	0.3
Sand, fine-grained buff and white, slightly carbonaceous	c.1.6

The upper sand was described as lenticular and dipped 10° E. The lower sand was regarded as part of the Reading Formation.

The clay above the Warmwell Farm Sand has a broad outcrop south of these sections, but it probably does not exceed 5m in thickness.

Another section [c.9547 9662] recorded by White (1917, pp. 17-18) revealed:

	Thickness (m)
Rounded flint pebbles in soil brash	
Sand and loams interstratified	c.2.4
Pebble bed dipping 5°W	
Sand, fine-grained, buff and white, lignite speckled	c.2.0
Unexposed	c.3.0
Sand and grey loam, evenly interbedded with much lenticular ironstone in the sand	1.8

White (1917) regarded the lower sand as occurring within the Reading Formation.

A fourth section [9546 9672] was recorded in an old pit on the east side of the main road (White, 1917, pp. 17-18):

	Thickness (m)
Clay, sandy, mottled grey-brown with clay-ironstone nodules	1.5
Warmwell Farm Sand	
Pebble bed of flint pebbles	0.1
Sand, fine-grained with bands of grey laminated loam; thin seam of ironstone in the upper part	2.1
Bed of flint and small quartz pebbles in a coarse-grained sand matrix	0.2
Sand, fine-grained, buff and white, with fine seams and specks of lignite near the top, cross-bedded	2.4

As in the previous sections, the lower sand was regarded as part of the Reading Formation. However, all the sands in the above section form part of a topographically well-defined integral unit, which in the absence of good exposure cannot be subdivided in the field. Hence all these fine-grained sand and pebble beds are regarded as constituting the Warmwell Farm Sand.

Northwards from the last section, the Warmwell Farm Sand dies out as a continuous mappable unit. It reappears for a short distance [around 959 981] south-east of Henbury Hall. In that area, clayey fine-grained sands were augered; no pebble bed was noted. Just south of Henbury Manor Farm, the basal bed of the London Clay is a glauconitic sandy clay [962 982]. The overlying clay consists of up to 25m of mottled orange and grey silty clay, locally lateritic.

There is an extensive outcrop of the Warmwell Farm Sand in the valley which extends from the type area [949 964] eastwards

and north-eastwards towards Henbury Plantation. In the lane banks and ditches by Warmwell Farm [9497 9637], orange, buff and grey fine-grained sand can be augered. A similar lithology occurs over most of the outcrop. At one place [9508 9642], clayey coarse-grained sand was augered above fine-grained sand.

On the south side of the valley, fine-grained yellow sand and pebbles is thrown out of a badger sett [9504 9616]. An old pit [9519 9617] 150m E, was dug into yellow fine-grained sand; mottled orange and grey silty clay occurs at the top of the pit. Some 130m SE, fine-grained sand, associated with well-rounded flint pebbles, is exposed. A section [9545 9612] a further 150m E showed:

	Thickness (m)
Clay, mottled orange and grey, lateritic; scattered matrix-supported well-rounded flints, tabular and angular ferruginous siltstone and fine-grained sandstone in basal 10 cm; most flints are less than 1cm diameter, but some are up to 3cm.	0.6
Warmwell Farm Sand	
Sand, very fine-grained, mottled orange and grey	0.1
Sand, fine-grained, yellow and orange, poorly exposed	c.1.0

A second section [9549 9614] hereabouts showed:

	Thickness (m)
Clay, silty, mottled orange and grey with a basal bed of well rounded flint pebbles, (mostly less than 1cm across, but one of 10cm diameter), cutting into	0.5
Warmwell Farm Sand	
Sand, fine-grained, buff-orange	0.5

A third section [9550 9614] to the east revealed:

	Thickness (m)
Clay, sandy, mottled orange and grey, with scattered well rounded flint pebbles (up to 15mm diameter) in the basal 5cm	0.6
Sand, very fine-grained, mottled orange and grey	0.1
Sand, very fine-grained, buff	0.1
Breccia of tabular and angular ferruginous siltstone and fine-grained sandstone; one rounded flint pebble	0.1
Warmwell Farm Sand	
Sand, fine-grained, buff-brown	0.2+

Mottled orange and grey silty clay above the Warmwell Farm Sand has been worked for bricks in two pits [947 956 and 959 957] in Lytchett Matravers, and in a third pit [9582 9623] near Crumpets Farm.

Continuing east and north-eastwards on the south side of the valley which extends north-eastwards from Crumpets Farm fine-grained, locally clayey, sands rest on clays of the Reading Formation, but they do not give rise to a good feature, and only locally is a spring-line developed at their base.

On the opposite side of the valley, the Warmwell Farm Sand is about 15m thick and the overlying clay up to 10m thick. The base of the sand is marked by a spring for much of its outcrop. A section [9645 9702] in an old pit reveals the junction of the Warmwell Farm Sand and overlying clay:

	Thickness (m)
Clay, silty, mottled orange and grey; a clay-clast breccia up to 0.1m thick with one rounded flint pebble, in a clay matrix at the base. Locally, where there are lateritic nodules at the base, moulds of Turritella and the bivalve ?Dosinopsis bellovacina occur.	c0.8
Warmwell Farm Sand	
Sand, very fine-grained, buff-orange, with thin clay layers up to 2cm thick. This sand has an irregular base and is either channelled into, or is strongly affected by dewatering structures. At one point, a flame of sandy clay passes up from the bed below, through the fine-grained sand, but stops beneath the overlying clay.	0 to 0.8
Sand, fine-grained, clayey, thinly bedded; pronounced lateritic layer, 1 to 2cm thick, between 0.1 and 0.25m above the base; irregular clay bed, 1 to 2cm thick above the laterite. At about 0.3m above the laterite, there is an impersistent pebble bed, varying from single small pebbles (1cm diameter) to an 0.6m thick bed with pebbles up to 0.8cm maximum diameter; locally the pebble bed is cemented by laterite to form an indurated pebble bed. Local thin interbeds, 1 to 2cm thick, of fine-grained sand.	c1.0
Sand, fine-grained, buff, with some lateritic sand, 1m exposed, but probably continues to bottom of pit 2m lower.	c3+

Local deep excavations in the Henbury sand and gravel pit [965 975] have exposed the top of the clay below. At two places [9631 9732 and 9590 9725], a blue-grey, very fine-grained sandy clay was dug from a depth of 10m beneath Poole Formation sands. In another part of the pit [9613 9766], pink and grey clay, bedded in 1 cm units floors the pit; dark grey, thinly bedded silty clay was dug out from beneath the pink and grey clay. Some 80m E of this section, interbedded thin beds of mottled pink and grey clay, and fine-grained sand occur [9620 9765] in the lowest part of the pit. Dinoflagellates from two of these clays [9631

9732 and 9613 9776] include Dracodinium simile, zone fossil of the early Eocene simile Zone. The presence of Homotryblium tenuispinosum may point to a lagoonal site of deposition.

The Knoll Manor clay pit [974 978] has been in existence for at least 100 years. A section in this pit was recorded by Cooper, Hooker and Ward (1976); the fauna collected by these authors is now in the British Museum (Natural History). Additional material (see below) collected during the present survey is in the BGS collection, Keyworth.

At the present day, the London Clay overburden is stripped off and the underlying clays of the Reading Formation extracted. Three different sections were measured in this pit. The first, [9742 9770] showed:

	Thickness (m)
London Clay	
Sand, very fine-grained, buff, interbedded with grey clay. Sand is dominant in beds up to 0.4m thick; clays are thinner and up to 12 cm thick, but with fine-grained sand laminae; thin lateritic layers	2.0
Sand, very clayey, laminated	1.0

The second section [9739 9767] exposed:

		Thickness (m)
Head		
Clay, gravelly	0.6	
London Clay		
Clay, greyish brown, with fine-grained sand partings	0.4	
Sand, fine-grained, buff	0.3	
Clay, grey, with fine-grained sand partings	1.0	
Sand, fine-grained with thin (up to 10cm) clay partings	1.0	
Sand, fine-grained, clayey, glauconitic	0.6	
Unexposed	c.0.6	
Reading Formation		
Clay, mottled red and grey	2.0+	

The third section [9736 9766] revealed:

	Thickness (m)
London Clay	
Clay, and fine-grained sand, poorly exposed	c.4.0
Sand, clayey, highly glauconitic	0.6
Pebble bed of small (generally less than 2cm) well-rounded flints, shelly with common Turritella and bivalves - locally laterite cemented. Spring at base	0.1
Reading Formation	
Clay, mottled red and grey	2.0+

The macrofauna, identified by Mr C.J.Wood, from the shelly pebble bed in the above section includes: Ditrupa plana (J.Sowerby), Rotularia bognoriensis (Mantell), ?Ancistosyrinx sp., Euspira glaucinoides (J.Sowerby), Turritella cf. interposita Deshayes, Caestocorbula sp?, Callista (Microcallista) proxima Deshayes, Corbula sp?, Dosiniopsis bellovacina (Deshayes), Glycymeris brevirostris (J.de C.Sowerby), Nemocardium plumstedianum (J. Sowerby), Nucula sp., Orthocardium cf. subporulosum (d'Orbigny) and Striatolamia macrota (Agassiz).

Although the fauna is not diagnostic, it suggests Division A, possibly Division A3, of King (1981). A sample from the glauconitic sandy clay in the above section yielded a single example of the facies-controlled dinoflagellate Apectodinium sp. This is indicative of a nearshore environment of deposition.

The base of the London Clay is marked by a prominent spring line east of the Knoll Manor pit and on the west side of the valley near Corfe Mullen. On the east side of the valley, the boundary and much of the lower clay is hidden beneath Head. Northwards along this valley and eastwards along the Stour

valley, the base of the London Clay is obscured beneath River Terrace Deposits. In an old brick pit [9893 9864], about 0.6m of glauconitic sand rests on mottled red and grey clay of the Reading Formation; higher strata of the London Clay consist of mottled orange and grey silty clay. Glauconitic clayey sand at the base of the London Clay was augered in a ditch [9899 9873], north-east of the latter pit. There is no exposure in the London Clay east of this locality; River Terrace Deposits and gravelly wash obscure most of the outcrop. Where it was possible to reach London Clay with the auger, mottled orange and grey silty and fine-grained sandy clay was proved.

Springs issue from the base of fine-grained sand of the Warmwell Farm Sand south of Lytchett Matravers. The sand, there about 3m thick, has a narrow outcrop around an inlier of Reading Formation south of Lytchett Matravers [9465 9480]. A more extensive outcrop [940 950] of sand occurs south-west of the village. There, springs at the base of the member are well developed on the west side of the valley. The sands east of the valley form a prominent scarp about 5m high. Fine- to medium-grained sand, locally clayey, was consistently augered in that area; rounded flint pebbles were noted at one point [9410 9507]. The overlying clay is about 5m thick.

An inlier of the Warmwell Farm Sand occupies the bottom of the steep-sided valley east-south-east of Lytchett Matravers. A section [9602 9538] in a gully shows:

	Thickness (m)
Sand, fine-grained, orange, horizontally bedded	2.00
Pebble bed of very well rounded flints 0.5 to 3 cm in diameter, matrix supported in a coarse-grained sand	0.06
Sand, clayey, coarse-grained	0.15
Sand, fine-grained, buff-orange	0.35

Fine-grained sand, some 3 to 5m thick, forms a steep-sided feature, with springs at its base, southwards as far as the Lytchett Minster road [9655 9435] where it disappears beneath the overlying clay. Beneath this sand there appears to be a lower clay with glauconite at the base. This was augered in a stream bed [9647 9451].

A smaller inlier of Warmwell Farm Sand occurs in the bottom of the valley west of Huntick Cottages [956 949].

Only a few small exposures occur in the Lytchett Minster area. A ditch section [9645 9397] showed 2m of orange to buff, very to extremely silty clay containing claystone nodules and a stringer of black rounded flint pebbles. Nearby, another ditch [9641 9382] showed yellowish brown, extremely silty clay grading into clayey fine-grained sand with several laterite layers. Farther east-south-east [9719 9365], yellowish grey clayey very fine-grained sands are exposed in a roadside ditch. West of Lytchett Minster [around 957 930], much lateritic cemented clay and clayey fine-grained sand debris is to be seen in the soil.

Lytchett Matravers Sand and overlying clay

White (1917, p.18) noted "a few feet of brown loam overlying a more sandy loam with nodules of ironstone" in a pit [9485 9520] at the eastern end of the village. The pit is now built over; mottled orange and grey silty clay can be augered around the top

of the pit. Other old pits are to be found to the north [9490 9543] and east [9515 9575] of the above pit.

Ferruginous, fine-grained sandstone floors ditches [9534 9572 and 9543 9578] east of Lytchett Matravers. North of the village, fine-grained sandstone at the base of the Member protrudes through the soil [9445 9614]; sandstone at a similar stratigraphical level was worked for building stone in a pit [9447 9609] 250m NE.

The Lytchett Matravers Sand is overstepped by the Poole Formation some 2 km NE of the village; a thin remnant of fine-grained sand caps a small spur [957 968] south-east of Notting Hill. Small outcrops of fine-grained sand, between 2 and 4m thick, form well-defined flats on Allen Hill [974 969], Broom Close [976 965] and at Knoll Farm [9790 9755].

Fine-grained sand crops out from beneath the Poole Formation on the west side of Corfe Mullen [around 982 966 and 9855 9725]. This last outcrop is the most north-easterly occurrence of the Lytchett Matravers Sand in the present district.

The Lytchett Matravers Sand forms large areas of gently sloping dip surfaces north-west of Lytchett Minster. Few exposures occur, but fine- to very fine-grained sand can be augered; and much laterite-cemented fine-grained sandstone debris can be seen in the fields [for exampple around 955 934]. Some beds of extremely sandy clay also occur hereabouts in this member. An excavation [9594 9364] exposed around 1m of yellowish brown extremely sandy clay grading to clayey fine-grained sand.

The base of the Lytchett Matravers Sand is marked by springs on the eastern side of the N-S valley [between 9560 9434-9538

9318], and on the side of a valley [9543 9462] farther north.

Large boulders of ferruginous-cemented fine-grained sandstone have been unearthed and lie at the side of a field [9512 9400] north-west of Post Green.

The clay above the Lytchett Matravers Sand is found only in small isolated patches. It caps the sand west of Race Farm as mottled orange and grey silty clays [around 9527 9472] and lies beneath coarse-grained sands of the Poole Formation. The clay is similar to that capping a hill [around 956 938] near Post Green, but at other outcrops [around 9585 9458 and 9500 9307] the clay is grey and very stiff with brick red mottles. It is probable that in these last localities the normal marine bioturbated London Clay has been uplifted and developed a palaeosol upon it; east of these localities, this part of the London Clay passes into the Creekmoor Clay which consists of laminated carbonaceous clay with palaeosols showing much red staining. Normally, this topmost clay of the London Clay is overlain by the coarse-grained sands of the Poole Formation, but in one locality [9565 9394], the clay is capped by buff fine-grained sands which probably form part of the London Clay succession rather than the Poole Formation.

BOURNEMOUTH GROUP

Poole Formation

The Poole Formation crops out principally in the south and east of the district, with a number of scattered outliers farther north and west (Fig.3). The Formation consists of four sand/clay couplets, each of which takes its name from the clay member. The lowest clay in the local succession is the Creekmoor Clay, followed by the Oakdale Clay, the Broadstone Clay and finally the Parkstone Clay.

The sands of the Creekmoor Clay couplet do not crop out, and have only been proved in one borehole. The Creekmoor Clay at the top of the couplet crops out extensively on the north side of Poole Harbour and around Creekmoor. It consists mainly of red-stained grey plastic silty clays with subordinate brown carbonaceous clays. In places, particularly in the upper part, the clays are olive grey and are poorly laminated with thin (0.5 to 5.0mm) discontinous very fine-grained sand to silt laminae and lenses. Locally, these clays are extensively bioturbated with small sub-vertical burrows. When traced westwards, this upper part of the clay, of simile Zone age (see Freshney, Bristow and Williams, 1985, p.30), appears to pass into London Clay, which is also partly of simile Zone age.

The clay is estimated to be between 6 to 18m thick at outcrop in the Upton area.

The sand/clay couplet of the Oakdale Clay crops out on either side of the Sherford River in the west, around Hamworthy, Upton and Upton Heath. The sand is of variable grain size, being mainly medium-grained, but with a considerable amount of very

coarse-grained material, and some fine-grained sand. The sand grains are mainly quartz, but flint grains are common, particularly in the coarser grades. The sands are dominantly moderately sorted, and symmetrically to positively skewed (Figs.

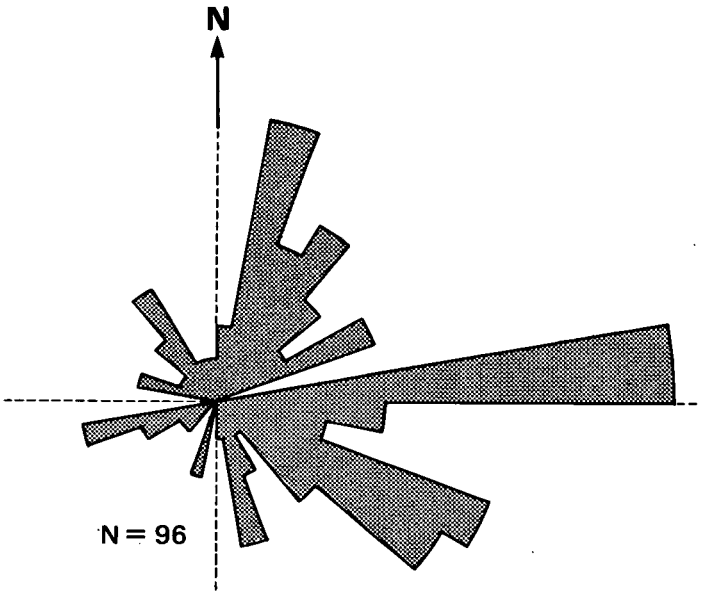

Fig.5 Current rose diagram for sands of the Poole Formation

6 and 7). An examination of sections in Poole Formation sands suggests that it is made up of fining-upward cycles on several scales. The elongate scatter of points on Fig.6 shows a range of Mean Grain Size from 0.5 to 3.3ϕ for a more constrained sorting of 0.2 to 0.6ϕ; this probably reflects variation in grain size within the cycles. Some bands are ferruginously cemented, in places in beds up to 0.8m thick. The sands are strongly cross-bedded showing direction of current derivation from the west (Fig.5). The thickness ranges from 5 to 10m at Lytchett Minster, 8 to 10m at Hamworthy, to 15m at Creekmoor.

In the western part of the district, the Oakdale Clay is dominantly mottled orange and grey, but mottled red and grey clay commonly occurs. Locally, pale grey silty clays are developed. In the east, the Oakdale Clay splits into two clay units separated by a sand. The lower clay consists dominantly of grey silty or sandy clay often mottled red; the upper clay usually consists of more carbonaceous clay commonly showing signs of lamination.

Dinoflagellates from the Oakdale Clay at Rockley Sands include members of the Apectodinium homomorphum plexus and Kisselovia cf. coleothrypta indicative of the coleothrypta Zone. Chandler (1962) recorded a rich, but non-age diagnostic macroflora from the Oakdale Clay in the cliffs in this same area.

The Broadstone Clay couplet crops out principally in the north-eastern part of the district, but the basal sand occurs as outliers at Upton [987 930], Hamworthy [99 91] and Holton Heath [91 91], farther south. In the north, this is the only couplet

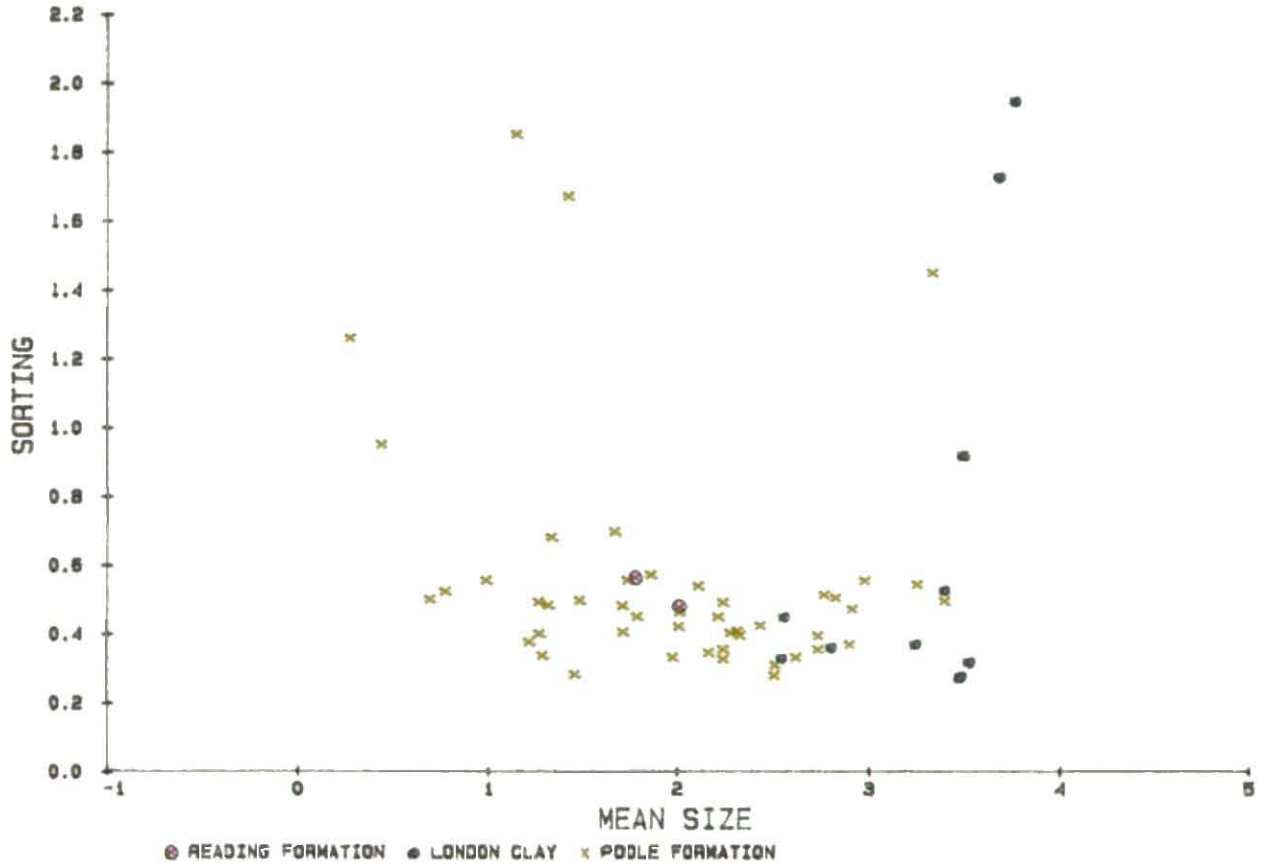

FIG - 6 PLOT OF MEAN SIZE/SORTING FOR SANDS OF THE READING FM. LONDON CLAY AND POOLE FM. FOR SHEET SY 99

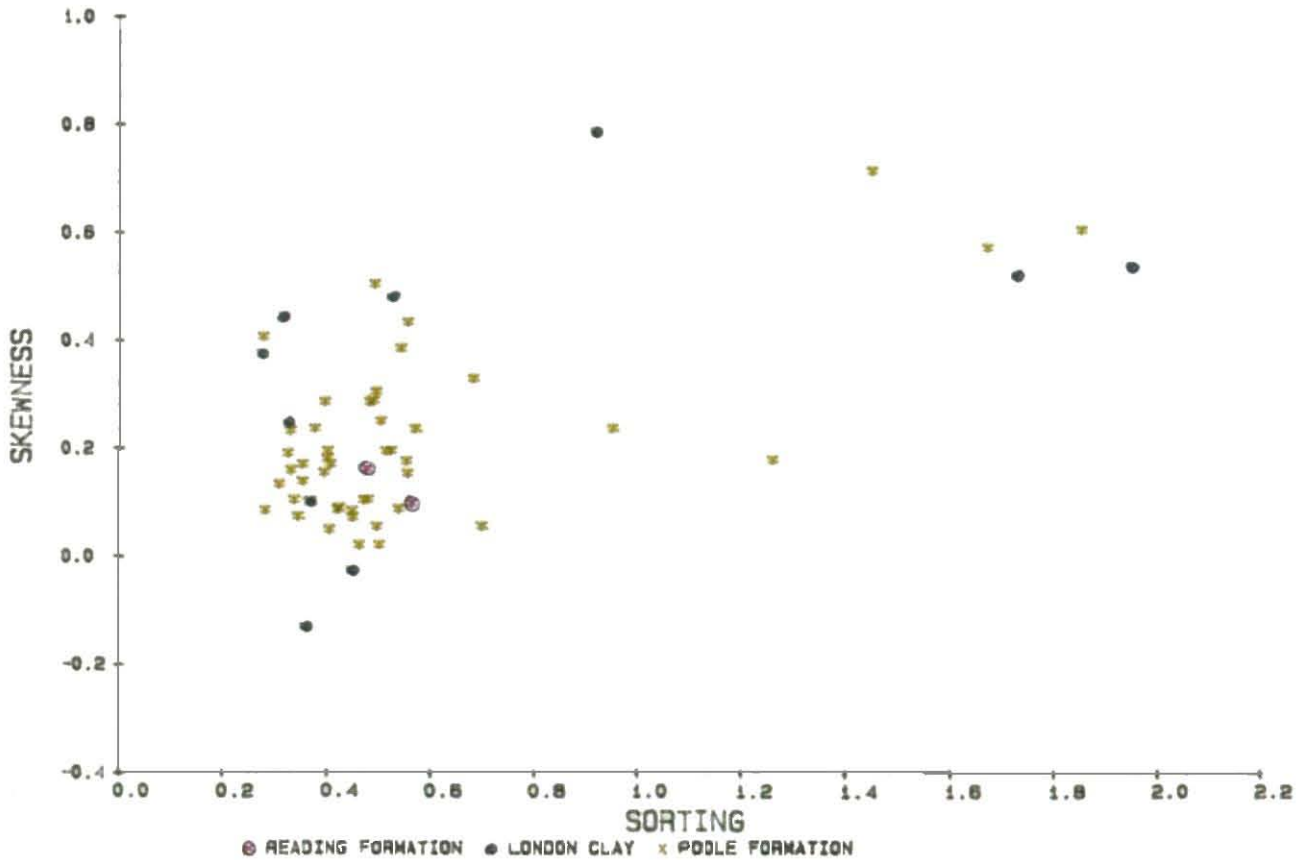

FIG - 7 SCATTER PLOT OF SORTING/SKEWNESS FOR SANDS OF THE READING FM. LONDON CLAY AND POOLE FM. FOR SHEET SY 99

to crop out, the older strata either having died out, been overstepped, or passed laterally into the London Clay. The basal sand of the couplet is dominantly coarse- to very coarse-grained. Locally it cuts across the various members of the London Clay. The dominant direction of sediment transport (the majority of observations incorporated in Fig.5 are from this sand) is from the west. There are excellent exposures of the sand in the Beacon Hill [980 952], Cherrett Clump [9755 9625] and Henbury [960 983] pits. The Broadstone Clay is dominantly a mottled orange and grey silty clay, locally red mottled. In places the clays are carbonaceous; the carbonaceous beds are commonly thinly laminated. The maximum thickness of the lower sand is about 26m; the Broadstone Clay varies from 0 to 10m. Dinoflagellates from the clay at Beacon Hill [9834 9523], and Ashington [SZ 0004 9787] just outside the present district (Freshney, Bristow and Williams, 1985, p.50), yielded Kisselovia cf. coleothrypta, type species of the coleothrypta Zone.

The Parkstone Clay couplet is developed principally between the Beacon Hill sand pit [984 952] and Corfe Hills [SU 000 965]. But this outlier, and that on the opposite side of the valley [990 973] which flows through Rushcombe Bottom, are largely hidden under River Terrace Deposits. The sand, up to 10m thick, and a thin development of the clay, is well seen in the Beacon Hill pit. There, within a dominantly sandy sequence, breccias with large clasts of clay and sand are interbedded with thinly bedded fine- to medium-grained sand (Plate 3); syndepositional faulting also occurs. Sections in the Parkstone Clay show up to 2m of pale and medium grey, locally reddened, clay.

Dinoflagellate floras from the Parkstone Clay east of the present district indicate the coleothrypta Zone.

Details

Creekmoor Clay Couplet

Upton to Creekmoor area

One borehole [9994 9303] penetrated about 1m of silty fine-grained sand with lenses of clayey silt and silty clay, below 5.1m of lignitic Creekmoor Clay. This sand, however, may be part of the Creekmoor Clay itself, and it is possible that no major sand unit occurs under the clay in this district. A well [9548 9087] in the south-western part of the district appears to show Creekmoor Clay resting on London Clay at a depth of 85.32m. In the E.C.C. Ball Clay Co.'s borehole [9761 9446] on the south side of Beacon Hill, Creekmoor Clay seems to be absent, with sands of the Poole Formation resting on London Clay at a depth of about 28m. The Creekmoor Clay has very few exposures in the east of the area. Augering [around 995 925 and 995 931] showed the presence of brown carbonaceous clays and grey red-stained clays. North-west of these localities [9928 9338], a roadside bank exposed 2.5m of yellowish grey, silty, poorly laminated clay with abundant ferruginous layers. Around Creekmoor, there were formerly several brick clay pits, but these are now filled in and no exposure remains. The following borehole [9994 9355] at Upton showed the presence of fine-grained sands within the clay sequence:

SL c.6m AOD
Creekmoor Clay

Sand, fine-grained, silty, yellowish brown, loose	0.76
Clay, firm, light grey	1.22
Clay, probably with ferruginous cemented siltstone at top	2.44
Clay, silty, pale grey, stiff	3.66

Another nearby borehole [9995 9346] penetrated 3.67m of very silty yellowish grey clay with red staining in the lower part. Creekmoor Clay underlies some of the wet boggy ground on the south side of Upton Heath. Debris from flooded clay test pits [9889 9430] comprised grey silty clay, together with blocks of ferruginous sandstone probably from the overlying sand. Farther west, flooded ponds now mark the sites where the Creekmoor Clay was formerley dug for brick clay. The only exposure [9809 9400] shows the following section:

SL c.24m above OD

Poole Formation, undivided	
Sand, fine- to medium-grained	c.1.0
Clay, grey	c.1.0
Sand, medium- to very coarse-grained, slightly clayey	c.1.5
Creekmoor Clay	
Clay, silty, grey to brownish grey and colour banded in shades of brown; very fine-grained sand to silt occurs in pods sub parallel to the bedding. Occasional silt partings also occur.	over 1.5

Although the clay in this section shows banding and some silt laminae, there are also strong signs of bioturbation; immediately west of this locality, this clay passes into London Clay.

Oakdale Clay Couplet

West of Lytchett Bay

The basal bed of the Poole Formation forms a low NE-facing scarp in the tract from Pike's Farm [940 930] to near Lytchett Minster [953 927]. It consists of about 5m of coarse-grained sand. Locally [for example around 943 929], fine-grained sands occur, but elsewhere, very coarse-grained sand is found. The sands are succeeded by the Oakdale Clay which consists of a variable sequence of up to 15m of pale grey silty clay, mottled orange and grey silty clay, and mottled red and grey clay. In boreholes just west of the present area, lignite occurs in part of the sequence. The clays have been extensively worked for brick clay just beyond the western margin of the district [939 919 to 939 915], and for ball clay [950 921] within the district.

The Lytchett outliers

A number of scattered outliers of coarse-grained sand cap small hills in the area between Lytchett Matravers and Lytchett Minster. From their isolated position it is not possible to say whether they belong to the Oakdale Clay or the Broadstone Clay couplets. For convenience they are all treated together here as one unit which forms the local base to the Poole Formation. The largest of these outliers [950 953] lies east of Lytchett Matravers. The dominant lithology is medium- to coarse-grained sand. The sand, about 10m thick, oversteps the higher clay of the London Clay and the Lytchett Matravers Sand, to rest on the lower clay. The sand has locally been worked, and poor exposures up to 1.5m high of medium- to coarse-grained orange sand still occur in two of the pits [9504 9518 and 9535 9520]. Where the sand rests

on clay, the base is marked by springs. Springs also mark the eastern boundary of the outlier of clayey, very coarse-grained sand south-east of the village [949 949]. Another outlier [948 943] farther south consists of coarse- to very coarse-grained ferruginous sand up to about 4m thick; springs mark the western boundary. Across the valley from this outlier, similar ferruginous coarse-grained sands with an estimated maximum thickness of 3m, overstep across the upper part of the London Clay to rest on the Lytchett Matravers Sand. Angular blocks of very fine-grained grey siliceously cemented sandstone (?silcrete) occur on the surface of this deposit [9435 9415]. There is a small outlier of coarse-grained orange sand a further 350m S [9445 9385]. Fox Hill [950 934] is formed of up to 6m of coarse-, locally very coarse-grained sand. A spring [9502 9330] marks the base at one place on the east side of the hill.

Upton- Creekmoor area

In the north-eastern part of this area, the Oakdale Clay is divided into two by sand. The upper part of the clay tends to be slightly carbonaceous and laminated, while the lower part is grey with red and lilac stains. The following section [9972 9488] is exposed in a bank west of the old railway:

SL c.45 above OD
Poole Formation, undivided
Sand, very clayey pebbly, laterite fragments 0.60
Oakdale Clay
Clay, brownish grey roughly fissile 1.50
Laterite, brown and orange, impersistent 0.03
Sand, medium- to coarse-grained, yellowish orange, ferruginous layer (2-3cm) at top, becomes very coarse-grained downwards with many flint grains, rather clayey at base with pebbles and clay clasts 4.00
Clay, grey,silty ,contains thin 2cm bed of very fine -grained sand 0.30
Sand,fine- to very fine-grained,layers of clay/silt 1.20
Sand,fine- to medium-grained ,yellow over 0.50
The fine-grained sand and clay units above die out south-eastwards into the coarse-grained sand
Clay, to medium grey with red and lilac mottles 3.50
Sand, fine- to coarse-grained, yellowish orange over 1.00

The overlying sand belongs to the Broadstone Clay Couplet.

The sand of the Oakdale Clay Couplet is exposed in a disused sand pit [9959 9397] at Creekmoor where the following section can be seen:

SL c.17m
Head
Sand, clayey, silty, mottled orange and yellowish brown with cryoturbated masses of flint pebbles forming pods 1.2
Poole Formation
Clay, very silty, grey and red mottled 1.0
Sand, fine- to very fine-grained, orange to greyish brown interbanded with very silty grey to greyish brown clay seams on a scale of 20-2mm, the sand being dominant. The bases of the clay seams are sharp 1.2
Sand, coarse- to medium-grained, cross-bedded, many flint chips. Ferruginous cemented sandstone band 0.7m thick 4m from the top; some bands of flattened grey clay clasts c.5.0

At the same pit, another section [9947 9402] in the Oakdale Clay shows:

SL c.17m
Oakdale Clay
Clay, mottled grey and orange, silty. Hard ferruginous layer at base. 0.8
Clay, silty, brownish grey, interlaminated with very fine-grained sand. The clay layers range from 2-5mm thick. The sands range between 1-5mm thick but pod like lenses occur up to 80mm thick. Some bands of clay and sand show intense disturbance in zones about 20-30mm thick. 0.5
Clay, silty and sandy shows a poorly defined banding in siltiness. Passes to a clayey very fine-grained sand at base. c.1.0
Sand, very clayey, fine-grained with variable amounts of clay bands and laminae ranging from 0.5-9mm. Clay seams sharpest at base. Some cross-cutting clay and sand units 0-1.0
Clay, in fairly regular units of 8mm with thin impersistent fine-grained sand layers up to 2mm thick. In this unit, the sands have the sharp bases 0-1.5
Poole Formation,undivided
Sand, medium-to coarse-grained, cross-bedded. over 2.0

In this section, the lowest clay unit exhibits small fining-upward micro-cycles (Plate 1). Cross bedding in the same pit in sands of the Oakdale Clay Couplet indicates derivation principally from the north-west and north.

Many sections in the Oakdale Clay and its underlying sand can be seen in a disused brick clay pit on Upton Heath [988 943]. The upper part of the sequence is typified by the following section [9877 9428]:

SL c.27 above OD
Oakdale Clay
Clay, greyish yellow. c1.0
Laterite, orange brown. 0.2-0.3
Sand, fine-grained, rather clayey c.2.0
Sand, buff,clayey c.1.5
Ferruginous layer, rather soft 0.1
Clay, brownish grey to greyish brown with plant debris 1.0
Silt, clayey , greyish brown to brownish grey roughly laminated and bedded over 2.0

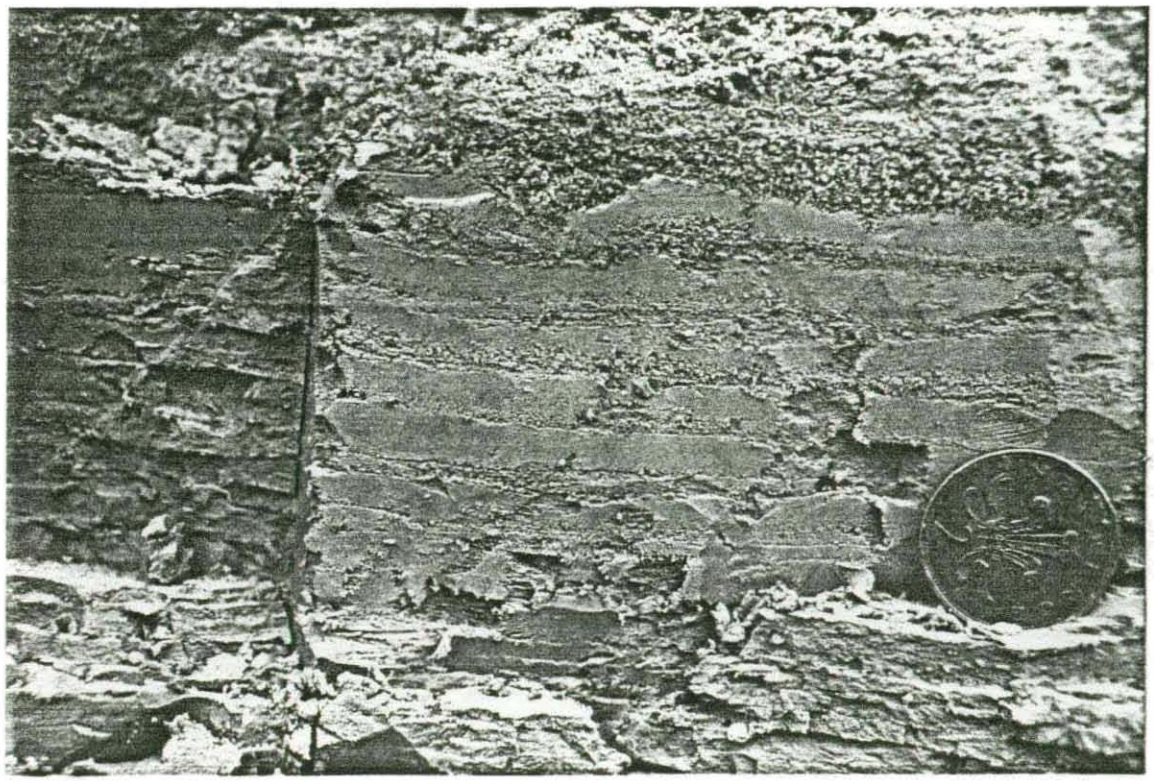

Plate 1,

Creekmoor Sand Pit. Fining-upward micro-cycles in the Oakdale Clay. The base of each cycle, a very coarse-grained sand, rests with a sharp base on the clay of the underlying cycle.

Sand, fine-grained , buff, rather clayey;
ferruginous layer at base 1.5
Clay, very silty and greyish brown clayey silt
with fine plant debris over 3.0

The lower part of the clay, passing into the sand below, is exposed in the following nearby section [9875 9421]:

Oakdale Clay
Laterite, hard brown 0.02
Silt, grey orange, clayey roughly laminated 2.00
Silt, very clayey to extremely silty clay, roughly laminated. Clay/silt well laminated at base 2.20
Poole Formation, undivided
Sand, medium- to coarse-grained. Ferruginous cemented layer 2cm thick at top. Flint grains common over2.00

North of the pit, large areas of Upton Heath are underlain by Oakdale Clay. Passing westward along the hillside on the south side of Beacon Heath, the Oakdale Clay seems to die out [around 975 943]. In the E.C.C. Ball Clay Co's borehole [9761 9446], the Oakdale Clay appears to be represented by only 1.5m of sandy clay, some of which is red stained and some brown and lignitic.

The Oakdale Clay and its sand below, form a cap to the higher ground of the Upton area. At one time there were pits in this area, but these are now all closed and many are built over. Augering in the eastern part of Upton showed the presence of much red-stained clay [for example 9874 9319, and also in the southern part of Upton 9800 9311]. In banks [9801 9338] at the side of a caravan park which is sited in an old brick pit, 0.8m of extremely sandy yellow clay overlies buff silty clay.

There are many exposures in the sand below the clay in a small stream west of Upton House [between 9900 9330 and 9894 9276]; the exposure at the northern end shows over 1.5m of fine- to medium-grained, strongly cross-bedded sand. On the north side

of Upton [9825 9382], 8m of fine- to medium-grained sand is exposed. In the south-western part of Upton, a borehole [9754 9306] penetrated the following sequence:

SL c.12m above OD	
Made Ground (Mainly sand)	0.4
Poole Formation	
Sand, medium-grained, with some cementation	1.2
Sand, medium-grained, silty, dark brown, medium dense	1.4
Sand, coarse- to medium-grained, light yellowish brown dense with some cementation	2.5
Sand, coarse- to medium-grained, clayey, light yellowish brown with some cementation	3.1

Hamworthy -Rockley area

The top of the sand below the Oakdale Clay skirts around the Hamworthy peninsula at or near sea level, and thus exposures are not common. One good exposure occurs in a ditch beside a railway line [9913 9212] . There, over 3m of very coarse- to medium-grained cross-bedded sand is exposed. A borehole near Turlin Moor [9877 9201] showed 1.22m of brown coarse-grained silty sand overlying Creekmoor Clay. Another borehole [9827 9184] showed probable Oakdale Clay resting on its underlying sand:

Head	
Sand, brown and white	1.12
Oakdale Clay	
Sand, brown with a little clay	1.22
Ball Clay, grey	2.24
Clay, stiff, greyish brown	3.05
Sand, brown and clay	3.12
Clay, stiff, greyish brown	3.91
Poole Formation	
Sand, limonitic	4.29
Sand, hard, limonitic with some grey clay	4.50
Sand, reddish brown with some clay	5.74
Sand, lignitic with clay	5.84
Sand, grey	6.10

The Oakdale Clay has been dug in this area for brick clay and partly for pottery clays, but there is now little exposure. One section [9739 9108] at Rockley Point, where it is overlain by

sands of the Broadstone couplet, shows:

SL c.6.0 above O.D.
Poole Formation
Sand, coarse- to very coarse-grained, cross-bedded from WSW and SW; some thin pipe-clay layers 1.5
Sand, medium- to coarse-grained, very coarse-grained at the base where it is also ferruginously cemented c. 3.0
Oakdale Clay
Clay, grey, silty, apparently structureless 0.5
Clay, brown, carbonaceous with some lignite. over 1.0

The clay is also visible below beach shingle near Rockley Point [9738 9093], where dark brown carbonaceous clays, containing patches of pale grey red-stained clay, are exposed. A dinoflagellate flora was recovered from clays at this locality (pp.00,00). In a railway cutting [9813 9147], coarse- to very coarse-grained sands of the Broadstone Clay couplet overlie pink and carbonaceous clays. Springs from the perched aquifer in the sands cause small landslips in the cutting. The Oakdale Clay was proved in many site investigation boreholes in the area. One [9827 9184], showed 0.76m of sandy brown clay overlying 2.75m of yellow and grey mottled clay, the whole under 1.37m of Estuarine Alluvium.

A borehole at Hamworthy Junction [9861 9144] appears to have penetrated the entire Oakdale Clay sequence:

SL c.12m
Broadstone Clay couplet
Sand, fine-grained, silty, clayey, grey 2.13
Oakdale Clay
Clay, stiff, sandy, silty, light grey 3.96
Clay, stiff, silty, dark grey 5.18
Clay, hard, silty, light grey and brown 6.10

Holton Heath area

In the north-western part of Holton Heath, the Oakdale Clay is about 3 to 4m thick, and consists of yellowish grey sticky clay and silt, with surface lateritic debris. Reid noted

carbonaceous brown clay at Holton Clump [9672 9135] during the original geological survey (1894), but this is no longer visible. North-west of Holton Heath [9515 9215], there was until 1978 an operating pit for ball clay in Oakdale Clay. This is now flooded and only poor exposures are visible. The clay is over 11m thick, and seems to have consisted mainly of plastic red and lilac-stained clays with about 2m of unstained grey clay.

Around the south-western part of Holton Heath, there is almost no exposure of the clay, with only a few signs of red-stained clay found by augering. The sand below the clay is exposed in a small pit [9538 9091] where over 0.8m of fine-grained buff sand with ferruginous layers occurs.

A well [9548 9087] penetrated a possible 31m of Oakdale Clay, consisting of mainly light grey clay, with considerable red and yellow mottling. The basal 10.67m were described as grey sandy clay, which may be a clayey sand from the sand unit below.

Broadstone Clay couplet

Barrow Hill [9585 9600], Forest Hill [9660 9585], Black Hill [965 952] and Allen Hill [972 968]

In this tract, the basal sand of the Poole Formation oversteps the upper clay of the London Clay to rest on the Lytchett Matravers Sand. This basal Poole Formation sand in turn is overstepped by the Broadstone Clay; finally a higher sand oversteps the Broadstone Clay to rest directly on the Lytchett Matravers Sand [958 960].

At Black Hill, a coarse-grained ferruginous sandstone, 10 to 15m thick, occurs within sands close to the local base of the

Poole Formation [9637 9518]; springs mark the junction of the sands and the London Clay. Similarly, springs mark the base on either side of Forest Bourne Farm [9685 9528] where the sand is about 15m thick. A small exposure [9711 9557] at the side of a track north-east of the farm, showed 1m of coarse- to very coarse-grained, clayey brown sand, beneath an irregular cover of gravel up to 0.8m thick. From hereabouts northwards, copious springs issue from the base of the Formation and give rise to extensive tracts of Head. In an area [9700 9627] north of Stoney Down House, the sands are dominantly fine-grained. Some 600m NW of the House, up to 0.8m of gravel overlies 0.8m of mottled orange and grey silty clay of the Broadstone Clay, which in turn rests on more than 1m of fine- to coarse-grained orange sand. About 300m ENE of this exposure, cryoturbated gravel rests on fine- to coarse-grained sand. The thickness of the sand hereabouts varies from 5 to 10m. Much of the northern and eastern boundary of the Poole Formation around Allen Hill is marked by springs.

The Broadstone Clay under Stony Down Plantation consists of either pale grey silty clay, or mottled orange and grey silty clay. Much of the outcrop is hidden beneath River Terrace Deposits.

A more extensive tract of Broadstone Clay, about 5m thick, crops out between Barrow Hill and just east of Forest Hill Farm [968 958]. For the most part, the clay consists of mottled orange and grey silty clay, but locally [9656 9554 and 9660 9545] mottled red and grey clay has been noted; pale grey clay also occurs [9647 9537 and 9661 9570]. Two former brick pits [9585

9575 and 9630 9575] occur; at the latter locality, White (1917, p.18) noted that the excavations were in "thin bedded sandy clay", regarded at that time as London Clay.

Notting Hill - Henbury Plantation and Heron Grove

The Notting Hill - Henbury Plantation outlier extends in a north-easterly direction for about 1.25km. Much of its outcrop is occupied by the Henbury sand and gravel pit. The maximum thickness is about 12m. Excellent sections can be seen in the pit, of which the following are a representative selection. Cross-bedding measurements from the sands are incorporated in Fig.5.

A section [9631 9732] on the south side of the pit showed:

	Thickness (m)
River Terrace Deposits (Thirteenth)	
Gravel, generally 1 to 1.5m thick, but locally up to	2.5
Sand of the Broadstone Clay couplet	
Sand, coarse- to very coarse-grained, cross-bedded, orange, scattered small (up to 5mm) lignite pieces	6.0
Sand, buff, fine-grained	1.0+
Unexposed	c3.0
London Clay	
Clay, very fine-grained, sandy, bluish grey	

A second section [9606 9724] revealed:

	Thickness m
River Terrace Deposits (Thirteenth)	
Gravel, roughly bedded at base, cryoturbated top	2 to 2.5
Sand of the Broadstone Clay couplet	
Sand, coarse- to very coarse-grained, thinly bedded (units 0.1 to 0.2m thick), finely cross-bedded; a finely laminated pale grey pipe clay up to 0.25m thick occurs in middle of bed; lenticular breccias of clay clasts in a coarse-grained sand matrix at various levels	2.5

A pale grey pipe clay, 0.3m thick, was noted in the corner of the pit [9597 9711].

A section [9633 9774] in the basal beds on the north side of the pit exposed:

	Thickness m
Sand, coarse-grained, orange	0.1
Clay, and fine-grained sand, thinly interbedded	0.1 to 0.3
Sand, fine- to medium-grained, cross-bedded, buff	0.8
Clay, and fine-grained sand, thinly interbedded	0.1 to 0.2
Sand, fine to medium-grained, buff-orange	0.5
Sand, fine-grained, buff	0.2+

Farther east, the following section [9668 9759] was measured:

	Thickness m
Sand, coarse-grained, orange	0.3
Clay, coarse-grained sandy, becoming more clayey downwards, orange-brown	1.2
Clay, pale grey	0.4
Sand, fine- to medium-grained, clayey, mottled orange and grey	0.4

A small outlier [975 962] of coarse-grained, cross-bedded, sand, up to 5m thick, caps Cherrett Clump. An old pit has a number of degraded sections; one such section [9754 9614] shows about 2m of thinly bedded, cross-bedded, coarse- to very coarse-grained sand with scattered clay clasts. Cross-bedding measurements from the sand are included in Fig.5.

Two smaller outliers of coarse-grained sand cap Mountain Clump [974 974] and Knoll Clump [978 974], but there is no section. The outcrop at Knoll Clump is largely obscured by River Terrace Deposits.

Beacon Hill

The Beacon Hill clay pit [982 951] and the Corfe Mullen clay pit [980 952] expose excellent sections in the upper part of the Poole Formation. For convenience, the whole Poole Formation sequence exposed in the pit is described in this section, rather than split the account under different couplet headings. The Broadstone Clay in the Corfe Mullen pit is not well exposed; the general sequence of clay and sand comprises:

	Thickness m
Broadstone Clay	
Clay, mottled dark grey and red	c.4-5
Clay, pale grey	c.2
Sand of the Broadstone Clay couplet	
Sand, fine-grained, thinly bedded and finely cross-bedded, and cross cutting; bedding units vary between 0.1 and 0.4m thick	10
Sand, fine- to coarse-grained, thinly bedded and cross bedded; cross beds commonly separated by thinly bedded (up to 8cm thick) silty sand; some alternating clay and sand beds up to 0.6m thick	3
Sand, coarse-grained to very coarse-grained, cross-bedded, with common scattered clay clasts - mostly less than 1cm, but some up to 15cm across The coarser clasts occur in the base of the unit and become finer upwards; finer clasts follow the cross bedding	15

Cross-bedding measurements from the sands are included in Fig.5 A higher section [9787 9502] exposed the junction between the sand of the Parkstone Clay couplet and the Broadstone Clay:

	Thickness (m)
Topsoil	0.3
Head	
Clay, pebbly, mottled orange and grey	0.5 to 1.3
Silt, clayey, with scattered flints, some clayey coarse-grained sand, mottled orange and grey	0.4 to 1.0
Sand of the Parkstone Clay couplet	
Clay, silty, pale grey and orange	0.4
Sand, medium- to coarse-grained, cross-bedded, buff	0.3 to 2
Broadstone Clay	
Clay, silty, mottled red and pale grey	0.3+

In another section close by, the sand above the Broadstone Clay consists of 2m of very coarse-grained and gritty, cross-bedded sand. The bedding is convoluted and there are some small-scale syndepositional faults.

A section [9796 9500] near the base of the sand of the Parkstone Clay couplet showed up to 6m of medium- to coarse-grained, cross-bedded friable sandstone. The cross-beds vary in thickness from units of 2 to 50cm, and show much cross cutting. Bedding in the upper part of the sequence is locally convoluted; tabular, post-depositional, cross-cutting, thin (up to 1cm) ferruginous sandstone layers occur at intervals of 0.1 to 0.4m (Plate 2). Scattered clay clasts and lignite fragments up to 1 to 2mm thick and 15mm long occur throughout, some of the cross beds have clay bases.

About 120m NE of the last section, another section [9807 9506] showed:

	Thickness m
Sand of the Parkstone Clay couplet	
Sand, medium- to coarse-grained, thinly bedded, cross-bedded, buff	c.5
Sand, medium- to coarse-grained, cross-bedded, contorted; bedding units up to 1.5m thick	2.5
Sand, medium- to coarse-grained, planar bedded, in units 0.1 to 0.4m thick, cross-bedded, buff; clay partings up to 1 cm thick and clay-rich fine-grained sand and sandy clay in units up to 15cm thick	2.5

In the floor of the pit, the top part of the Broadstone Clay is exposed [982 952]. There, pale and dark grey clay with a lateritic cap is overlain by coarse- to very coarse-grained and gritty, cross-bedded sand.

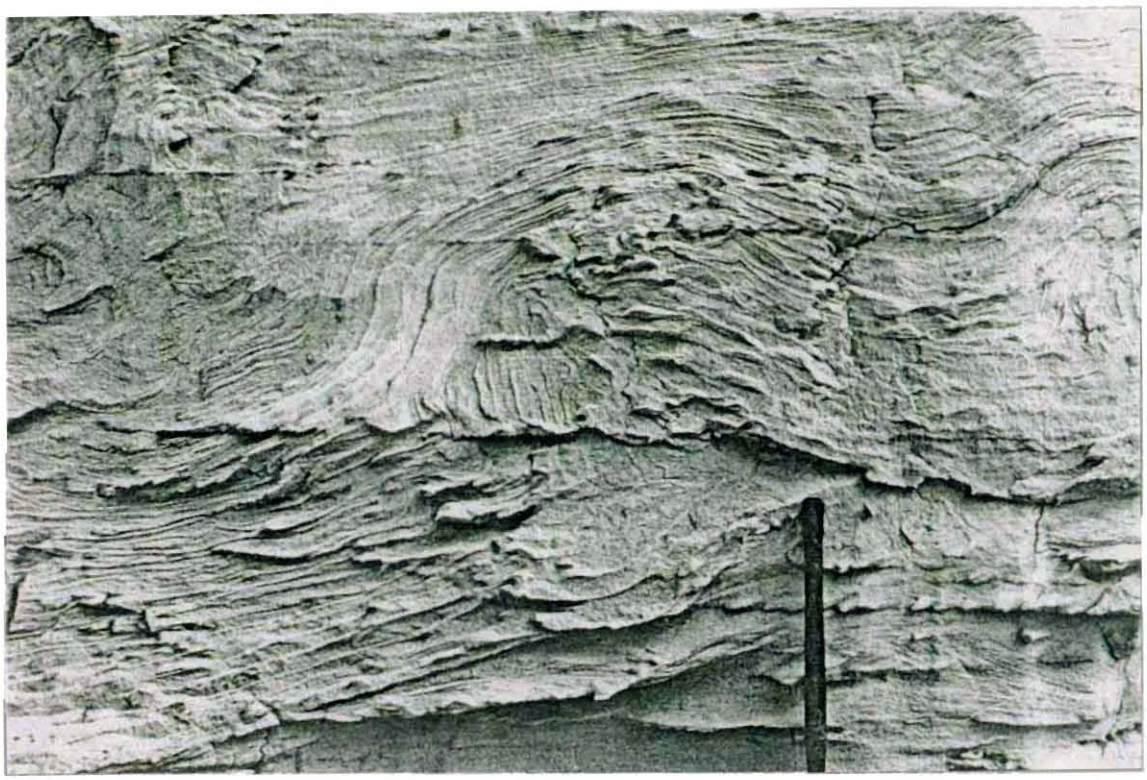

Plate 2.

Beacon Hill Sand Pit. Convoluted bedding (?dewatering structures) in sands of the Poole Formation. Harder, horizontal, ferruginous, cross-cutting sandstones are post-depositional features.

Two sections [9826 9523 and 9831 9509] to the east and south-east, at about the same stratigraphical level, reveal clay and sandstone breccias within the sands (Plate 3). At the former, there are five levels of breccia within a 6-m section. There, the beds are up to 0.8m thick and 5m across; clasts of sandstone are up to 0.1m thick and 0.5m across. A small syn-depositional fault with a 0.7m displacement was seen. The breccia at the latter locality has clasts up to 0.4m thick and 1m long; the breccias are interbedded with thinly bedded fine- to medium-grained sand with clay-rich partings.

A clay seam, up to 2m thick, in the middle of a face in the eastern part of the pit is a remnant of the Broadstone Clay. The base of the clay consists of a dark grey structureless clay resting on the ferruginously cemented top of a coarse-grained sandstone at one place [9834 9520]. Kisselovia cf. coleothrypta, indicative of the coleothrypta Zone, was obtained from the clay.

Close by, another section [9832 9524] showed 1m of medium grey, thinly laminated silty clay resting on 1.5m of finely laminated, fine-grained sand, silty sand and friable sandstone, with thin (up to 2cm) greyish brown clay beds. The top of the clay was exposed in a third section [9835 9517]:

	Thickness m
Sand of the Parkstone Clay couplet	
Sand, coarse-grained, cross-bedded, ferruginous	0.15
Sand, coarse-grained, thinly interbedded with olive-grey clay	0.18
Sand, coarse-grained, ferruginous with thin clay partings	0.15
Broadstone Clay	
Clay, medium grey, laminated	c1.50
Sand of the Broadstone Clay couplet	
Sandstone, medium-grained, ferruginous	1.20

Plate 3. Beacon Hill Sand Pit. Clay-clast breccias in sand of the Poole Formation.

A higher face farther east in the pit [9844 9520] exposes Parkstone Clay and the overlying Branksome Sand. The southern end of the section [9840 9511] shows 1.9m of clay, pale and medium grey in the lower part, with the top 0.4m red-brown. Farther north in the face, a section [9840 9524] in theParkstone Clay comprises by 0.9m of mottled orange and grey silty clay, overlain by a ferruginously cemented coarse-grained, cross-cutting sandstone. A few metres west of this section, the Parkstone Clay is completely cut out beneath the Branksome Sand, but reappears 20m to the W.

Beacon Hill - Corfe Mullen - Sleight

North of Beacon Hill, exposures in the Broadstone Clay couplet are rare. North-east of the Corfe Mullen clay pit a medium-grained sand, up to 2m thick, within the Broadstone Clay can be traced northwards for about 350m. The base is locally marked by springs [9828 9568 and 9827 9573]. At the latter locality, the underlying clay was formerly worked for bricks.

The junction of the Broadstone Clay and underlying sand can still be seen in the old pit [9860 9653] south of Wyatts Lane, Corfe Mullen. There, a section [9856 9653] showed:

	Thickness m
Broadstone Clay	
Clay, silty, pale grey	0.9
Sand of the Broadstone Clay couplet	
Sandstone, ferruginously cemented, medium-grained	0.1
Sand, fine- to medium-grained, orange	3.0+

The total thickness of the sand hereabouts is about 12m.

The top of the Broadstone Clay is exposed in the grounds [9884 9652] of Corfe Mullen School, and consists of mottled red

and yellow-brown clay.

Some 3m of medium- to coarse-grained sand can be seen in the old pit [9852 9708] north-east of Brook Lane Farm.

Springs mark much of the base of the Poole Formation northwards and eastwards from the last locality. Much of the outcrop is hidden beneath River Terrace Deposits. A section [9862 9802] in the bottom of a 4-m deep gravel pit shows fine- to medium-grained yellowish brown sand.

Friable orange-brown, medium-grained sandstone can still be seen at the top of the old railway cuttings [9946 9843 and 9951 9845] near the Wimborne Road. A borehole [9947 9840] just south of the cutting proved:

	Thickness m
River Terrace Deposits	
Gravel, sandy, and brown-mottled grey clay	0.30
Broadstone Clay	
Clay, stiff, grey	0.50
Clay, sandy, stiff, grey-brown mottled	0.30
Sand of the Broadstone Clay couplet	
Sand, medium-grained, orange-brown	0.65

Farther south-east in the cutting [9975 9829], up to 2m of fine- to coarse-grained orange sand is exposed. The top of the sand in the cutting [9993 9800] south of Happy Bottom consists of ferruginously cemented, fine- to coarse-grained sandstone which forms a rib protruding through the turf of the cutting; the sandstone is overlain by mottled orange and grey silty clay. The dinoflagellate Kisselovia coleothrypta, zonal index of the coleothrypta Zone was obtained from a dark greyish brown silty clay in the south-easternmost part of the cutting (Freshney, Bristow and Williams, 1985, p.50). The total thickness of the sand hereabouts is about 12m.

West-south-westwards from the railway cutting, the Broadstone Clay has a broad outcrop with an estimated thickness of 7 to 10m, on the flanks of Barrow Hill [996 976]. The dominant lithology is mottled orange and grey silty clay, although medium grey [999 976] and dark grey [9958 9778] clay was augered in place.

Springs mark the base of the Poole Formation along Rushcombe Bottom [around 999 973]. The junction of the Broadstone Clay, here about 10m thick, and underlying sand was proved in a borehole [9939 9712] at Rushcombe Bottom. There, beneath 2.2m of Head, 1.3m of banded sandy silt and grey sandy clay above 3m of clayey fine-grained sand was proved.

In a ditch [9987 9708] on the golf course, mottled purple and grey-brown clay can be seen.

There are few exposures in the Broadstone Clay couplet in the urban area of Broadstone [around 995 960]. Boreholes for the Springdale Road School proved the junction of the Broadstone Clay and underlying sand. A typical borehole [9947 9572] proved:

	Thickness m	Depth m
Topsoil	0.30	0.30
Broadstone Clay		
Clay, sandy brown and grey	1.68	1.98
Clay, silty, with a thin bed of sandstone, grey	0.31	2.29
Sand of the Broadstone Clay couplet		
Sandstone, iron cemented	1.06	3.35
Sand, brown	2.75	6.10

The Broadstone Clay in this area is probably only about 3m thick.

Mottled orange and grey silty clay can be augered around The Clump [998 954], and in the fields [around 994 950] 500m to the SW.

Upton Heath area

The sand unit below the Broadstone Clay has a wide outcrop, but is poorly exposed, west and south-west of Beacon Hill where it merges with the sand below the Oakdale Clay as that clay dies out westward. Eastwards, the sand unit disappears under the downcutting sand of the Parkstone Clay Couplet around [9828 9494], but reappears east of Upton Heath [9927 9478]. A small exposure [9972 9488] in an old clay pit at Broadstone showed very clayey sand containing pebbles of laterite.

The Broadstone Clay is also poorly exposed, but can be traced by augering. East of Upton Heath [around 994 948] and in the Beacon Hill area, the clay consists mainly of red-stained grey clays. One exposure [9744 9462] on Beacon Hill shows a dark grey clay passing down into a pale grey silty clay with some red staining. The junction of the Broadstone Clay with the sand below is seen in a pit [9720 9471]:

SL c.57m above O.D.	
Broadstone Clay	
Clay, silty, mottled grey and orange	over 1.00
Sand of the Broadstone Clay Couplet	
Laterite	0.05
Silt, clayey and silty clay, rubbly with much lateritic material	0.40
Laterite	0.04
Sand, fine-grained ,grey and orange, bedded in units of 0.2-0.1m with thin grey silty clay layers up to 20mm thick	1.00
Sand, fine- to medium-grained, buff to orange; cross-bedding common from 060°,080°,100°,100°	over 6.00

Upton area

Only the sand of the couplet occurs in this area; the best exposures are in a bank in an old brick-clay pit. One section [9869 9279] here is as follows:

SL c.10m above OD

Made Ground	
Sand, clayey with clay	1.0
Poole Formation	
Sand, medium- to fine-grained, clayey, orange with reddish grey silty clay layers.	2.8
Clay, grey with some red staining	2.9
Sand, fine-grained, white with occasional clay layers; cross bedded from south	4.1

Hamworthy area

Only the sand of the Broadstone Clay Couplet is present in this area, where it forms most of the high ground of the peninsula. Exposures are common in the disused Lake clay pit. A typical section [9798 9092] shows:

SL c.21m above OD

River Terrace Deposits (4th)	
Gravel, sandy with some masses of mottled sandy clay near the top	1.25
Poole Formation	
Sand, fine-grained , yellow to orange	1.50
Sand, fine-grained becoming very fine-grained and clayey down	over 1.50

At Rockley Point, a bank section [9737 9102] exposed coarse- to very coarse-grained sand in three fining-upward sequences, each 0.8m thick. In a railway cutting between [9860 9135 and 9867 9116], several small exposures of fine- to medium-grained sands occur; a grassed-over bank [9855 9085] showed 2.5m of fine-grained sand beneath gravelly sand ascribed to the 4th River Terrace Deposits.

Holton Heath area

Most of Holton Heath is underlain by sands of this couplet, for the most part covered by terrace deposits. Some exposures occur, however, in cuttings made when the heath was the site of an ordnance factory. Two sections [9519 9126 and 9513 9136] in these cuttings are as follows:

SL c.15m above OD
Poole Formation,undivided
Sand,very fine-grained, gradual increase in clay content down becoming extremely sandy clay at base which is sharp 0.15
Sand as above, but festoon cross-laminated on a scale of 1-2cm, also grading down into 4cm thick clayey very fine-grained sand with sharp base 0.20
As above, but without cross-lamination. Very clayey unit at base 2-5cm thick 0.40-0.60
Sand, buff, fine-grained, cross-bedded in dm scale. Clayey and ferruginous in basal 1cm 0.60
Sand, fine-grained, buff 0.30

SL c. 15m above OD
River Terrace Deposits
Sand, very fine-grained very clayey, mottled yellow orange grey and red with scattered pebbles over 1.0
Poole Formation, undivided
Sand very fine-grained to silt, clayey, pink to pale red and grey, laminated seen 1.5

Other small outliers, possibly of this sand occur [around 952 929 and 951 935]. There is no good exposure, but augering and surface debris indicate that it mainly consists of coarse-grained sand.

Parkstone Clay couplet

Some sections in this couplet have been described under the Beacon Hill section of the Broadstone Clay couplet.

Some 5m of medium- and coarse-grained sand, resting partly on Broadstone Clay and partly on Lytchett Matravers Sand, caps Barrow Hill. Springs mark the base of the deposit on the south and north-west sides of the hill. There is no exposure in the tract of coarse-grained sand which extends from the cross roads east of Barrow Hill to Forest Hill [9560 9585]. Springs occur at the base on the south side of this outcrop.

Sections in the Parkstone Clay couplet in the Beacon Hill clay pit have been described under the Broadstone Clay.

Northwards from Beacon Hill, mottled orange and grey very silty clay can be found in an old gravel pit [9845 9565]. From here northwards, the outcrop of the clay is hidden by River Terrace Deposits, but poor exposures of the underlying sand, here about 10m thick, are locally exposed. The base of the sand is marked in places [for example 9824 9618 and 9838 9637] by springs. The base of the Barrow Hill sand outlier [995 976] is well defined by springs on the eastern side.

Coarse-grained buff and brown sand is exposed in banks [9885 9648] in the grounds of Corfe Mullen School.

A section [9934 9668] beneath the Roman Road, Broadstone, shows:

	Thickness m
River Terrace Deposits	
Gravel, cryoturbated	0.90
Parkstone Clay	
Clay, silty, pale grey	0 to 0.25
Sand of the Parkstone Clay couplet	
Sand, fine-grained, orange, planar bedded in units 10 to 15cm thick	2.00

The total thickness of the sand is about 10m.

The base of the Parkstone Clay in cuttings on the Higher Blandford Road [9962 9687] consists of chocolate-brown clay. Farther east, on the golf course, mottled orange and grey silty clay occurs beneath River Terrace Deposits. A thin remnant of Parkstone Clay, consisting of up to 0.75m of stiff grey silty clay, was proved in boreholes [9981 9665] beneath River Terrace Deposits at Broadstone School.

The outcrop of the Parkstone Clay can be traced through the gardens of urban Broadstone by a series of powerful springs [9893 9547, 9904 9555, 9914 9565 and 9928 9572] issuing from the base of the overlying Branksome Sand. The Parkstone Clay is about 4m

thick, and the underlying sand about 10m thick. Temporary sections [9934 9580] and augering in ditches [9929 9572 and 9887 9543] show the Parkstone Clay to consist of mottled orange and grey silty clay.

Branksome Sand

The Branksome Sand is exposed in the easternmost part of the Beacon Hill pit. A typical section shows up to 10m of fine-grained sand, thinly bedded, with fine-grained sandy clay and clay. The clay beds are up to 3cm thick and are commonly disrupted; in places they form clay-clast conglomerates with rounded pebbles up to 2cm across. Some large-scale channels cut down 5m into beds below; small syndepositional faults with up to 10 cm displacement occur.

3. STRUCTURE

The Palaeogene rocks of this district generally dip at very low angles (0.5-2.0°) to the SSE, with an overall dip of about 1°. In the western part of the district an E-W zone of dips of up to 2°S occurs between Lytchett Matravers and Lytchett Minster. North of Lytchett Matravers, the strata are almost horizontal, and south of Lytchett Minster, the dip is 0.5-1° S. These areas of steeper dips appear to be caused by small ripples in the Palaeogene and Cretaceous strata and probably overlie pre-Aptian faults analogous to the Cranborne Fault (Allen and Holloway, 1984), which affects Palaeogene beds farther east. It is possible that some of the Palaeogene facies changes, such as the change from Creekmoor Clay to London Clay, may reflect underlying fault structures that were active during Tertiary times.

4. DRIFT DEPOSITS (Figure 8)

Head

Head deposits in the Corfe Mullen-Lytchett Minster district occur mainly in the valley bottoms, and to a lesser extent on the valley slopes between the river terraces. They are formed from a soliflucted downwash of gravel, sand and clay from the terrace deposits, and sand and clay derived from the solid formations.

The thickness of Head probably does not exceed 3m.

Details

In the south, the broad shallow valley [946 933] west of Foxhills Dairy is floored by a mixture of clayey coarse-grained sand, clayey sand and gravel and gravelly silty clay. The deposits in this area probably do not exceed 2m as London Clay can commonly be augered in the bottoms of some of the deeper ditches.

On the north side of the Sherford River, the valley sides are mantled with at least 1.2 of clayey coarse-grained sand [around 943 923].

The broad eastward-trending valley north of Lytchett Matravers [953 963] is floored by clayey, locally gravelly sand. Farther north, there is a 200-m-wide north-eastward draining valley [954 980] which is filled with clayey, locally pebbly sand.

The tract of ground [958 957] south of Barrow Hill is covered with a wash of coarse-grained sand derived from the Poole Formation of Barrow Hill. Similarly, there is an area [964 957] on the south side of Forest Hill where the Broadstone Clay is obscured by a mantle of downwashed coarse-grained Poole Formation

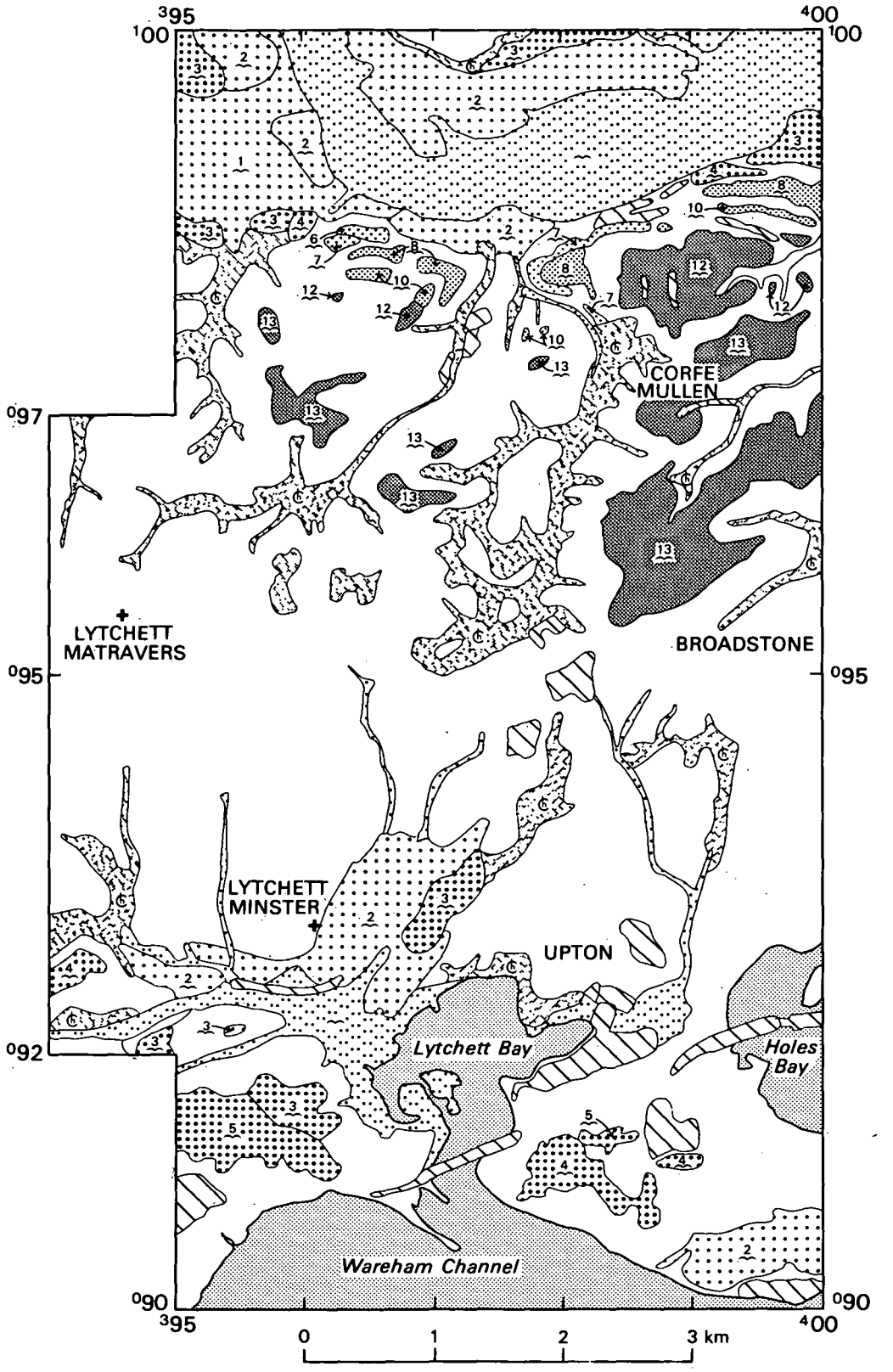

Fig.8 Sketch-map of the Drift Geology of the Corfe Mullen-Lytchett Minster area.

coarse-grained sand related to spring lines at the Poole Formation/London Clay junction [around 973 953, 972 958, 977 960, and 970 965]. In most of these areas, the deposits are more than 1.2m thick, but locally the London Clay was encountered at a depth of about 1m. All these tracts of Head either lead into, or flank the sides of valleys which connect with the unnamed northward trending valley which joins the River Stour near Corfe Mullen church. On the east side of the northern part of this valley [985 975], there is a broad area of clayey sand and gravel, boggy in the upper reaches, which is also associated with springs issuing from the base of the Poole Formation. A borehole [9820 9731] on the opposite (west) side of the valley proved the following descending sequence: Topsoil, 0.23m; clayey sandy silt with some scattered gravel, to 0.84m; silty clay with pockets of fine-grained sand, to 1.07m; fine- and medium-grained sand, to 1.22; medium flint gravel, to 1.68m, resting on London Clay.

At Lambs Green [996 986], some of the slopes on the London Clay between River Terrace Deposits have a blanket of clayey coarse-grained, locally gravelly sand. A borehole [9956 9865] in this area proved more than 2.4m of sand, silt and gravel.

In the south, the valley system on the west side of urban Broadstone is filled with up to 2.9m of silt, sand and gravel. A borehole [9985 9613] proved the following descending sequence: Made ground, to 0.45m; gravelly silt with some sand, to 1.0m; gravel and sand, to 2.9m, on Poole Formation sands.

Head occurs commonly in narrow boggy streamless valleys on the lower part of Upton Heath. Debris from flooded test pits for clay [around 9834 9429] indicate that there the Head consists of

sand with flint pebbles and with some peat and peaty sand. Augering to the north-east [9920 9445] proved at least 1.2m of peaty clay.

Head also underlies the gentle slopes stretching down from Upton to the northern margin of Lytchett Bay. The deposit consists mainly of sand, locally pebbly; in some places it rests on gravel. At one such locality [9777 9233], beside an old pit, gravel was augered below soft yellow sand. North-west of this [9719 9264], soft peaty sand was augered.

Marine Beach Deposits

The only outcrop of this deposit is on the southern coast of the Hamworthy peninsula where it consists mainly of sand and clayey gravelly sand. A borehole [9833 9046] showed 0.7m of beach sand on soft grey silty clay, sand, and soft organic clayey silt to a depth of 3.1m. The sediments below the top sand are probably Marine Alluvium.

River Terrace Deposits

River Terrace Deposits, laid down principally by the River Stour, Sherford River and the former Solent River (Reid, 1902) have been recognized at ten different levels within the present district. They range in height from 1 to 66m above the flood plain and correspond to terraces 1 to 8, and 10 to 13 of the Poole-Bournemouth area (Freshney, Bristow and Williams, 1984; 1985). The older terraces, the sixth to thirteenth, are probably related to a drainage system that flowed eastwards via the Solent, to join the sea south-east of the Isle of Wight - the Solent River of Reid (1902).

The deposits consist of gravels, commonly very sandy and locally clayey. The clasts are mainly flint, with small proportions of chert, sarsen (Tertiary sandstone) and limestones of probable Jurassic age. The maximum pebble size is usually around 5cm. The pebbles are mostly subangular to subrounded, but well-rounded flints, reworked from the Tertiary deposits, are locally present.

The thickness of the River Terrace Deposits is highly variable. In general, the thickness of the higher terraces ranges from 1 to 4m, but probably on average the terrace deposits are about 2m thick. The lower terraces vary from 2 to 6m in thickness, with an average thickness of about 3 to 4m.

Most of the higher terraces are cryoturbated and have an irregular fabric with involutions and flame structures, especially where the gravels overlie clay. Where the gravel is convoluted it may be as thin as 1m.

There is little direct evidence for the ages of the terrace deposits district. Bury (1932), Green (1947) and Calkin and Green (1949) recorded Acheulian implements in Twelfth River Terrace Deposits at Sleight, and also in Thirteenth River Terrace Deposits at New Town near Poole, east of the present district. In the Hurn-Christchurch area, implements of Acheulian type have been found in the Sixth to Eleventh River Terrace Deposits (White, 1917; Freshney, Bristow and Williams, 1984), thus suggesting a Middle Pleistocene age for these deposits, although some of the implements found in the lower terraces may be reworked material from higher terraces.

Details

Thirteenth River Terrace Deposits

Dissected remnants of this terrace occupy a large flat between Corfe Mullen and Broadstone. Smaller tracts occur at Stony Down Plantation [968 964], Notting Hill [96 97] and Heron Grove [958 978].

The base of the terrace falls eastwards from about 82m AOD at Notting Hill to about 73m at Corfe Hills [000 967]. There is a corresponding eastward fall in height of the upper surface from 89m in the west to 78m AOD in the east.

Thirteenth River Terrace Deposits are well exposed on the south side of Henbury Sand and Gravel pit. There, they vary in thickness generally between 1m and 1.5m, but locally are up to 4m thick. One section [9606 9724] showed a lower unit, 1m thick, of roughly bedded gravel beneath 1m of cryoturbated gravel. In another section [9597 9111], the 2m of very clayey gravel are strongly cryoturbated.

An old gravel pit [9604 9696] on the east side of Notting Hill exposed 2m of unsorted and unbedded clayey gravel.

At Newtown, Corfe Mullen, Reid (Ms map, BGS) noted a section [9912 9728] in 2.4m of gravel.

Boreholes at Corfe Mullen School showed that the gravel varies from 2.8m [9970 9669] to 3.8m in thickness [9981 9665]. The deposits are described as dense brown sandy gravel with clay in the lower part, and with up to 1.3m of stiff brown mottled sandy clay or clayey sand forming the upper part of the deposit. The deposits were worked for sand and gravel in a pit [9975 9650] 100m SSE of the school, where a thickness of 3.3m was formerly exposed. West of the school, 0.9m of cryoturbated sand and

gravel overlies Poole Formation sands [9934 9668].

One small outcrop of Thirteenth Terrace Deposits occurs in the side of a disused pit [9759 9474] at the top of Beacon Hill at a height of about 82m. Here 0.5m of sandy orange gravel overlies sands of the Poole Formation

Twelfth River Terrace Deposits

The most extensive occurrence of Twelfth River Terrace Deposits is east of Sleight [99 98] where they have been dug for sand and gravel. In the westermmost pit, up to 1.2m of medium gravel with interbeds of clayey coarse-grained sand up to 0.3m thick, can be seen on the west side [9854 9802]. In the north-east of the pit [9864 9814], up to 1.6m of cryoturbated medium gravel with thin stringers of clayey coarse-grained sand is exposed. Another pit [988 980] has been backfilled. In a third pit, largely built over, up to 2m of gravel in an orange clayey sand matrix is visible on the west side [9912 9825]. The gravel is mostly subangular, but some rounded pebbles occur. Most pebbles are less than 10cm across.

Bury (1932) mentioned several sections [986 980, 992 983 and 984 980] at Sleight in which the deposits consisted of an upper part containing lenticles of sand, overlying 2 to 5m of more homogeneous gravel, locally "loamy". The deposits are commonly contorted. Green (1947) distinguished a suite of in situ terrace gravels and "Bluff deposits" [Head] in this area. In the absence of exposure, it has not been possible to separate these marginal head deposits from River Terrace Deposits. Acheulian-type implements have been found in the pits at Sleight, together with sarsens and ice-striated flints.

Small areas of Twelfth River Terrace Deposits occupy hill tops at Mansion Hill [9675 9490] and at Round Hill [9690 9493] . At the first locality, all that can be seen is about 0.8m of sandy gravel in an old pit; on the second hill, only gravel debris is visible.

Tenth River Terrace Deposits

These deposits form two small outliers [9625 9797and 968 978] south of Henbury Manor. The base of the deposit lies at about 50m OD, and the upper surface at about 53m AOD.

Ninth River Terrace Deposits

These deposits form an elongate strip on the south side of the River Stour at Lambs Green [9910 9865 to 9995 9850], and as dissected remnants capping interfluves in the west. The base level of these deposits falls eastwards from about 43m AOD [9585 9815] to about 39m [9995 9850]. A borehole [9954 9857] in the eastern spread proved 0.5m of brown silty sandy clay on more than 1m of brown clayey sandy gravel.

Eighth River Terrace Deposits

The distribution of Eighth River Terrace Deposits follows those of the Tenth, with an additional spread [980 982] west of Sleight. The base level of the deposits falls eastwards from about 37m AOD [9685 9830] to 30m AOD [000 988].

In the eastern spread, surface indications are of a very clayey deposit. Springs issue from the northern boundary between Candys Farm [992 980] and Lambs Green [9968 9882].

Seventh River Terrace Deposits

Deposits of this interval occur at Little Henbury [9530 9815], Henbury Manor [962 983] and in a narrow strip [9775 9810 to 986 985] south and east of Corfe Mullen Church. The base level of the deposits falls eastwards from 35m AOD, 13m above the floodplain, at Henbury Manor to 30m AOD at Brog Street.

The deposits at Little Henbury are very gravelly. No details are available for the other deposits, but surface indications are of dominantly gravelly deposits with only a minor clay content. The thickness probably does not exceed 2m.

Sixth River Terrace Deposits

The only occurrance of Sixth River Terrace Deposits is just north of Henbury Manor [964 984] where they have a base level of 30m AOD, about 8m above the floodplain.

Fifth River Terrace Deposits

A small area of this terrace occurs at the top of Ham Hill in Hamworthy. An exposure [9847 9138] showed 2m of sandy gravel, but site investigation boreholes on the edge of the deposit [9820 9126] shows only 0.3m of gravelly sand.

Another small deposit of Fifth Terrace caps a small hill on Holton Heath [9568 9107]; there, a disused gravel pit exposed up to 1m of orange brown sandy gravel on coarse- to very coarse-grained sands of the Poole Formation.

Fourth River Terrace Deposits

In the north, the only occurrence of Fourth Terrace Deposits are along the A31 [990 980 to 9950 9888] and Willett Road near Lambs Green [990 988 to 999 989]. The base of the deposits is

irregular, but is generally at about 21 to 23m AOD, some 3 to 4m above the floodplain. The upper surface is about 25m AOD towards the back of the terrace.

Boreholes at the Sewage works indicate variations in the deposit. One borehole [9944 9888] proved a total of 1.98m of very clayey sand and gravel, whilst in another borehole [9943 9892], 5.33m of sand and sandy gravel were encountered.

In the southern part of the district, Fourth River Terrace Deposits occur on the north side of the Sherford River [942 947]. For the most part the deposits consist of coarse- to very coarse-grained sand; flints are common at the surface 200m NE of Organford Manor [9440 9274].

Spreads of this terrace occur in the western part of Hamworthy, and on the higher parts of Holton Heath. Wells of uncertain location [about 9905 9112] proved up to 3.7m of sand and gravel. A section at the top of an old pit [9886 9122] exposed 2m of clayey coarse- to very coarse-grained sand, locally very gravelly and cryoturbated. Another exposure at the back of the old Lake clay pit [9798 9092] revealed 1.25m of sandy gravel containing masses of mottled sandy clay near the top.

The deposits on Holton Heath show much cryoturbation. An exposure in a disused cutting [9525 9130] consisted of orange brown coarse-grained sand with gravel layers and clay-rich layers, some of which are sub-vertical and red mottled. Another exposure [9617 9098] at the side of the old railway cutting showed 2.5m of sandy gravel.

Third River Terrace Deposits

These deposits form broad flats in the north-west [952 987], north [98 00] and north-east [00 99] of the distirct. The base of the deposit is not seen; the upper surface falls from about 26m AOD (about 4 to 5m above the floodplain) to about 22m AOD in the east. In the west, the surface is about 1.5m higher than the Second Terrace Deposits; there is a marked step between the two terraces.

Boreholes at the western end of the Wimborne By-pass in the north-eastern spread, proved up to 6.3m of terrace deposits. The deposits have a variable lithology; the log of one borehole [9994 9915] is reproduced below:

	Thickness m	Depth m
Topsoil, gravelly	0.3	0.3
River Terrace Deposits (Third)		
Sand, clayey, very silty with abundant gravel and carbonaceoous material (possible fill)	1.2	1.5
Clay, very silty, sand with abundant gravel	0.7	2.2
Sand, clayey, silty with abundant gravel	0.5	2.7
Gravel, dark brown, loose in a matrix of silty sandy clay	1.2	3.9
Gravel, medium dense, rounded and subangular flints in a sand matrix	2.4	6.3
Reading Formation	6.3	12.5

Third River Terrace Deposits also occur on the south side of the Sherford River. They consist dominantly of coarse-grained sand. A section [9493 9204] in an old clay pit showed 1.5m of coarse-grained sand resting on mottled red and grey clay.

Another section [9495 9206] revealed 1m of coarse-grained sand, resting on 0.2m of gravel which in turn overlies mottled red and grey clay.

A small area of Third Terrace Deposits occurs on the lower part of Holton Heath at a height of about 7 to 9m. North of Lytchett Bay, a spread occurs west of Upton. Debris from test pits [9685 9310] indicates gravelly sand resting on medium-grained sand of the Poole Formation.

Second River Terrace Deposits

Second Terrace deposits form an extensive spread along valley of the River Stour from Barford Dairy [965 995] in the north-west, to below Cowgrove Farm in the north-east [993 000]. More fragmented occurrences are found south of the river. The surface of the deposit falls eastwards from about 24m AOD to about 19m AOD.

A borehole [9704 9849] at Barford Dairy proved more than 3m of gravel. On the opposite side of the river, a borehole [9704 9849] at the Waterworks was still in sand and gravel at a depth of 7.93m. Farther east, a borehole [9743 9851] proved 1.5m of made ground, on 4.8m of clayey very gravelly sand, becoming a sandy gravel with depth.

Second River Terrace Deposits occur on the south side of a north bank tributary to the Sherford River alongside the A35. Ditch sections [9479 9275 to 9495 9266] expose up to 1.5m of clayey, coarse-grained sandy gravel.

This terrace forms a flat or gently sloping area at a height of about 2m to 5m AOD near Lytchett Minster. The deposit has a

clayey fine-grained sand top which was seen to be up to 1.8m thick in a ditch [9636 9310]. Augering indicates that gravel lies below this sand, but it is of unknown thickness. A site investigation borehole [9530 9261] showed 1.2m of greyish brown silty clayey sand, on 1.2m of brown sandy clayey gravel.

Another area of Second Terrace occurs in the eastern part of Hamworthy where it lies at a height of 2 to 5m AOD. In this spread, a borehole [9987 9028] showed yellowish brown very sandy fine, medium and coarse gravel down to a depth of 3.2m, below about 0.3m of silty gravelly sand. Another borehole [9922 9052] revealed 1.4m of yellowish grey very sandy gravel overlain by 1.1m of gravelly black sandy silt.

First River Terrace Deposits

There is an extensive spread of low-lying sand and gravel in the north-west of the district. Much of the surface of the deposit, which lies between 0.5 and 1m above the floodplain, is undulating [952 989, 954 988, 956 994 and 958 991]; locally up to 1.2m of peat and peaty clay occurs in the bottoms of the depressions. A section [9549 9932] south-east of the Sewage Farm showed 1m of peat and peaty clay, resting on 0.6m of grey fine-grained sand with scattered flints, which in turn rests on more than 1m of clayey sand and gravel. Another section [9552 9935] close by, exposed 1m of mottled orange and grey clayey fine-grained sand on gravel. The fine-grained sand decreases in thickness north-eastward to 0.3m over a distance of 20m. A third section [9562 9922] showed 3m of poorly sorted, bedded gravel; Chalk was exposed at one place [9560 9923] at a depth of 3m in the bottom of the excavation.

Alluvium and Estuarine Alluvium

The principal occurrences of Alluvium within the present district are along the River Stour in the north, and along the Sherford River in the south. Minor tracts of Alluvium are to be found along some of the larger tributaries of the above rivers. In the south, the Alluvium of the Sherford River merges imperceptibly into Estuarine Alluvium.

The Alluvium consists of an upper unit of mottled dark grey and orange, commonly organic, shelly silts, silty clays and clayey sands, and a lower unit of sand and gravel. Along the Stour, the upper unit varies from 0.5 to 2.6m in thickness; the lower unit varies from about 2.5 to 6m.

Locally the Alluvium is richly fossiliferous. Mr D Graham has examined the fauna from two sites south of Barford Dairy and south-east of Cowgrove Farm respectively (see below and Table 2) and makes the following comments: both assemblages are predominantly aquatic with minor terrestrial elements. Neither shows any marine influence, and there is no indication that temperatures differed appreciably from those at present. The fauna of the western sample is much more abundant and slightly more diverse than the other and clearly represents a more favourable environment for aquatic species. Bithynia tentacula occurs commonly in quiet rivers with hard water, whilst Ancyclus fluviatilis and Theodoxus fluviatilis are indicators of stony river bottoms. The latter usually avoids light and it is possible that its occurrence in numbers points to a shady palaeoenvironment. On the whole, the assemblage indicates hard, slow-flowing, water with a stony bottom, probably with marshy

	[9659 9929]	[9873 9936]
Ancyclus fluviatilis	38	1
Anisus vortex	5	44
Armiger crista	4	2
Bathyomphalus contortus	43	23
Bithynia tentacula	617	2
Bithynia tentacula (opercula)	132	2
Carychium minimum	-5	
Cochlicopa lubrica	1	-
Discus rotundatus	1	-
Gyraulus albus	124	4
Lymnaea palustris	-	3
Lymnaea peregra ovata	52	28
Lymnaea truncatula	4	134
Lymnaea sp.	-	1
Planorbis planorbis	2	-
Punctum pygmaeum?	-	4
Succinea elegans	1	-
Succinea oblonga	10	-
Succinea sp.	20	2
Theodoxus fluviatilis	215	-
Trichia hispida	28	11
Vallonia excentrica	-	9
Valvata cristata	-	3
Valvata macrostoma	-	4
Valvata piscinalis	355	-
gastropod indet.	-	fragments
Anodonta anatina	1	-
Pisidium amnicum	8	-
Pisidium nitidum	188	-
Pisidium subtruncatum	1	-
Pisidium sp.	-	5
Sphaerium corneum	23	-
Sphaerium corneum? (fragments)	18	-

Table 2. Mollusca from the Alluvium of the River Stour

ground near to the river banks at, or upstream, from the locality sampled. Terrestrial elements included were probably introduced by flooding and/or the collapse of river banks.

Most abundant in the assemblage from the eastern sample is Lymnaea truncatula, an amphibious gastropod which lives in shallow well-aerated water. There is a higher proportion of taxa associated with moist and possibly dry situations and no good evidence of stony bottom conditions. It is possible, therefore, that this sample was deposited in shallower water or even marshy ground (perhaps adjacent to the present course of the river) which could be subject to periods of flooding, but might occasionally dry out.

Details

A borehole [9647 9967] near Barford Dairy proved 2.5m of light brown, sandy and silty clay, on 2.5m of very coarse gravel, which in turn rested on broken chalk.

Exposures along the banks of the River Stour are common and mostly show 1.4m of mottled grey-brown shelly clay. The fauna from a locality [9659 9929] south of Barford Dairy is included in Table 2. On the western margin of the Alluvium near Barford Dairy, the upper clayey unit thins to 0.4m [9595 9964].

A borehole [9726 9860] near the Old Mill proved 1m of brown "mould" and clay, resting on 6m of coarse red ballast, which in turn rests on Chalk.

Farther downstream, exposures in the river bank show an irregular variation in thickness of the upper unit from 0.7m [9782 9907] to more than 2m [9873 9936]. A list of molluscs from the latter locality is included in Table 2. The gravel (lower

unit) in an exposure close by [9885 9934] consists of knobbly and sub-angular blue and brown flints up to 15cm across.

A borehole [9874 9872] at the southern margin of the Alluvium proved 0.3m of very silty, clayey, fine-grained sand, resting on 1.45m of mottled red-brown, very silty sandy "marl", which in turn overlies 1.27m of sandy, silty gravel.

An exposure [9764 9811] of Alluvium in a tributary valley to the Stour south of Corfe Mullen Church, shows 0.4m of grey-brown clay resting on gravel.

In the western reaches of the Sherford River, the Alluvium consists of at least 1.1m of organic sandy clay [around 944 922].

Large tracts of mud of the Estuarine Alluvium surround Poole Harbour and Lytchett Bay. Boreholes at Turlin Moor penetrated sediments of this deposit below Made Ground. One [9815 9184], was as follows:

	Thickness (m)
Made Ground	
Silt, clinker, roots, glass, and ash	1.55
Estuarine Alluvium	
Clay, soft, black with vegetation	2.65
Sand, light grey to fine gravel	3.60

Landslip

Landslips have been mapped at only two localities within the present district, but they have been recognised at a number of localities adjacent to the study area. All are developed on clays of the Reading Formation and are associated with springs issuing from the base of the overlying Warmwell Farm Sand, or from sands within the Reading Formation. Although just outside the present district, it is worth noting that the most

spectacular of the slips, 650m long and a maximum of 200m across, occurs just north of Higher Combe Farm [945 977]. With its hummocky and stepped surface, enclosed ponds, irregular spring lines and a prominent toe it has a typical landslip morphology.

Slips involving the Reading Formation have taken place on slopes of 10° or less. Slopes in the mixed sand/clay sequences of the London Clay are locally as steep as 25° (Fig.15) and yet appear to be stable.

Details

A slip [941 962] on clays of the Reading Formation north of Dyett's Coppice, Lytchett Matravers, has resulted in an area of hummocky ground measuring 250m by 100m. The natural slope of the ground is about 10°. The slip is associated with springs issuing from the base of the Warmwell Farm Sand on the west of the site.

The Reading Formation north-west of Mountain Clump, Corfe Mullen [973 975], has a hummocky surface; springs issue from the base of the London Clay on the east side of the slip. The overall slope in the area is about 6°.

5. ECONOMIC GEOLOGY

Bricks and pipes

At the present day, the only working brick pit [98 95] is operated by the Beacon Hill Brick Co.Ltd., who make sand/lime bricks using sand of the Poole Formation mixed with lime. Bricks were formerly made at this site using the local Broadstone Clay, but this was discontinued some years age. Production in 1985 was 43,322 tons (Mrs Hemsley pers. comm.)

Some sand from the Henbury pit (see below) is also used for brickmaking. Several other brick making operations have operated in this district (see Figure 14 and Young, 1972) using Creekmoor, Oakdale and Broadstone Clay, London Clay and clay of the Reading Formation.

One of the largest of the former operations, the former Hamworthy Junction Brickworks (later part of the Kinson Pottery Company) [988 915], made bricks and glazed pipeware up until about 1965.

Until 1968, both the Oakdale and Creekmoor clays were worked for bricks on Upton Heath [983 940] and supplied clays to kilns in Upton [984 928], where brick clay from the Oakdale Clay had previously been dug.

Creekmoor Clay was also dug for brick clay at Creekmoor [998 938 and 9998 9330].

The Upton Heath pits lie in the current Ball Clay Consultation area (see Highley, 1975, fig.4) but no ball clay has been worked from the heath. The Creekmoor and Oakdale clays may contain workable ball clay, but no test results are available.

Clay from the pits at Lake [982 908] was worked until about

1950 for pipes, bricks and insulators. Much of the clay was supplied to the Stoke on Trent potteries. White (1917, p.70) noted that clay was mined at Hamworthy [=Ham] Common. This is almost certainly a reference to adits which were driven northwards in Oakdale Clay from the pit at Lake. Reid shows the position of one such mine [c9808 9095] on his BGS ms map.

Ceramics

There is now only one pit [974 978] in which clay is dug for making ceramics. This is the pit of Pilkington & Carters Tiles of Poole, who work the uppermost clays of the Reading Formation at the Knoll Manor clay pit, to produce 2500 to 3000 tons of unglazed floor tiles per year (Mr A.Smith, pers. comm.). Some of the clay from this pit is supplied to a pottery at Stoke on Trent.

In the 1880's the pit operated as a brick pit. Prior to their acquisition of the Knoll Manor clay pit from Kinson Pottery, Pilkington and Carter worked clays of the Reading Formation in a pit [989 987] at Candy's Lane. The clay was moved out of the pit on a narrow gauge railway, to the nearby Carter's Siding on the former Somerset & Dorset Railway, and then transported by rail to the tile factory at Poole, which also had its own sidings.

Working of this pit changed from opencast to adit mining in about 1950 (Mr G. Barrington, pers. comm.). The adits, about 30m long, were driven back from the face. However, this method of working proved uneconomic and the Candys Lane pit closed in the late 1950's. Clay was then purchased from Kinson's Knoll Manor

pit, until the pit itself was bought by Pilkington & Carter.

The Beacon Hill Pottery [976 944] was abandoned by the time (1894) of the original geological survey by C. Read. He noted on this field slip that white clay (of the Broadstone Clay) was mined in the northern part [about 9760 9462] of the pit. The adits were presumably driven northwards under Beacon Hill.

Until 1978, a seam of grey clay in the Oakdale Clay was dug for ball clay from a pit [951 921] south-west of Lytchett Minster. This clay was blended with other clays from south Devon and used for frost resistant tiles.

Work by the authors and Dr J.D. Cornwell using the EM31 and EM34 for measuring ground conductivity in areas of mixed sand/clay sequences, suggests that the technique could be used to provide additional information concerning the thickness and disposition of clay seams in areas of poor exposure (see Appendix 1).

Sand

As well as the sand which is used for brick making at Beacon Hill, Poole Formation sand is dug from the Henbury Pit [964 975] of M.B.Wilkes Ltd. The sand is used for building, horticulture and brick making. Some is sold "as dug" without being screened; other sand is screened for building purposes. Plastering sand, which is also produced at this pit, is a mixture of washed and screened sand.

Sand has been worked until recently from the sand below the Oakdale Clay at Creekmoor [996 939], and from sand below the Broadstone Clay near Broadstone [972 947]. Many pits at Hamworthy, besides producing clay for brickmaking, also produced

as a by-product, sand which occurred as an overburden.

Sand and Gravel

Sand and gravel has been extracted in recent years from Twelfth River Terrace Deposits in the tract between Sleight [986 975] and near Lambs Green [995 983]. There is no extraction at the present day, but it is understood that an application to work gravel in this area has recently been applied for.

Gravel of the Thirteenth River Terrace Deposits was once exploited in the Henbury pit [963 974], but this resource has been exhausted.

The only significant areas of potentially workable sand and gravel are the River Terrace Deposits on either side of the River Stour, and the alluvial gravel of the Stour. There are insufficient data to calculate the resources in these areas, but the Second River Terrace Gravels are at least 5m thick; the alluvial gravel of the Stour is known to be up to 6m thick.

In the south, River Terrace Deposits under Holton Heath [955 915] are dominantly clayey gravelly sand, and thus probably do not form a potential resource.

Building Stone

White (1917) noted that ferruginous cemented sandstones of the Reading Formation and London Clay have been used in local buildings. He quoted examples of their use in the walls of Wimborne Minster and in the bridge at Sturminster Marshall. White (1917) recorded that stone was dug from the London Clay in a pit [9447 9609] north of Lytchett Matravers, and from the Reading Formation in a pit [9463 9722] at Coombe Almer just outside the present district.

Lime and Marl

White (1917) noted that at that time, the soft flintless Chalk was little exploited for marling. Nevertheless, the extensive pits near Combe Almer [for example 944 969] are witness of a once important local industry. There is no sign of a kiln near any of the old Chalk pits, and it is probable that most of the pits were opened for marling purposes.

ENGINEERING GEOLOGY

The soils of the district consist of both granular soils such as the gravels and sands of the River Terrace Deposits, Reading Formation and Poole Formation, and clay soils from the Reading Formation, London Clay and Poole Formation. The gravels are usually compact and well graded with a high sand content and also some clay. Some of the gravel terraces also have a silty clay to clayey fine-grained sand top. This is especially true of the Second River Terrace Deposits which consist mainly of clayey fine-grained silty sand up to 1.8m thick, with perhaps only 0.5m of gravel below. River Terrace Deposits range from 2 to 4m thick, but average about 3m.

The sands of the Poole Formation are predominantly medium-grained with always less than 8% silt and clay, and an average silt/clay content of 3% (Figure 10). Coarse-grained, and even very coarse-grained, sands also occur at the bottoms of fining-upward cycles. The sands are themselves free draining, but the presence of interspersed clay beds commonly causes perched water tables. Sands also occur in the London Clay, but these are dominantly fine-grained and usually have a considerable clay and

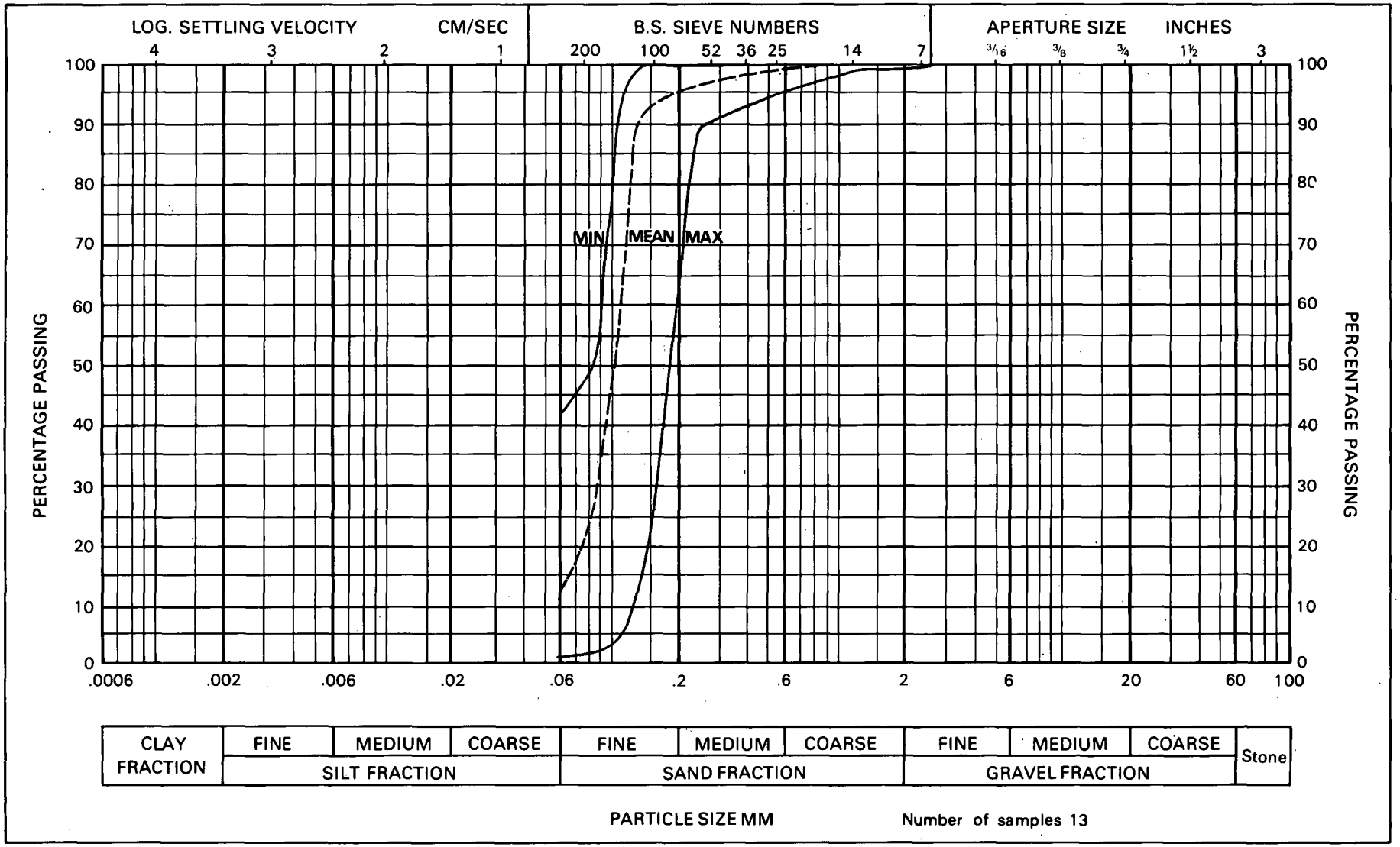

Fig.9 Grading curve envelope for sands of the London Clay of the Corfe Mullen-Lytchett Minster area.

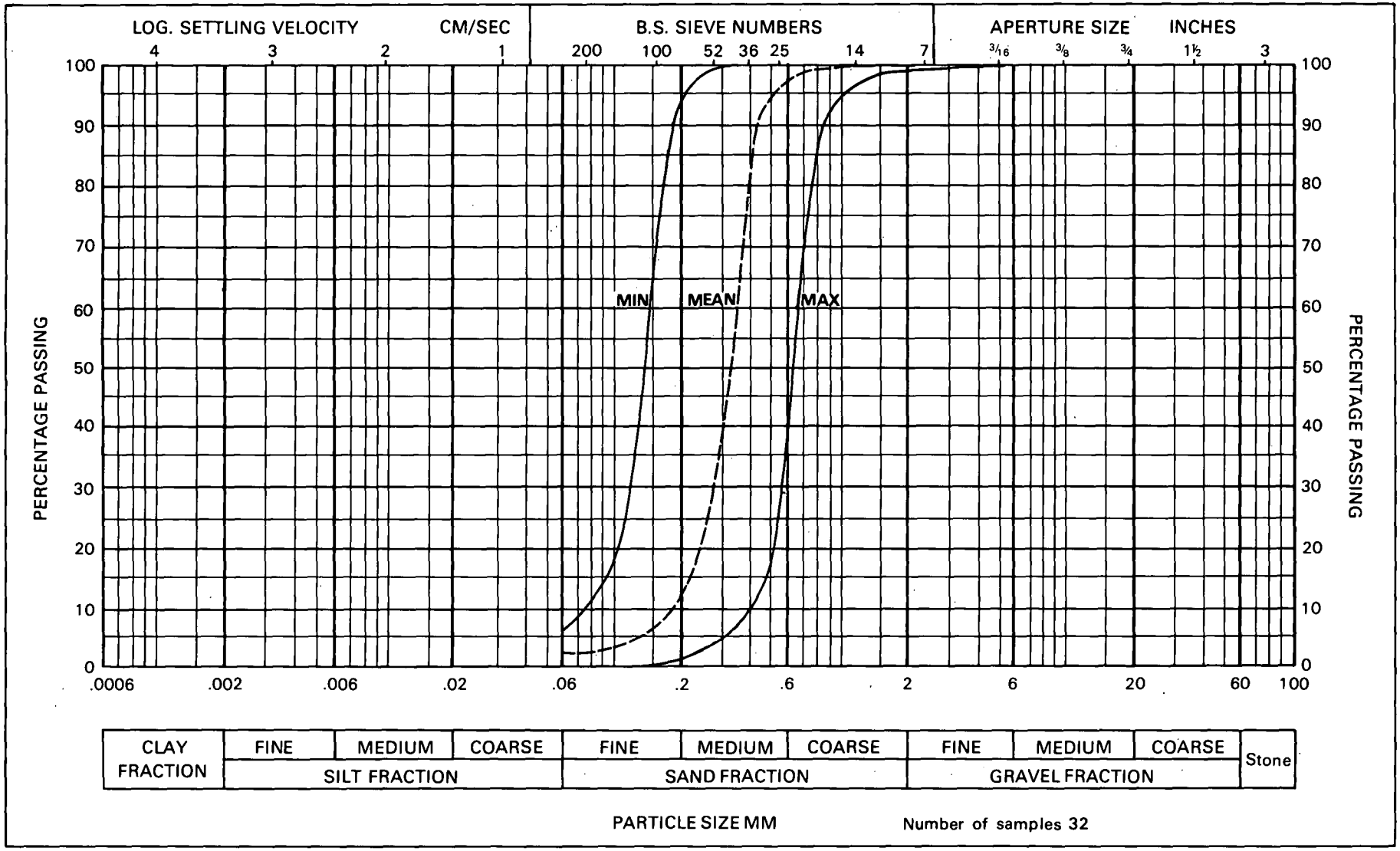

Fig.10 Grading curve envelope for sands of the Poole Formation of the Corfe Mullen-Lytchett Minster area.

silt content which can be as much as 40% (Figure 9).

The clays of the London Clay are usually very sandy and where unweathered are stiff to very stiff. There is a lack of geotechnical data from this district. Extensive areas of clay subsoil occur in the Reading Formation; these clays tend to be lower in sand content than the London Clay. Since they also are usually palaeosol clays, they are likely to have been fig.9 dessicated, and when unweathered tend to be stiff to very stiff. All the landslips recognised in the present district occur on clays of the Reading Formation (see below).

The clays of the Poole Formation show considerable variation in shear strength and cohesion (Table 3). The Oakdale Clay ranges between 29-375Kn/m^2 in shear strength, and between 17-380Kn/m^2 in cohesion, with averages of 97Kn/m^2 and 149Kn/m^2 respectively. The Creekmoor Clay is slightly less variable, with a range in shear strength of 60-144Kn/m^2 and an average of 95Kn/m^2. In many instances, the strength is a reflection of moisture content, but in others, the origin of the clay is important, with the clays that have formed palaeosols being the strongest.

The clays of the Poole Formation range in plasticity from low to very high (Figure 11). This may also reflect the origin of the clays and their consequent clay mineralogies.

The mixed clay/sand stratigraphy of the Poole Formation causes the development of many perched water tables. Springs from these are commonly seen in such areas as Upton Heath, especially in the lower ground where boggy areas occur. There, the downward drainage of water is impeded by the presence at shallow depth of the Creekmoor Clay. Little sign, however, is seen of ground

SILT (M-SOIL), M, plots below A-line
CLAY. C, plots above A-line
} M and C may be combined as FINE SOIL, F.

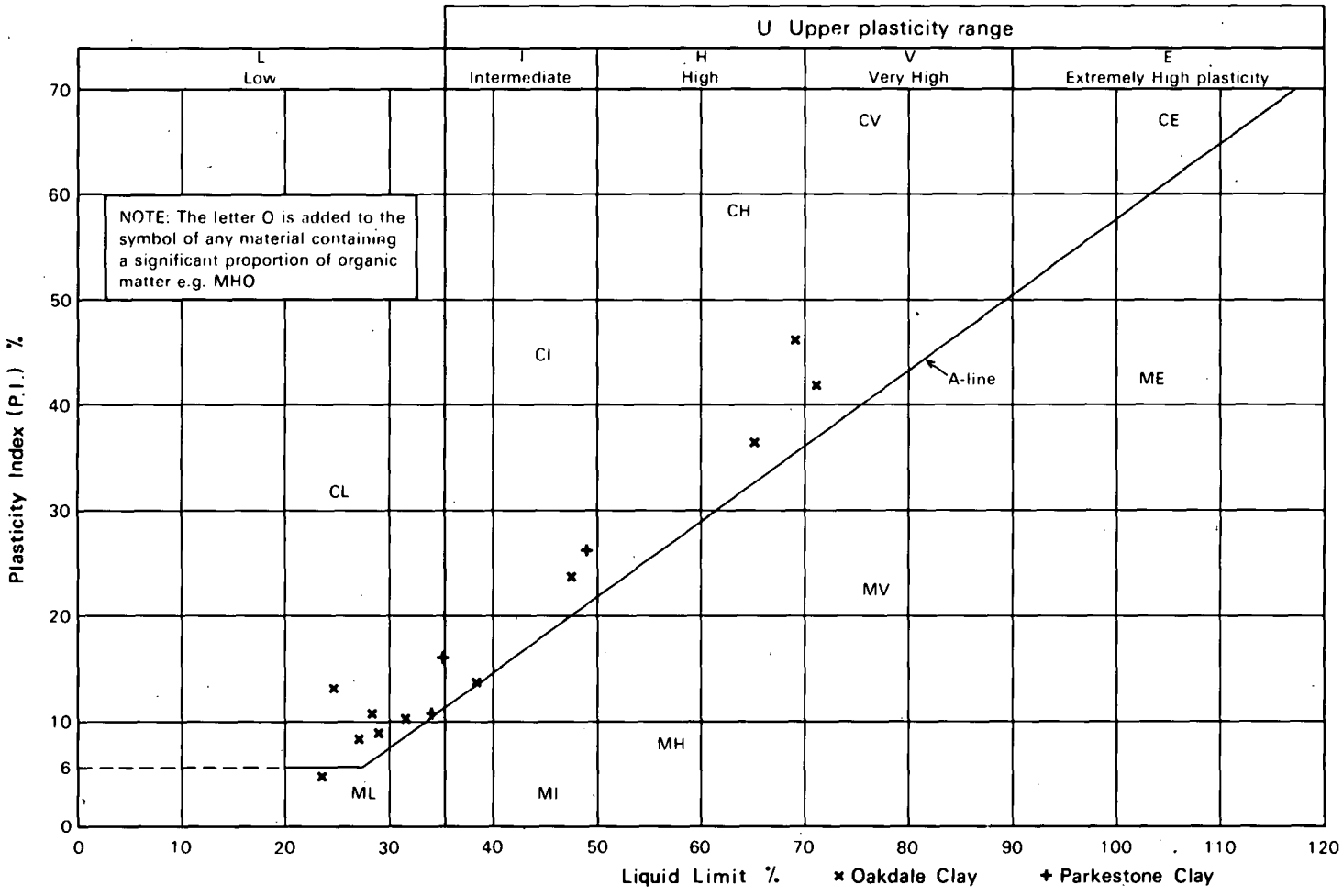

Fig.11 Plasticity chart for clays of the Oakdale Clay and Parkstone Clay

Depth	Moisture Content %	Bulk Density Kg/m^3	Lateral Pressure Kn/m^2	Shearing Strength Kn/m^2	Cohesion Kn/m^2	Angle of Friction degrees
OAKDALE CLAY						
2.7	33	1802		95		--
3.4	20	1930		99		--
4.25	10.5	1751		65		--
6.75	22.4	2042		107		--
6.65	22.8	2004		64		--
6			138		57	--
3.6	25	1968	276		61	--
			414		64	--
		2032	138		102	--
5.1	23	2016	276		89	--
		2016	414		99	--
	14	2083	139		213	--
8.2	19	2067	276		215	--
	18	2099	414		242	--
		1986	138		79	--
3.7	25	2018	276		85	--
		1986	414		57	--
	14	2195	138		259	--
5.2	13	2179	276		365	--
	14	2163	414		321	--
		2002	138		250	--
6.7	20	2018	276		207	--
		2051	414		273	--
		2034	138		110	--
8.2	20	2051	276		98	--
		2067	414		102	--
		2002	138		147	--
11.2	22	2018	276		143	--
		2002	414		131	--
14.2	24	1938	138		17	--
	24	1922	276		79	--
	25	1906	414		380	--
3.0	16	2099	138		72	--
	17	2067	276		70	--
	16	2147	414		78	--

Table 3 Engineering parameters for samples from the Reading and Poole Formation

Depth	Moisture Content %	Bulk Density Kg/m^3	Lateral Pressure Kn/m^2	Shearing Strength Kn/m^2	Cohesion Kn/m^2	Angle of Friction degrees
0.9	17.8	c1865				
2.4	27.5					
3.0	21.9	1865				
1.95	24.1	1865				
1.65	16.0	2083		96		0
2.55	22.0	1920		58		4
3.75	14.0	1808		67		31
4.95	15.0	1680		58		35
2.5	26.0	2002		105		0
4.0	12.0	1746		96		0
1.65	24	2202		58		0
2.55	24	1984		91		0
0.5	13	2211		29		35
2.55	24	1952		63		0
3.75	29	2018		111		0
2.4	18	2115		72		0
2.1	19	2100		140		--
1.9	16	2122		160		--
2.85	22	2646		135		--
2.0	12	2174		250		--
3.2	23	2104		307		--
2.7	15	2186		225		--
3.8	23	2046		157		--
2.9	13	2163		241		--
1.4	14	2244		375		--
9.6	26	1920		70		28
CREEKMOOR CLAY						
1.6	25	2018		144		0
2.5	25	2002		60		0
3.7	24	1890		95		0
1.6	15	2131		72		31
2.5	22	1938		41		41
3.7	22	1938		101		24
1.0	35	1954		72		0
1.6	21	1938		78		0
2.5	25	1986		96		0
3.7	25	1986		89		0
0.5	30	1890		47		0
0.8	29	1922		86		0
2.8	28	1954		140		0
3.7	23	1954		144		0
1.6	25	1922		144		0

Depth	Moisture Content %	Bulk Density Kg/m^3	Lateral Pressure Kn/m^2	Shearing Strength Kn/m^2	Cohesion Kn/m^2	Angle of Friction degrees
1.6	21	1938		144		0
2.5	24			63		
0.5	28			86		
1.6	26	1856		96		0
READING FORMATION						
2.3	19	2131	35			
	21	2147	207		86	0
	22	2147	414			
		2083	35			
5.5	23	2099	207		47	3
		2115	414			
7.9	20	2228	35			
		2228	207		145	13
	17	2195	414			

instability in this area, perhaps because the sands are so free-draining. Landslips do occur, however, on Reading Formation clays near Mountain Clump [973 975], at Dyett's Coppice [941 962] and near Higher Combe Farm [945 977] just outside the present district, where they are overlain by water-saturated Warmwell Farm Sand. In these cases, the sands over the clay are horizontal and fine-grained enough to restrict draining. Figure 15 shows the distribution of areas underlain by mixed clay and sand sequences in the district, and consequently those are the areas most at risk from landslip.

Many of the clays in the district contain pyrite (iron sulphide); when weathered this breaks down to sulphates and can give rise to sulphate-rich groundwaters.

Other geotechnical problems, particularly subsidence, can arise due to the presence of Made Ground. Figure 13 shows the distribution of the larger areas of known Made Ground and the nature of the dominant fill.

Sink hole or solution-collapse hollows

Swallow holes were recognized by Reid in 1894 during the original geological survey in the north-western part of the district. In places, the individual holes are noted, elsewhere the general note "swallows" is written on the map. White (1917) noted that the holes "lie mostly in the paths of intermittent brooks which collect the surface-drainage of the adjacent slopes on the Eocene beds; for swallow holes, in the early stage of their development, thrive best on light and occasional draughts of acidulated soil-water and are liable to be choked by sediment when the inflow is rapid or sustained".

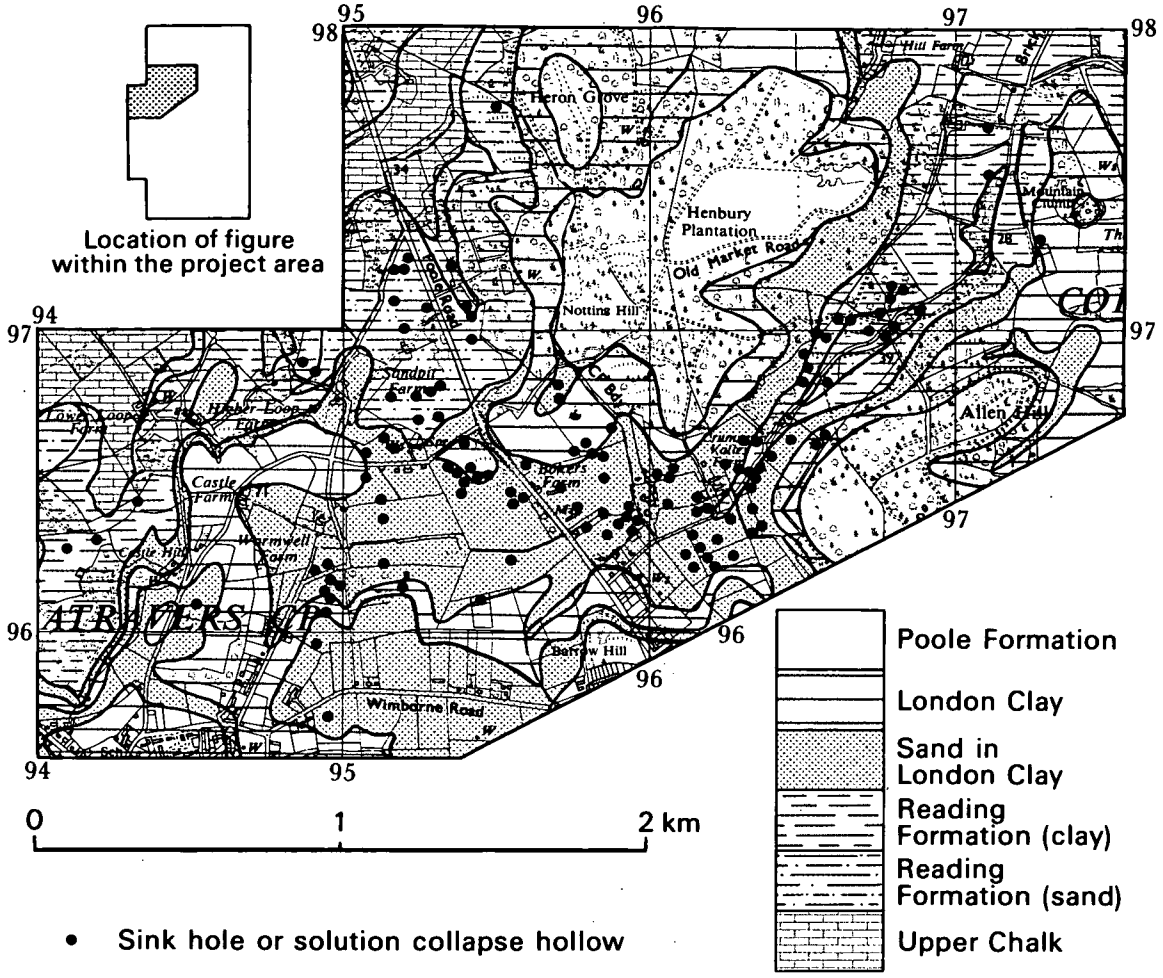

Fig.12 Distribution of sink holes or solution collapse hollows in the Corfe-Mullen – Lytchett Matravers area.

The larger depressions are found along the courses of the larger dry, or intermittently dry, valleys. Within the present district, their maximum diameter is about 50m, and their depth is up to 2 to 3m; 60 or 70m diameter depressions up to 4m deep have been noted farther west. In places, two holes may partially overlap to give a dumb-bell shaped depression.

In addition to the depressions along the major valleys, some of which have recognisable outlets in their floors, there are a number of saucer-shaped depressions, varying from 5 to 40m across and up to 2m deep, on the valley sides (Fig.12). Whilst one or two of these depressions on Tertiary strata away from the valley bottoms may be old pits, their large number, concentrated in areas where the Chalk lies at shallow depth, suggests that they are collapse structures developed over solution cavities in the Chalk.

Hollows other than those in the major valleys are locally aligned at right angles to the valley sides [for example around 9612 9627 and 9495 9611], or follow the courses, commonly straight [for example around 9538 9650], of minor dry valleys. This suggests that some at least of the collapses are joint controlled.

One of the local farmers, Mr Guest of Sunnyside Dairy, Lytchett Matravers, who has filled in several of these depressions, states that "they continue to grow over the years".

From Fig.12 it can be seen that the majority of the depressions are developed on either sands of the Reading Formation or London Clay. The sandy strata no doubt facilitate the passage of "acidulated" ground water to the Chalk.

Details

One of the biggest of the depressions [9675 9700] is that in the valley which flows south of Henbury Plantation. There, there is a 2-m high lip in the valley profile. No outlet is visible in the floor of the hollow; the ditch alongside the hollow was dry at the time (May) of the survey. At certain times, water obviously ponds up behind the lip as there is a 170-m strip of Alluvium behind the lip. Reid (Ms. map) noted a swallow hole [9697 9712] in the floor of the stream some 230m downstream.

(figs 13-16 folded in end pockets)

HYDROGEOLOGY

The district lies across the boundary between Hydrometric Areas 43 and 44. The water resources are managed by the Wessex Water Authority. The district lies mainly within Unit 4 of the Wessex Water Authority, with a small part in the south-west being within Unit 5 (Monkhouse and Richards, 1982). Information on the area is also published in the Hydrological Survey for the Wessex Rivers (Anon., 1967), and further details are given by White (1917).

The central part of the district rises in places to more than 60m above sea level. The northern flank of the higher ground drains to the River Stour which flows approximately along the northern margin of the district. The southern flank is drained by small streams flowing directly into the sea in Lytchett Bay and Poole Harbour.

The mean annual rainfall is about 900mm, and the mean annual evaporation probably about 450mm. Infiltration into the Chalk outcrop, which in this district is largely covered by drift, is probably about 300 mm/yr, while that into the outcrop of the Tertiary sands is probably not less than 350 mm/yr.

Much of the public water supply comes from sources outside the district. However, some 33 megalitres per day (Mld) is available from boreholes in the Chalk at Corfe Mullen [974 983], while a further 20 Mld can be taken from a site just outside the district near Sturminster Marshall, also from the Chalk.

Chalk, the major aquifer in the district, crops out in the valley of the River Stour, although it is there almost completely concealed by drift. Chalk underlies Tertiary strata in the rest

of the district. Southwards, the top of the Chalk is at considerable depth; a borehole at Beacon Hill [2761 9446] reached Chalk at a depth of 78m, and another at Holton Heath [956 909] reached Chalk at a depth of 130m.

In the Stour valley, and beneath a thin cover of Reading Formation, the Chalk has a mean yield of 1000 m^3/d for a drawdown of 10m from boreholes of 300mm diameter penetrating 30m into the saturated aquifer. As the thickness of cover increases, yields tend to become less, and near to the coast, a borehole of similar dimensions might be expected to yield less than 50 m^3 /d for a drawdown of 10m.

The quality of Chalk groundwater in the north is generally good, with a total hardness of 350 to 400 mg/l and a chloride ion concentration of about 30 mg/l. Towards the coast, information is limited, but the chloride ion concentration appears to increase to more than 200 mg/l, and possibly to more than 500 mg/l.

Moderate yields of groundwater have been recorded from the sandy beds (where present) of the Reading Formation. However, most of the sandy horizons within this formation contain a significant clay and silt fraction, permeability is usually low, and the Reading Formation is generally regarded as an aquiclude.

The London Clay is for the most part an aquiclude. Small supplies of groundwater can be obtained from the thicker sandy beds, but even these yield water only reluctantly to wells and boreholes. The thicker sands such as the Warmwell Farm Sand, do throw out springs of some size, even as much as 50m^3/d. However, the water quality is usually poor with high concentrations of

iron and sulphate.

Potentially, the Poole Formation forms a good aquifer consisting of sandy beds separated by clays. Nevertheless, relatively little use has been made of this aquifer in this district other than a few shallow wells for domestic supplies. Boreholes with properly designed filter packs and sand screens should be capable of yielding up to 300 m^3/d, possibly up to 700 m^3/d.

The groundwater quality in the Poole Formation should generally be good. The total dissolved solids content should not exceed 300 mg/l or the total hardness 200 mg/l. The chloride ion concentration should be less than 30 mg/l, although adjacent to the coast higher concentrations might be expected. Nitrate and sulphate concentrations should also be low. However, iron may often be present in concentrations of more than 1.0 mg/l.

A number of shallow wells and boreholes have in the past taken groundwater from sands and gravels (River Terrace Deposits) in the Stour valley. One site north of Corfe Mullen yielded up to 390 m^3/d for public supply. Most of the sources in these superficial deposits are now no longer in use. Wells and boreholes in these deposits are particularly vulnerable to pollution from discharges on the ground surface.

In the reports on earlier phases of this project, comments were made concerning the protection of aquifers and of groundwater resources from pollution. These comments will apply also to Phase 3.

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APPENDIX 1 Application of geophysical methods to geological mapping of the Bournemouth(329) Sheet. J.D.Cornwell

Experience with the application of various geophysical methods to aid geological mapping indicates that one of the most successful techniques is conductivity (or conversely resistivity) mapping. In recent years, equipment has become available which measures the conductivity of the ground by inductive methods, as opposed to the more traditional galvanic methods using electrodes. This equipment (EM31 and EM34, manufactured by Geonics Limited) has the important advantage of producing reliable data at a sufficiently high rate that its use can be considered for systematic geological mapping. The data are particularly useful for mapping sequences of contrasting conductivities, such as the Tertiary sands and clays of the Bournemouth district.

A 2-day trial survey was carried out to assess the application of the EM 31 and EM 34 as an aid to geological mapping of a relatively complex area near Upton Heath, Poole [985 945]. The main conclusions were:

1. A good conductivity contrast exists between the clays (30 mmhos/m or less than 33 ohm metre) and the sands (less than 5 mmhos/m or more than 200 ohm metre).

2. Where the surface mapping indicated sand/clay boundaries, the conductivity data agreed with the locations.

3. The existence, however, of a clay bed at the surface, indicated by the conductivity data, could not always be predicted from the ground conditions/topography.

4. The facility provided by the EM 34 of using two 'depths of exploration' can be useful in determining the dip of sand/clay interfaces (Fig.17).

5. Even with the fairly intensive coverage (about 6.2 line km/km^2) available for the area, the conductivity data were difficult to interpret in places, and even more intensive surveys are necessary.

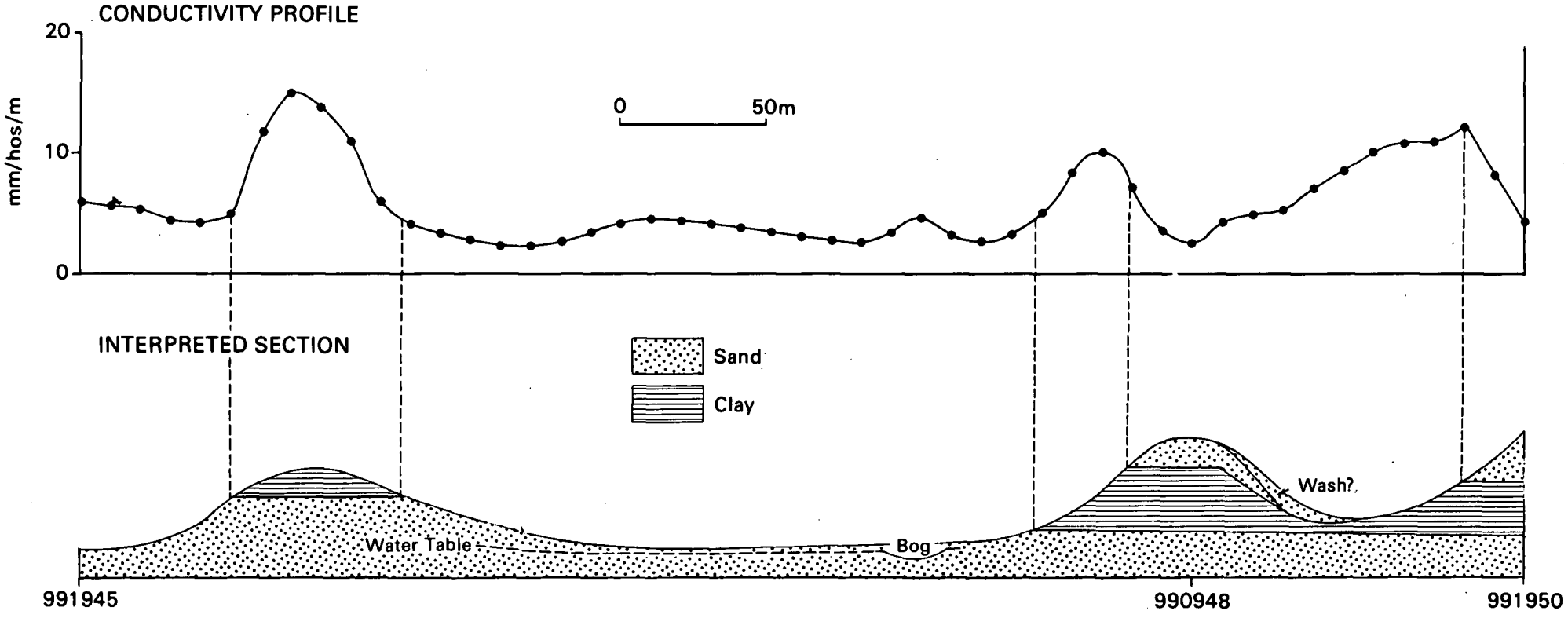

Fig. 17. Conductivity profile (EM31) and interpreted section for a profile near Beacon Hill

6. Smaller conductivity contrasts than those between the sands and the clays can provide useful information, for example on the position of the water table in sands.

It is suggested on the strength of the trial survey, that future mapping projects in areas geologically comparable to Upton Heath should include an element of geophysical surveying based on the use of the EM 31/EM 34, supported by the results of electrical soundings. In an effort to produce accurate boundaries for the geological map and also to increase knowledge of the vertical distribution of the beds, the following approach could be considered:

1. An awareness of the significance of the conductivity mapping results has to be based on a 'calibration' survey in an area with good exposure or borehole control. Resistivity soundings using conventional galvanic methods should also be made to provide more reliable conductivity values for individual beds. The availability of these values offers the opportunity in certain conditions of quantitatively interpreting the conductivity mapping results, for example in terms of bed thicknesses.

2. If the geology is not complicated, conductivity mapping is needed only at intervals to confirm the surface evidence.

3. Conductivity mapping of more complicated areas should be based, if possibles on a regular series of parallel traverses, perhaps 100m or so apart.

4. For most near-surface routine mapping, the EM31 is adequate, but control at intervals using the EM 34 or resistivity soundings is desirable.

From the practical point of view, most EM 31 profiling could be carried out as part of the regular geological mapping procedure so that the results are available immediately. Electrical soundings and use of the EM 34 are more cumbersome and are probably more efficiently carried out by a small team visiting critical sites.

APPENDIX 2

Glossary

AQUITARD

A confining bed that retards, but does not prevent the flow of water from an adjacent aquifer.

AQUICLUDE

A body of relatively impermeable rock that is capable of absorbing water slowly, but functions as an upper or lower boundary of an aquifer and does not transmit ground water rapidly enough to supply a well or spring.

BI-DIRECTIONAL CROSS-BEDDING

Almost equal abundance of cross-bedding orientations approximately diametrically opposite to each other.

CHANNEL PLUG

Sediments filling an abandoned riverine or estuarine channel.

DEWATERING STRUCTURE

Structure caused by the rapid dewatering of a sediment, usually a poorly compacted, saturated sand under load, to produce convoluted bedding and sometimes a sub-vertical lineation through the sediment.

DINOFLAGELLATE

A unicellular microscopic alga, chiefly marine. Many dinoflagellates have a test; others produce a cyst. Both tests and cysts are resistant to decay and are locally common as fossils.

FLAME STRUCTURE

A sedimentary structure consisting of flame-shaped plumes of unconsolidated material that have been squeezed irregularly upwards into an overlying layer.

HOMOMORPHA - PLEXUS

An assemblage of variants of the dinoflagellate species Wetzeliella (Apectodinium) homomorpha which characterise an inner neritic, shallow, marine environment.

KAOLINITE

A high-alumina clay mineral of the kaolin group that does not appreciably expand under varying water content. Commonly white to grey or yellow.

LATERITE

A highly weathered residual soil, or material rich in secondary oxides of iron,aluminium, or both, developed in humid tropical and subtropical regions.

LEVEE

A natural low ridge or embankment of sand and coarse silt, built by a stream on its flood plain and along both banks of its channel during times of flood.

LISTRIC SURFACE

A curvilinear, usually concave-upward, surface of a fracture that curves, at first gently and then more steeply, from a horizontal position.

OVERBANK DEPOSIT

Silt or clay deposited from suspension on an alluvial flood plain by floodwaters that cannot be contained within the stream channel.

PALAEOSOL

A fossil soil horizon.

PIPE CLAY

Originally a clay suitable for making tobacco-pipes; now mostly used for sanitary ware and ceramics because of its white-firing properties. Usually kaolinite rich.

THALWEG

Longitudinal profile of a river valley.