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Geology of the Petersfield district, Hampshire

Explanation of 1:10 000 geological sheets SU72NW, 72NE, 72SW, 72SE, 82NW and 82SW Part of 1:50 000 Sheet 300 (Alresford)

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PREFACE

This account describes the geology depicted either in whole or in part, on the following 1:10,000 sheets: SU72NW (Steep); SU72NE (Liss); SU72SW (Petersfield); SU72SE (Sheet); SU82NW (Rake) and SU82SW (Rogate), which form part of the 1:50,000 Alresford (300) geological Sheet. This district was first geologically surveyed on the one-inch scale by F Drew, H W Bristow and C Gould and published as Old Series One-inch Sheets 9 (1864) and 11 (1858). The descriptive memoir covering these sheets was compiled by W Topley and published in 1875. H E Hawkins resurveyed the area at the six-inch scale between 1888 and 1896 and the results were incorporated in One-inch New Series Alresford (300) Sheet first published in 1898. This sheet was reconstituted without geological revision on to a 1:50,000 base and reprinted in 1975. A Memoir covering this new sheet area was compiled by White (1910). Several of the Geological Survey 'Water Supply' Memoirs have dealt in part with this district, namely The Water Supply of Hampshire with records of sinkings and borings (including the Isle of Wight) (Whitaker, 1910); The Water Supply of Sussex from underground sources (Whitaker and Reid, 1899) with a supplement (Whitaker, 1910); Wells and Springs of Sussex (Edmunds, 1928); Wartime Pamphlet No.15, part V (Buchan et al., 1942) and Records of wells in the area around Alresford (Flatt et al., 1976). Abstracts of the geological strata encountered in some of these wells, together with trial borehole records held by the British Geological Survey, are included in Appendix 2.

The revision six-inch geological survey of the Petersfield area was made by Dr C R Bristow in 1981 under the direction of Dr D B Smith as District Geologist. Additional resurvey to complete the mapping of sheets SU72SE and 82SW (parts of the Fareham (316) and Chichester (317) sheets) was carried out by C R Bristow in 1982 under the direction of Dr W A Read as District Geologist. This account by Dr Bristow, which includes contributions on the palaeontology by Mr A A Morter, and on the petrology by Messrs R J Merriman and R W Sanderson, was first produced as an internal report for the Department of Energy in 1981. In publishing the present account, advantage has been taken to incorporate additional figures and references, and to make minor corrections and editorial changes.

Dyeline black and white copies of the geological maps can be ordered from the British Geological Survey, Keyworth.

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1. INTRODUCTION

The area of the present study lies in the Vale of Fernhurst at the south-western end of the Weald where it straddles the county boundaries of Hampshire and Sussex. With the exception of Petersfield in the west, it is dominantly an agricultural landscape. Large stands of woodland, both indigenous broad-leaved trees and conifer plantations, occupy large tracts of land, particularly on the more acid soils of the Lower Greensand. Farming presents a mixture of arable and pasture, with the former becoming increasingly important, leading to hedgerow removal and the destruction of woodland.

Geologically, the area lies at the western end of the Wealden Anticlinorium. The Harting Combe Anticline of Thurrell, Worssam and Edmonds (1968, pl.II) which crosses the area, is flanked successively westwards and north-westwards by the prominent inward-facing scarps of the Hythe Beds, which rise to some 160m OD, the Upper Greensand at about 130m OD, and the Upper Chalk whose scarp rises to almost 200m OD. All of this area is drained by the River Rother and its tributaries. The Rother for the most part curves round the western end of the anticline in a strike-aligned valley. Its tributaries are principally those draining the dip slope of the Hythe Beds, or those flowing from the scarps of the Chalk and Upper Greensand.

The solid formations and members and superficial deposits of the Petersfield district are shown in Table 1.

Table 1. Geological succession in the Petersfield district

	Estimated thickness (m)
RECENT AND PLEISTOCENE	
Landslip	
Alluvium	up to 3.5
Peat	up to 2
Blown Sand	up to 2
River Terrace Deposits	up to 4
Head	up to 3
Older Head	up to 3
Clay-with-flints	up to 14
CRETACEOUS	
Upper Chalk	20+
Middle Chalk	c.55
Lower Chalk	c.55
Upper Greensand	20 to 30
Gault	c.90
Lower Greensand	
Folkestone Beds	10 to 54
Sandgate Beds	
Marehill Clay	7 to 37
Pulborough Sandrock	9 to 33
Rogate Beds	4 to 46
Hythe Beds	64 to 96
Atherfield Clay	c.20
Weald Clay	35+

As a result of the recent detailed resurvey of the Petersfield district, a much clearer picture has been obtained of the stratigraphy, structure and facies changes of the solid geology, and also of the widespread superficial mass-movement that has taken place. In particular, mapping of the members of the Sandgate Beds, combined with the descriptions of several boreholes drilled by the Southern Water Authority which penetrated, in most cases, the whole of the Lower Greensand, has established a detailed sequence which can be correlated with that of the eastern part of the adjacent Chichester (317) Sheet in the east, with that of the Isle of Wight in the west, and the Bargate and Puttenham beds succession of Knowles and Middlemiss (1959) to the north. As a result of the refined stratigraphy, the exact limits of the various formations are clearly established and are readily identifiable in boreholes. For example, this has enabled marked changes in thickness in the Folkestone Beds to be recognized. Huge spectacular landslips are a ubiquitous feature of the Upper Greensand/Gault outcrop, and extend to the north considerably beyond the mapped area. Extensive solifluction sheets of two distinct periods, which mask large areas of the solid formations, have been mapped for the first time.

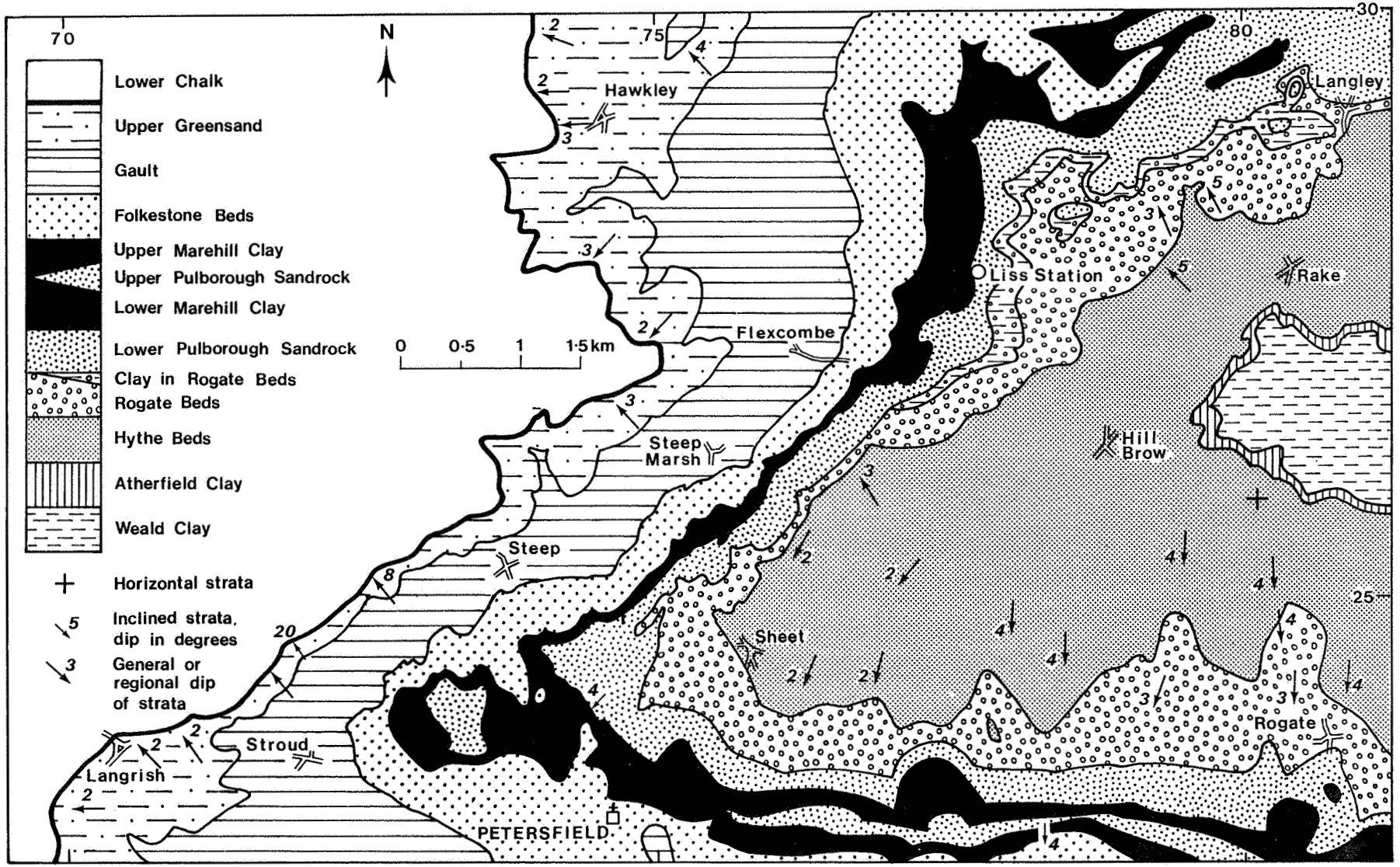

Figure 1 Sketch-map of the solid geology of the Petersfield district

History of Research (see Figures 2 and 3)

One of the earliest publications setting out the stratigraphy of the Weald was Gilbert White's 'Natural History and Antiquities of Selborne in the County of Southampton' (1789) (Figure 2). Mantell (1822) and Fitton (1824) used differing names for the same basic sequence.

Murchison (1826) was the first author to list the names of the major stratigraphic units still in current use. He recognized, but did not name, the subdivisions (Folkestone Beds, Sandgate Beds in part, and Hythe Beds) of the Lower Greensand. He introduced 'Bargate Stone', a name which appears to have been colloquially used, presumably by quarrymen for many years before, as a stratum in the middle of the Lower Greensand.

In an important memoir devoted to western Sussex, Martin (1828) clearly recognized the major subdivisions of the Lower Greensand, although the Sandgate Beds were included in the lower part of his Ferruginous Sands (Figure 2). He noted occurrences of what came to be known later as the Sandgate Beds (p.29) and its minor subdivisions of Marehill Clay (pp.27, 30), fossiliferous Pulborough Sandrock (pp.31, 33-34) and Selham Ironshot Sand (p.3), together with deposits of fuller's earth in the Tillington area (pp.30-31). The name Pulborough Stone was used for beds within the Hythe Beds, and should not be confused with the later named Pulborough Sandrock of the Sandgate Beds. It was not until about 1858 (Old Series Sheet 11, 1858) that the term Sandgate Beds was introduced for the beds occurring between the Folkestone and Hythe Beds. The tripartite subdivision of the Sandgate Beds, which has been recognized, at least in part since 1828, are graphically portrayed by Gould (in Topley, 1875, fig.20) (Figure 3).

The terminology of Dines and Edmunds (1929), Kirkaldy (1932) and Middlemiss (1962) in relation to the Sandgate Beds, and in particular to the Puttenham Beds is shown in Figure 3.

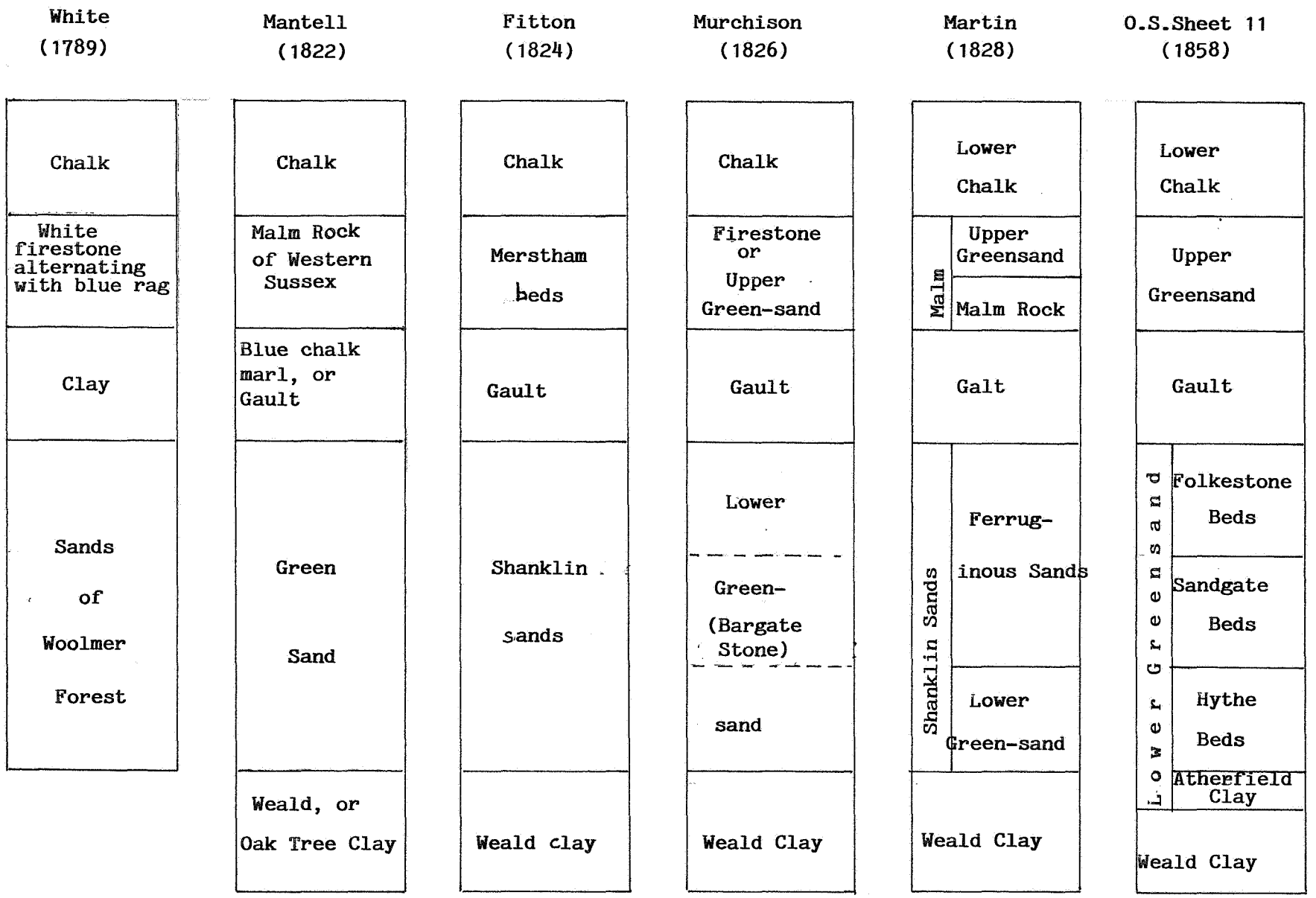

Figure 2. Stages in the evolution of the nomenclature of the Lower Cretaceous strata of the western Weald

Humphries (1964) studied the Lower Greensand in the area from Storrington westwards to Petersfield and then north-eastwards towards Liphook, and was able to trace the Marehill Clay, Pulborough Sandrock and Selham Ironshot Sands. This last name, a modification of the Selham Ironsands of Wooldridge (1947), was introduced for the local development of sands rich in polished ironstone within the basal Sandgate Beds. In this present account, the Selham Ironshot Sands are regarded as one of several lithologies included within the Rogate Beds.

Aspects of the sedimentology have been studied by several workers: Humphries (1957) discussed the origin of the chert in the Hythe Beds; Wood (1957) examined the heavy mineral suites of the Lower Greensand, and Narayan (1963; 1971) and Allen and Narayan (1964) studied the cross-stratification within the Lower Greensand. Casey (1961) reviewed the palaeontology of the Lower Greensand and provided a reliable zonal framework to which the various formations and members could be assigned. Owen's (1963; 1971; 1975) studies on the Gault, and in part on the Upper Greensand, provide a detailed zonal scheme for these formations.

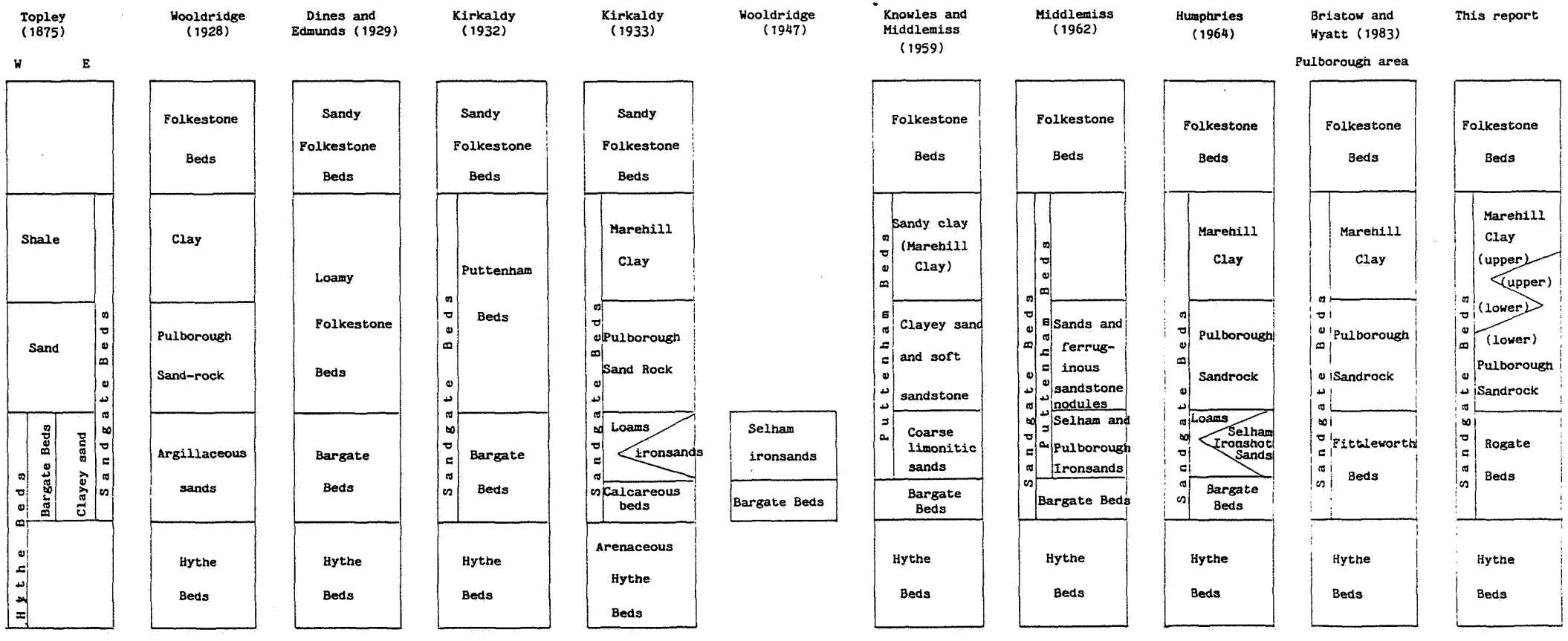

Figure 3. Stages in the evolution of the nomenclature of the Lower Greensand of the western Weald

2. CRETACEOUS

Weald Clay

General

The Weald Clay crops out over a small area at the western margin of the Vale of Fernhurst on the east side of the district. It consists of grey when unweathered, locally red, silty clay and clayey silts with minor beds of fine-grained sandstone, siltstone and clay ironstone. Generally, the grey clays appear at the surface as mottled orange and grey clays; the red clays still retain their red colour when weathered.

Within the Alresford district, only the uppermost 25m of the Weald Clay are present. The oldest recognizable datum is a sideritic mudstone traceable by the bell-pits which have been sunk through the overlying clays down to the 'pay horizon'. For the most part, this ironstone rests on mottled orange and grey silty clays, but at least locally, fine-grained buff sandstones lie only a short distance below the ironstone on the adjacent Haslemere (301) Sheet [819 266] (Thurrell, Worssam and Edmonds, 1968, p.32). Above the ironstone, comes some 15m dominantly of mottled orange and grey silty clay, but with some red, and red and grey mottled clay. These clays are succeeded by an impersistent bed of fine-grained yellow sand in the west of the district. A further 5m of mottled orange and grey silty clay separates this sand from a higher one, up to 5m thick, which forms the local top to the Weald Clay. These sands were included in Beds 7^{ef} on the adjacent Haslemere (301) Sheet, and it was thought that the overlying beds of the Weald Clay had been removed by erosion prior to the deposition of the Atherfield Clay. The recent mapping has shown, however, that the basis for this assumption is erroneous. Whilst the Atherfield Clay may rests on a sandstone of the Weald Clay, there is no direct correlation of this sandstone with beds 7^{ef} of areas farther east. Furthermore, much of the sandstone soil brash thought to be *in situ* sandstone of the Weald Clay, is in fact derived and incorporated in the head deposits. Thus, the postulated unconformable overstep of the Atherfield Clay across the various members of the Weald Clay in this part of the Vale of Fernhurst is not proven.

Allen (1976) regards the sand beds of the Weald Clay as fluviatile deposits in braided channels within a 'normal' environment of a variable-salinity coastal mudplain. There is a major component of 'western' [Armorica-Cornubia] detritus.

Depending on the amount of erosion, if any, of the topmost Weald Clay, only the upper part of the *Cypridea clavata* and/or *C. valdensis* ostracod zones are present within the Alresford district (Thurrell, Worssam and Edmunds, 1968, fig.2). The *clavata* Zone extends up to the topmost sand of Bed 7, whilst the *valdensis* Zone ranges from the top of Bed 7 to the base of the Atherfield Clay.

Details

The lowest mappable horizon of the Weald Clay within the present district is an ironstone. It can be traced readily through Lower Common Wood [819 265 - 8225 2665] on the adjacent Haslemere (301) Sheet by the number of bell-pits which have been sunk through the overlying clay into the ironstone. A stream section [8190 2651] on the west side of the wood reveals sideritic ironstone nodules, 0.3m diam. x 0.1m thick, set in mottled orange and grey silty clay.

Farther west, the outcrop of the ironstone is largely hidden under Head, but at the margins of the head, or where the ground is drift-free, bell-pits can again be found [8076 2665, 8063 2664, 8075 2698 and 8097 2704]. The overall impression gained from tracing this ironstone bed around the closure of the Fernhurst Anticline is that the dip on both limbs is very gentle.

Above the ironstone, there occurs about 15m of mottled orange and grey silty clay. These clays were formerly extensively worked for bricks [8027 2728 and 804 270], but no section remains. White (1910, p.7) recorded a section there as:

	Thickness m
Soil	
Sandy, with scattered stones	thin
Weald Clay	
Sand, light yellow and grey mottled	0.6
Clay, mottled greyish brown, sandy	0.3
Clay, greyish brown mottled, silty with nodules of clay ironstone	0.6

Possibly the ironstone noted in this section, and also in another one 90m E, belong to the ironstone horizon recorded above. Mottled red and grey clays were also noted in this pit, and have been recorded at a number of localities at about the same stratigraphic level during the present survey [8025 2666, 8022 2692, 8028 2692 and 805 270]. Reddish brown and grey silty clay was also found at a higher level beneath an impersistent sand bed [8002 2677 and 8015 2654]. This fine-grained yellowish orange sand, which lies about 10m below the base of the Atherfield Clay, can be followed for about 1km around the valley sides [between 7995 2680 and 803 265]. There are many springs issuing from its base. Above, comes some 5 to 8m of stiff, mottled orange and grey, silty clay. This in turn is succeeded by a 4 to 5m impersistent bed of fine-grained yellowish orange sandstone on which the Atherfield Clay locally rests. It forms the top to the Weald Clay over a 2km tract on the south side of the Fernhurst Anticline, being generally thicker in the west than in the east. On the north side of the anticline, it appears to be absent in the area of Birch and Rough copses [801 271], but reappears north of the brick field [8035 2720], but is not seen to the east of this locality.

Lower Greensand

Atherfield Clay

General

The Atherfield Clay is poorly exposed, and as a consequence is poorly known. The weathered surface deposits are generally mottled orange and grey, locally reddish brown, silty clays or clayey silts. Glauconite is present in variable quantities, and on the south side of the outcrop, the Atherfield Clay is a highly glauconitic sandy clay. At depth, the formation is probably a dark grey or brown stiff shaly fossiliferous clay. The thickness is thought to be about 20m. No fossil has been recorded from the Petersfield area, but on general considerations the Atherfield Clay probably belongs to the *forbesi* Zone of the Lower Aptian (Bristow et al., 1987) (Figure 4).

Details

Nowhere is there any exposure in the Atherfield Clay of the Alresford district. It was formerly exposed in the northern part of the Harting Combe brickyard [8033 2731], but no significant records exist of the former exposures. The bulk of the formation consists of mottled orange and grey slightly sandy clay with some fine-grained sand. By the Harting Coombe crossroads, the deposits consist of a fine-grained sandy glauconitic clay and clayey sand [around 803 262]. Similar glauconitic sandy clay can be found in the fields 500m N of Combe Hill [around 797 265], to the north of Birch and Rough copses [around 8010 2705] and to the south of Rake [around 8035 2735]. Eastwards of this last locality, the dominant lithology is a mottled yellowish brown sandy clay; red-brown mottling was noted at two points [8087 2717 and 8124 2724].

Hythe Beds

The Hythe Beds are dominantly medium-grained, glauconitic yellow and buff sands and sandstones. The glauconite imparts the characteristic 'pepper and salt' texture to the deposit. The grain size varies, and there are locally fine-grained, and, towards the top, coarser pebbly beds. Thin siliceously cemented sandstones and chert beds are a common feature. Fuller's earth, found at many localities on the adjacent Chichester (317) Sheet, has not been noted in this area. Cross bedding occurs, but much of the bedding is in tabular units. A variety of sedimentary structures, including those resulting from dewatering, have locally been noted. Fossils, other than sponge spicules, have not been encountered during the present survey, but they are probably locally common. The Hythe Beds span the Lower Aptian/Upper Aptian boundary, and range from the *deshayesi* Zone at the base, possibly to the *martinioides* Zone at the top, although on the Chichester Sheet there are indications that this zone is absent and that the *bowerbanki* Zone is the highest zone of the Hythe Beds (Bristow et al., 1987) (Figure 4).

The thickness of the Hythe Beds varies from 64 to about 95m.

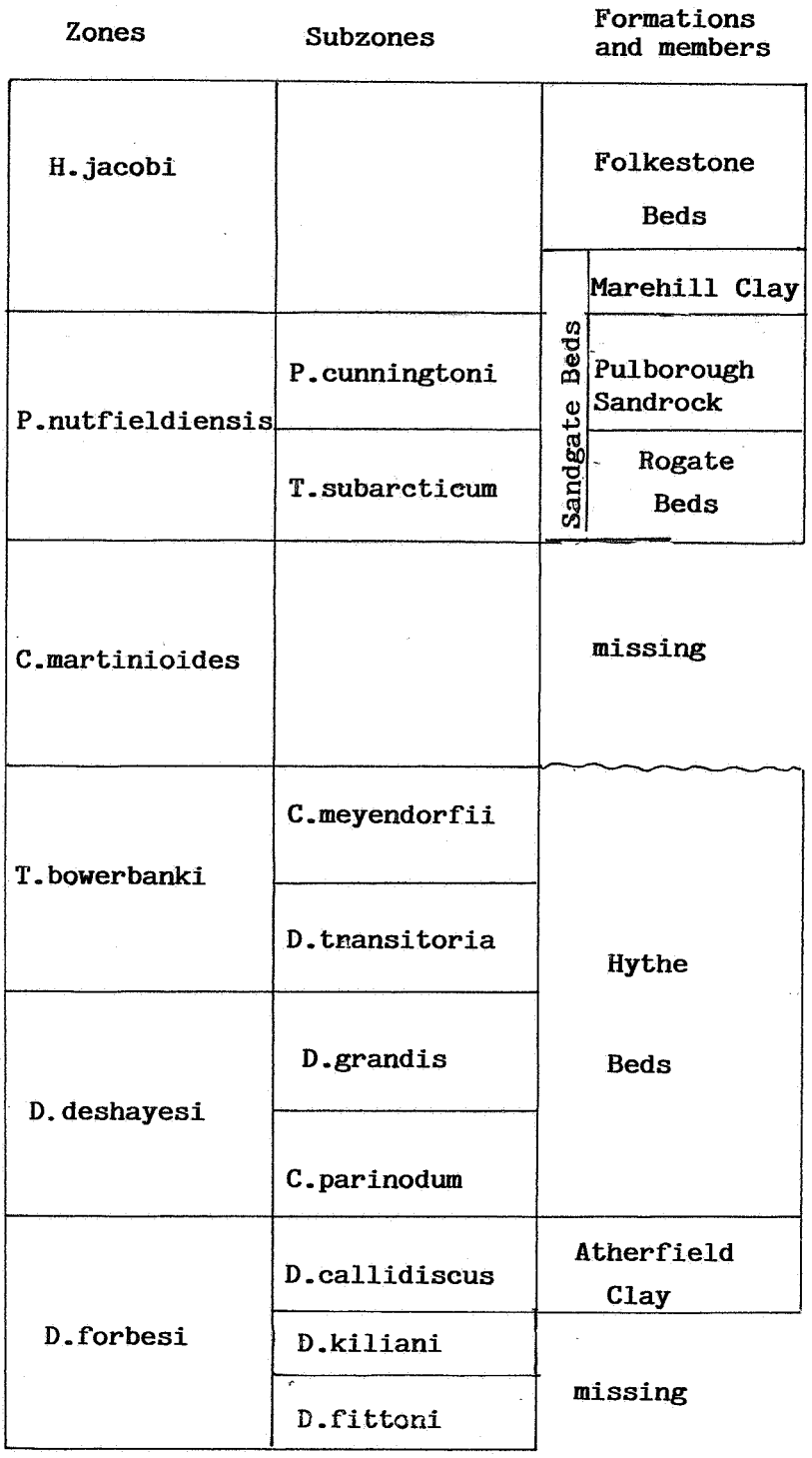

Figure 4. Lithostratigraphical and biostratigraphical units of the Lower Greensand

Details

North of Rogate, the higher beds of the Hythe Beds form long dip slopes inclined at about 4°S or SSW. The north-facing scarp is between 30 and 45m high. Exposures of the lower strata on the scarp face are rare, but appear to consist dominantly of orange-brown, or yellowish brown, glauconitic, fine- to coarse-grained sands. There is a small, but interesting, roadside section [8012 2582] on the Rogate to Rake road. There, there are about 8m of horizontally bedded sands as follow:

	Thickness m
Sandstone, orange and buff, fine- to medium-grained, cross-bedded in horizontal units; some of the cross bedding is picked out by glauconite. About 4m from the top is a thin (5cm) siliceously cemented sandstone rich in sponge spicules; the beds above this layer are intensely bioturbated. A further metre below is a layer of impersistent siliceous doggers which rest with marked disconformity on	6
Sandstone, buff to yellowish orange, glauconitic, cross-bedded, fine- to medium-grained, friable. Some of the foresets are steeply dipping (up to 35°), and some of these appear to be slumped; a number of dewatering structures are visible	2

A thin section of one of the siliceous sandstones is described by R W Sanderson as follows:

This specimen is a porous, pale-yellow, rough-textured silicified glauconitic sandstone. It consists of moderately well-sorted, angular to sub-angular quartz, 0.15-0.3mm across, with common rounded or lobately ovoid pellets of glauconite and glauconitic mudstone, some of which exhibit thin fibro-concentric veneers of more highly birefringent material, dispersed in a microcrystalline chalcedonic matrix. A few silicified simple sponge spicules are present, together with rare grains of zircon, muscovite, colourless pyroxene and plagioclase as accessories.

Horizontal, buff, fine- to medium-grained sandstones was seen in the bank [8065 2565] 550m ESE of the above exposures. There are poor sections in the higher strata in the woods to the north of Rogate Lodge. One of the old degraded quarries [8060 2515] has poor exposures of buff, medium- to coarse-grained, non-porous, siliceously cemented, spicular sandstone. The sponge spicules are particularly evident on the weathered surface. Another quarry [806 250] 150m S of the above has no good exposure, but there are many blocks of medium-grained, non-porous, fine- to medium-grained, siliceously cemented sandstone on the quarry floor; the sandstone weathers orange and friable. Blocks of medium-grained spicular sandstone are to be found on the path [8017 2508] in the wood on the south-west side of the Rogate road. The Hythe Beds hereabouts form a long dip slope inclined at about 4°S. Continuing southwards and higher up the sequence, yellowish orange and ferruginous brown, medium- to coarse-grained sand appears to be the dominant lithology.

Farther west, the Hythe Beds have a total thickness of about 84m [7906 2396]. Just north of this borehole, greenish yellow clayey medium- to coarse-grained sand is commonly augered at the surface; blocks of siliceous sandstone are locally common on the surface [7974 2486 and 7910 2455]. Large dip-slope surfaces south and south-west of Durford Wood [around 776 246, 781 248 and 785 246] dip at about 4° just west of south. The dip appears to decrease westwards to about 2° [around 763 243, 770 245 and 773 245] and to swing round to south-south-west.

To the south at Ryefield, the Hythe Beds, mostly fine- to medium-grained, yellowish green sands, are 94m thick [7761 2230].

There are excellent sections in the sunken lane [7622 2440 to 7640 2436] on the east side of the Rother near Sheet of up to 4m of medium-grained orange-ferruginous brown, glauconitic friable sandstone, with a few thin (2 to 3cm) seams of siliceous sandstone. Thin coarse-grained pebbly beds with scattered quartz pebbles up to 8mm diameter, also occur, together with some buff glauconitic beds. This section occurs high up in the Hythe Beds. Beds at a similar stratigraphic position and formerly exposed in the road bank by the railway bridge [7570 2485] north of Sheet (White, 1910, p.9), are described as brown, ferruginous glauconitic sand with cherty concretions, resting on bright orange sand.

In the borehole at the Petersfield Waterworks [7529 2480] 400m W of the railway bridge, the Hythe Beds are 85m thick. This compares with the 88m in the Itshide Rubber Co. Ltd Borehole, Petersfield [7465 2374] and 90.7m at the Petersfield Laundry [7417 2344].

About 3m of horizontal orange glauconitic friable sandstone is exposed in the bank of the Rother [7620 7517]. Some 600m NE, yellowish brown, medium-grained, friable sandstones with silicified concretions 0.5m thick towards the top, occurs in the lane bank [766 257] south of Tankerdale Farm. Hawkins (in White, 1910, p.9) noted brown sands and sandstones dipping 3°NE in the railway cutting [7680 2615] west of Stodham Park (formerly Stodham House). In the deeply-cut lane [7710 2605] south of Stodham Park there are 3 to 4m of orange, medium-grained, friable sandstone with layers of buff, glauconitic, coarse-grained siliceously cemented sandstone. Medium- to coarse-grained ferruginous sand can be augered in the bank of the sunken lane [772 262 to 7775 2645]. All these occurrences, from the River Rother to here, are in the uppermost Hythe Beds. The junction with the Rogate Beds in Stodham Lane is described under the Rogate Beds. Stratigraphically lower beds to the east, consist dominantly of coarse-grained yellowish brown sand.

The total thickness of the Hythe Beds at Greatham [7785 2964] is 64m, if the 1.5m of clay at the base of the hole is correctly identified as the Atherfield Clay.

Sandgate Beds (Formation)

The Sandgate Beds of the western Weald have never properly been defined. A loose, but in general practical, definition is that they are all the strata between the Hythe and Folkestone Beds. They correspond to the lower part of Martin's (1828) upper division [his Ferruginous Sands] of the Shanklin Sands. The term Sandgate Beds was never formally introduced, but it was in use by 1858 (Old Series Sheet 11) in the western Weald. The earliest workers from Martin (1828 pp.27, 29, 31, 33-34) onwards realized that the Sandgate Beds embraced a variety of lithologies, the continuities of which were recognized during the survey of Old Series Sheet 9 (see Topley, 1875), although they were not mapped separately. Essentially, the Sandgate Beds can be divided into three members, the upper two of which have been formally named (Pulborough Sandrock (Wooldridge, 1928) and Marehill Clay (Kirkaldy, 1933)) and traced, but not previously mapped, over a wide area of western Sussex and Hampshire. The lowest unit is generally referred to as 'loams'. In the area between Thakenham and Petworth on the Chichester (317) Sheet, these 'loams', which consist of highly glauconitic sandy clay and clayey sand, and which weather to give a very sticky yellowish brown soil, have been named the Fittleworth Beds (Bristow and Wyatt, 1983). Within the district, the beds occurring between the Pulborough Sandrock and the Hythe Beds, although occupying the same relative stratigraphical position as the Fittleworth Beds, differ markedly in their lithology. They form a heterogeneous sequence of coarse-grained pebbly sands, very glauconitic clayey pebbly sands, glauconitic pebbly and sandy clays, calcareously cemented pebbly beds ('Bargate Stone') and coarse-grained pebbly sands with an abundance of polished limonite pebbles (the Selham Ironsands (Wooldridge, 1947) or Selham Ironshot Sands (Humphries, 1964)). In view of the heterogeneity of the deposits between the Pulborough Sandrock and Hythe Beds, it was felt that a new name was needed to encompass all the lithologies. The name Rogate Beds have been adopted as it is a largish village situated on this member and lies close to several small exposures or localities where many of the differing lithologies occur.

As defined, the Rogate Beds include beds of 'Bargate Stone'. On the adjacent Haslemere (301) Sheet, the Bargage Beds are treated as a separate formation between the Hythe and Sandgate Beds. However, the Bargate Beds along the south side of the Haslemere Sheet (i.e. in the Easebourne area, [90 23])

consist of an alternating sequence of calcareously cemented sandstones and uncemented, or poorly cemented sands, and thus differ markedly from the pebbly 'Bargate Stone' of the Liss area of the Alresford Sheet, or the Bargate Beds on the north crop of the Haslemere Sheet and on the adjacent Aldershot (285) Sheet.

Kirkaldy (1932) introduced the term Puttenham Beds for strata in the north-west Weald between the pebbly Bargate Beds and the Folkestone Beds. This is equivalent to the Sandgate Beds of earlier Survey authors and those of the Haslemere Sheet. Knowles and Middlemiss (1959), in a detailed account, with map, of the Puttenham Beds in the area between Thursley [90 39] and Conford [83 33], described a sequence of strata which can be matched very closely with the present author's Rogate Beds, Pulborough Sandrock and Marehill Clay in the Langley area [81 30], except that the pebbly beds which form an intimate part of the Rogate Beds in the Alresford area, are excluded from the Puttenham Beds and included within the Bargate Beds. Nevertheless, the very clayey top to the Rogate Beds is clearly identifiable as the basal bed of the Puttenham Beds.

The age of the Sandgate Beds is Upper Aptian, and it is probable that they fall mostly within the single ammonite zone of *Parahoplites nutfieldiensis* (more details are to be found in the account of each member), but with the Marehill Clay possibly falling in the *Hypacanthoplites jacobi* Zone (Figure 4).

Rogate Beds (Member)

The Rogate Beds comprize a number of lithologies, of which the most characteristic are its coarse- to pebbly grain size, including pebbles of highly polished limonite, its richness in glauconite and its clayiness. Usually, the lithology is a combination of two or more of the above characters. The pebbliness, and especially the limonite, serve to distinguish the Rogate Beds from any other member of the Sandgate Beds, or the underlying Hythe Beds. It is the incoming of the pebbles, usually set in a slightly clayey, glauconitic, sandy matrix, which define the base of the Rogate Beds.

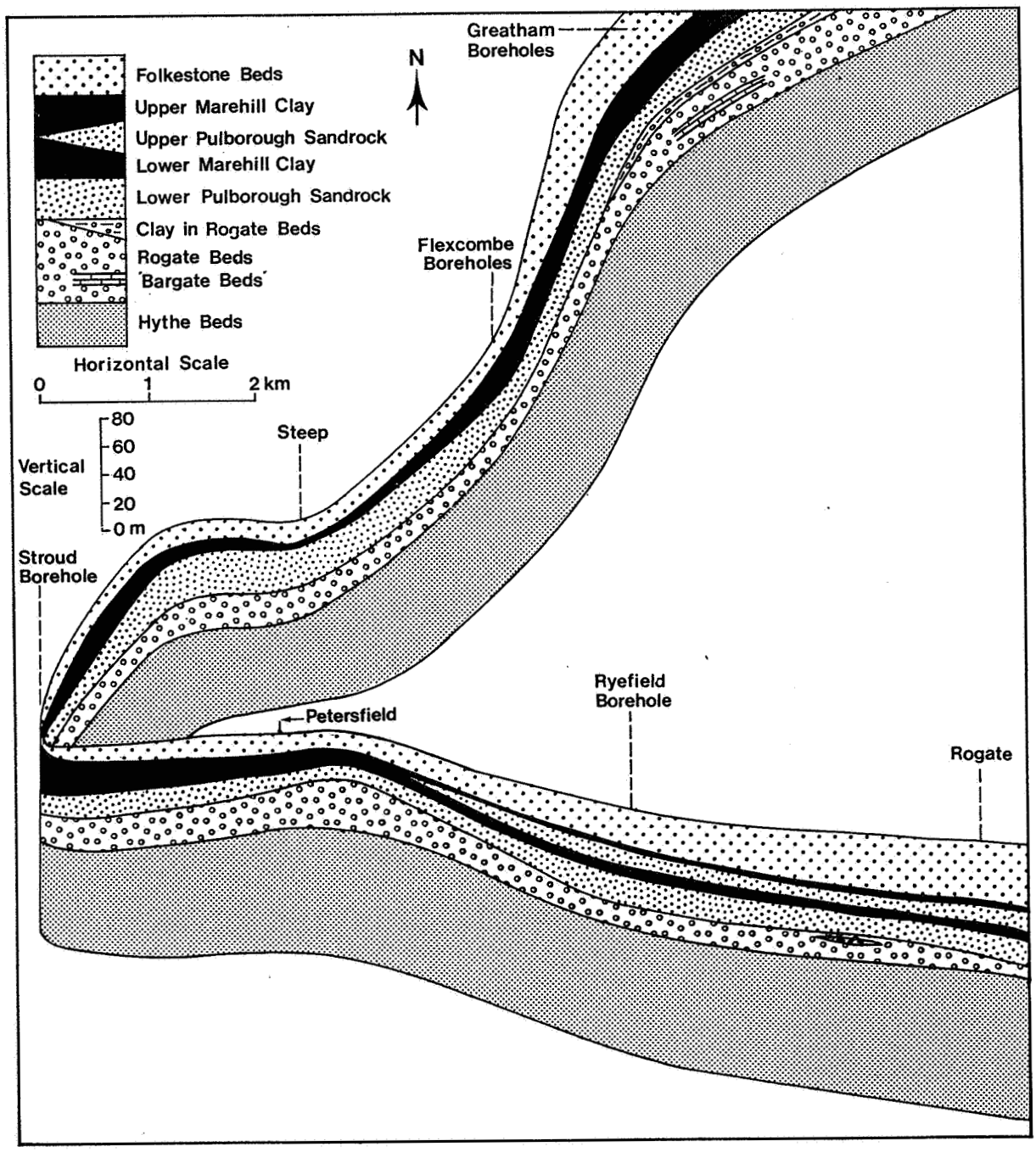

Figure 5 Ribbon diagram showing the lithological variations of the Lower Greensand of the Petersfield district

Dominantly clayey beds, thick enough to map separately, are developed in the middle of the sequence about 1.5km W of Rogate, where the deposits consist of glauconitic, coarse-grained, locally pebbly clay, with pebbles of polished limonite. Between there and Liss, where mappable clay beds are next seen, but at the top of the Rogate Beds, the Rogate Beds consist mainly of clayey, glauconitic, coarse-grained pebbly sand. In the lane cuttings at Rogate, and in the formerly excellent cutting [778 237] north of Durford Abbey Farm, the Rogate Beds contain an abundance of medium-grained to pebbly pieces of highly polished limonite within a virtually clay-free, medium- to coarse-grained, pebbly sand. These deposits appear to be identical to the Selham Iron (or Ironshot) Sands well seen in the lanes near Cowdray Park to the east. If it was possible to map them separately from the rest of the Rogate Beds, the same name could be applied to these limonite-rich deposits. They pass, however, imperceptibly into the more clayey beds of the Rogate Beds and no firm boundaries can be placed at their top and bottom. Deposits formerley well seen in the road cuttings [around 775 241] near Sheet contain an abundance of polished limonite and were regarded by Humphries (1964, pp.44, 53) as a local development of the Selham Ironshot Sands. They are, however, far more clayey than the sands at Selham. Limonite pebbles decrease in importance as the outcrop is followed northwards, and disappear in the region of Tankerdale Farm [around 763 257].

Another lithology is seen in the tract of ground between Stodham Park [771 261] and the east side of Liss. There, the lower part of the Rogate Beds is clay free and consist of glauconitic, coarse-grained, pebbly sands. This facies passes northwards into a local development of 'Bargate Stone' [around 786 279], a calcareously cemented pebble bed. Continuing north-eastwards to the limit of the district, the lithology of the Rogate Beds is dominantly coarse-grained, pebbly glauconitic clayey sands. From just south of Liss to the limit of the mapping, a glauconitic pebbly sandy clay is present almost continuously at the top of the Rogate Beds. For this tract, the top of the Rogate Beds is taken at the top of the clay and is easily defined. Elsewhere, in the absence of the clay, the top of the Rogate Beds is marked by a fairly rapid change from poorly graded pebbly sands, to the fine-grained, well-sorted Pulborough Sandrock. Scattered coarse grains occur in the basal metre or so of the sandrock.

No diagnostic fauna has been found in the Rogate Beds. At Liss, a few poorly preserved fossils have been found, and fossils have also been recorded in the railway cutting at Langley. Unfortunately, none of these fossils remain. The Pulborough Sandrock which overlies the Rogate Beds belongs to the *cunningtoni* Subzone of the *nutfieldiensis* Zone (Middlemiss, 1962; Morter - see Appendix 1). At Easebourne to the east, the Bargate Beds belong to the *subarcticum* Subzone of the *nutfieldiensis* Zone (Casey, 1961, p.556). Thus, on general considerations, the Rogate Beds probably fall within the *subarcticum* subzone (Figure 4).

Details

Rogate Beds

There are poor exposures of glauconitic, yellowish brown clayey pebbly sand and sandy pebbly clay in Garbitts Lane [around 8095 2345] to the south-south-east of Rogate. Farther north along this lane, the Rogate Beds are less clayey and contain much polished ironstone debris [around 810 237]. From the point [8107 2387] where the lane meets the main road, a prominent north-eastwards facing scarp formed by the Rogate Beds extends north-westwards. Over much of the tract from Rogate to Rogate Lodge [807 247], augering reveals that the deposits are variable and consist of medium- to coarse-grained ferruginous sands, locally clayey and glauconitic. The junction with the Hythe Beds is gradational and is taken where the coarse-grained, heavily ferruginized, sands pass down into medium-grained yellowish brown glauconitic sands and sandstone. The beds in this vicinity form long dip slope with an overall dip of about 4°S.

West of Rogate, there is an extensive occurrence of Rogate Beds, but much of the outcrop is hidden beneath drift. The beds are locally sufficiently clayey to be mapped separately. South of Slade Farm, a low hill is formed of very coarse-grained clayey sand with much polished ironstone [around 798 238]. North-east of the farm, there are poor exposures of coarse-grained ferruginous sand, and glauconitic orange-brown, medium- to coarse-grained sand at the minor cross roads [7995 2420]. From this point north-westwards, coarse-grained ferruginous pebbly sand, with only minor amounts of clay, is the dominant lithology. It was in this vicinity [c.792 244] that Kirkaldy (1933, p.292) recorded 2.4m of coarse-grained, shelly and pebbly glauconitic sand with a small amount of calcareous sandstone, and which he regarded as part of the Bargate Beds.

Two boreholes [7943 2409 and 7944 2411] commence within the basal part of a clay within the Rogate Beds. In the latter bore, 0.9m of 'brown clay' was encountered beneath 'sand and soil'. The former bore appears to have commenced in Made Ground and/or drift, although the record of 'brown clay with sand and small flints' at 5.33m is probably not drift, but one of the pebbly clays within the Rogate Beds. The base of the Rogate Beds is taken below the

'conglomerate rock' at 18.59m. Augering in the ditches close by to these wells reveals glauconitic, coarse-grained sandy clay at the surface. North-west of these wells, a prominent low hill [793 243] is capped by a glauconitic ferruginous clayey, coarse-grained pebbly sand which lies above the clay of the Rogate Beds. Another well [7906 2396] passed through 1.22m of Head and then 6.44m of Rogate Beds; the base being taken at the 'fine-grained, reddish brown loamy sand with quartz pebbles'.

There are good exposures in the sunken lane leading north from Durleighmarsh Farm. Travelling southwards, up the sequence, the first exposure [7877 2427] above the Hythe Beds is in a coarse-grained pebbly sand with rounded quartz pebbles up to 10mm across. Some 70m S [7877 2419], glauconitic, coarse-grained clayey sand is seen. A farther 110m to the south, coarse-grained ferruginous pebbly sand occurs. At the junction of two lanes [7873 2396], an orange, coarse-grained sandy clay is overlain by a coarse-grained pebbly sand. For the next 100m to the south-west, buff and orange, coarse-grained pebbly clayey sand is exposed. Polished ironstone pebbles are a common constituent of the coarse/very coarse-grained ferruginous sandstone in the next section [7858 2386]. A little farther south [7858 2382], a glauconitic, coarse-grained well-sorted, friable sandstone is overlain by a coarse-grained, buff sand with many polished ironstone pebbles.

Poor exposures in the uppermost beds are visible in the road cutting [7775 2385 to 7795 2370] west of Durleigh Marsh Farm. The lithology is dominantly a coarse-grained pebbly sand with much polished ironstone, identical to the sands of the Selham Ironshot Sands of the type area farther east. A sample from this road cutting is described by Mr R Sanderson as follows: the sample is an incoherent dark, 'pepper and salt', glauconitic ferruginous coarse-grained sand. The grains possess a very thin veer of limonitised clay, but insufficient to form a cement. The chief constituents are abundant rounded grains of ferruginous sandstone and siltstone, limonitic pellets, a few limonite ooliths, 0.15-3mm across, and dominant, finer, 0.12-1.2mm, poorly sorted quartz grains. The latter are commonly angular with irregular etched outlines. Glauconite is more or less oxidised, with common lobate, ovoid, homogeneous grains which may attain 0.45mm diameter. Rock fragments, including chert, and alkali feldspar grains are rare.

West of this cutting, the Rogate Beds are largely hidden beneath drift, but small outcrops of coarse-grained, clayey, pebbly sand occur west [768 241] and south-east [773 238] of Westmark Farm.

There is an extensive outcrop of the Rogate Beds around Sheet. Exposures in the road banks [7575 2435 to 7555 2410] show coarse-grained, glauconitic clayey pebbly sand with ironstone fragments. At the junction of the Sheet and Portsmouth roads [7555 2410], White (1910, pp.11-12) recorded 9 to 12m of fine- to coarse-grained reddish brown ferruginous sand, with coarser beds abounding in small brown pebbles, some cross bedding was noted with an overall low true dip to the south-west. Over most of the outcrop to the west and north-west, a clayey, coarse-grained pebbly sand, locally with polished ironstone, can be augered. A well [7529 2480] at the waterworks on the road to Steep penetrated 11.43m of Rogate Beds which are described by the driller as 'gravel with streaks of ironstone'.

The Rogate Beds appear to be 31.54m thick at the Itshide Rubber Co., Petersfield [7465 2374], and 28.05m thick at the Petersfield Laundry [7417 2344]. At Stroud, the most westerly locality where the Rogate Beds have been recognized, they are 21.8m thick [7225 2360]. White (1910, p.11) recorded a section 'half a mile west-north-west of Sheet Church' totalling 7.46m, of which the upper 5.63m at least is referable to the Rogate Beds. Possibly, the base can be taken at the 0.15m thick 'uneven seam of small pebbles'; this is succeeded by white and yellow sands, 4.27m thick, which in turn are capped by 1.22m of reddish brown, ferruginous, cross-bedded sand and sandstone.

From Steep, the outcrop narrows and swings round to strike north-eastwards. In this tract, the pebbles of polished ironstone, although locally present [eg around 7605 2545 and 7625 2560], are not such an important constituent. To the east of Bowyer's Common, the beds are quite clayey and very glauconitic [766 261]. At Flexcombe, the Rogate Beds are 13.8m thick [7684 2692].

On the east side of the River Rother, the outcrop widens, and from there as far as Langley, a glauconitic sandy clay is present at the top of the Rogate Beds. The roadside bank [776 264] north-east of Stodham Park has 2.5m of yellowish orange, slightly glauconitic, pebbly sand at the top, resting on yellowish orange, coarse-grained sand without pebbles. This division is taken

to mark the junction of the Hythe and Rogate Beds. A sample from this locality is described by Mr R Sanderson as follows: the specimen is a very weakly coherent glauconitic pebbly sand, composed of poorly sorted, sub-angular grains with an apparent bimodal grain-size distribution. The pebbles attain 2.75mm diameter, with the dominant fraction being <0.85mm. The coarser fraction is composed of granitic quartz and ferruginous siltstone grains which are commonly moderately well rounded. The finer fraction is composed dominantly of strained quartz, minor alkali feldspar and plagioclase, rare chert fragments and abundant, more or less oxidised, glauconite pellets which have a tendency to be moulded on the harder grains. The glauconite is commonly irregularly lobate or ovoid. A sparse cellular cement of ironstained clay (?glauconite) coats the grains; a few ovoid limonitic ooliths up to 0.25mm are present.

North and north-east of this section, the coarse-grained pebbly sands are largely clay free [around 777 267]. Similarly in the road [7840 2705] in Hill Brow Road, the coarse-grained pebbly sands and friable sandstone are clay free, but glauconitic. These clay-free beds are last seen in the Allotment gardens [782 280 east of Liss. In the sunken lane heading north-north-westwards from Hill Brown Road, there are intermittent exposures of thin flaggy, calcareously cemented, coarse-grained pebbly sandstone [7847 2725 and 7848 2733] interspersed with clayey, coarse-grained pebbly sand, locally glauconitic. This flaggy stone is referred to as the Bargate Stone by Murchison (1826) and White (1910). Mr R Sanderson described a thin section of 'Bargate Stone' from one of the lane cuts [7846 2726] as follows: the sample is a coarse-grained, flaggy, very pale orange pebbly glauconitic sandy limestone. A sparry calcitic cement contains grain-supported clasts with an apparant bimodal size distribution. The larger size fraction is composed of rounded and polished grains, 1.4-5.5mm across, of quartz, ferruginous sandstone and siltstone, with rare granitic quartz grains and chert, and elongate fragments of recrystallised bivalve shell. Weakly strained quartz, lobate structureless glauconite, rarely with a thin fibro-concentric veneer and more or less limonitised, form the finer fraction. Some ?cylindrical thick-walled fossils (0.2mm diameter) have glauconitic-filled cores. Grain size in this fraction attains 0.5mm, and the shapes are irregular due to etching by the calcite cement.

In the Liss area, there are a number of old pits from which 'Bargate Stone' was extracted. In the pit [7875 2785], now partially back-filled, 270m SSW of Ciddy Hall, White (1910, p.9) recorded about 3m of coarse-grained, cross-bedded calcareous grit with pebbles of quartz, dark siliceous flint-like stone, hard ironstone and grains of glauconite. The grit is partially cemented and partly in thin, lenticular, flaggy beds (Bargate Stone) which follow the south-easterly dips of the foresets. Decalcification by weathering reduces the deposit to a dark brown loamy sand with an irregular contact with the unweathered portion. A few poorly preserved fossils were noted in the stone beds. In another pit [784 277], now built over, 800m E of the railway station, about 3.6m of uncemented calcareous grit with relatively few cemented beds of 'Bargate Stone' was formerly exposed. The beds are covered and deeply piped into, by a brown earthy sand (White, 1910, p.10, fig.2). Other old pits [7860 2775 and 789 279] have gone unrecorded. The easternmost of these two pits is where 'Bargate Stone' was last worked; it is said to have been opened specifically to obtain stone for repairing Liss Church, and ceased operating about 1932. 'Bargate Stone' can be seen in the road bank 700m SW of Ciddy Hall [7847 2768] and along the lane [7915 2816 - 7928 2810]. Elsewhere in these vicinities, the Rogate Beds consist of clayey, coarse-grained, pebbly sand, locally glauconitic.

The top of the Rogate Beds is marked by a highly glauconitic sandy clay in the area north-east of Liss. This clay can be augered in the fields [around 780 271] at East Hill, and can be found in the road bank [7808 2713] and banks of the playing field [7805 2727 and 7808 2737]. The clayey top is more pebbly to the north of East Liss [around 7815 2825 and 7855 2815]. In the vicinity of Mangers [795 285], the top Rogate Beds consist of glauconitic yellowish grey sandy clay; below, occurs coarse- to very coarse-grained clayey pebbly sand which form gentle north-westerly dip slopes. In the Greatham Borehole [7785 2964], the upper 15m of the 46m of the Rogate Beds is dominantly clayey.

The railway cutting [8002 2907 - 8100 2906] was described by Drew (in Topley, 1875, p.135), but unfortunately, the individual thicknesses for most of the beds were not stated:

Pulborough Sandrock

Sand, buff	
Sand, buff, with drab clay in patches	
Rogate Beds	
Clay, blue, black, green and drab with sand	
Sand, light-coloured with ironstone	0.6-0.9m
Sand, clayey and clay	
Sand, black, clayey	1.5m
Band of fossiliferous nodules, calcareous and ferruginous	0.3m
Sand, black, clayey	1.8m
Nodules (as above)	
Sand, with crumbly nodules of fossiliferous 'Bargate Stone'	

Glauconitic mottled orange and grey sandy clay can be augered in the fields [804 289] to the south of the Langley cutting. Coarse-grained clayey glauconitic pebbly sand occurs in the banks of the deeply cut Reeds Lane [7952 2864 - 8023 2874].

Pulborough Sandrock (Member)

The Pulborough Sandrock is a uniformly fine-grained friable, grey when fresh, but yellowish brown when weathered, rarely cross-bedded, fossiliferous sandstone. The name was introduced by Wooldridge (1928) for the sandrock well-exposed beneath the Marehill Clay in road cuttings and quarries near Pulborough [TQ 035 185] some 30km E of the district. In the type area, there is only one development of fine-grained sandstone, overlain by an undivided Marehill Clay. However, where it is first seen in the Alresford district, there are two mappable units of fine-grained Pulborough-type sandrock and two of black silty Marehill-type clay. In the Elsted Borehole [8423 2093], some 3km ESE beyond the district, the same duplicated sequence is present. It is unfortunate that the passage from a single unit (last definitely recorded to the south-west of Petworth on the Chichester (317) Sheet) into the two units occurs in a tract of ground which has not been recently surveyed, and therefore it is not known whether the Pulborough Sandrock of the type area is split by the incoming of a clay of Marehill type, or vice-versa. It is equally regretable that the westward passage from the dual sequence into a single Pulborough Sandrock and Marehill Clay takes place in the drift-covered ground of urban Petersfield. There is some evidence to suggest that it is the upper sandrock which dies out westwards. In view of the close lithological similarities between the two sandrocks (and also the clays), and the

uncertainty of their stratigraphic relationship, it is proposed to simply name them upper and lower and not to introduce separate stratal names.

As stated above, the characteristic feature of the Pulborough Sandrock is its fine-grainedness, and only locally does it depart from this lithology. The basal metre or so may contain some coarse-grains, including polished limonite, but, unlike the Rogate Beds, such a bed is usually well sorted, well bedded and clay free. In the area south of Steep Marsh [between 756 253 and 761 259], coarse-grained, cross-bedded, ferruginous sandstone is locally present near the top.

In the type area, a cemented ironstone, up to 0.3m thick, forms a sharp top to the sandrock. This does not appear to be present over most of the present district, although it was noted in the Tilmore Road section [7447 2407], Petersfield, and near the Harrow Inn [7555 2555], Steep Marsh. There appears to be a transition into the Marehill Clay in the area south of Steep Marsh. The upper beds of the Pulborough Sandrock contain many thin beds of grey clay, and the basal Marehill Clay contains much glauconitic fine-grained sand.

In the Langley area [810 293] on the northern edge of the district, there is a very glauconitic mottled orange and grey clay, similar to the top clay of the Rogate Beds, but without pebbles, in the lower part of the Pulborough Sandrock.

North of this locality, Middlemiss (1962) recognized the Pulborough Sandrock within his Puttenham Beds, and obtained an important fauna from them at Headley Wood [814 372].

The thickness of the Pulborough Sandrock varies along the outcrop, but there does not appear to be any systematic thinning or thickening. At Elsted, the upper and lower beds are each 8m thick; at Ryefield the respective thicknesses are 12 and 20m; in Petersfield, between 9 and 12m are recorded for the undivided sandrock; at Stroud, the most westerly occurrence, it is 14.63m thick; at Flexcombe the thickness is 33.71m, whilst at Greatham, two adjacent boreholes appear to show a variation in thickness from 12.8m to 16.76m.

Locally, the beds are richly fossiliferous. Within the district, the Habin Bridge locality near Rogate is the best known and most important (see Appendix 1), but other occurrences have been found during the resurvey, of which the one near Bedale's School is the most significant. To the north, the Headley Wood locality of Middlemiss (1962), in what is almost certainly the Pulborough Sandrock, is the only locality that has yielded ammonites - amongst others *Parahoplites cunningtoni*, the index fossil of the *cunningtoni* Subzone of the *P. nutfieldiensis* Zone. This confirms Casey's (1961) earlier assignment of the sandrock faunas, based largely on bivalves and gastropods, to the *cunningtoni* Subzone, and also the correlation of the sandrock with the Group XIV Sand at the top of the Ferruginous Sands of the Isle of Wight, as had earlier been suggested by Kirkaldy (1933).

The collective fauna from the Pulborough Sandrock, although never fully represented at any one locality, contains some very characteristic and important forms, and appears to be, for all practical purposes, confined to one horizon. The fauna witnesses an important event during the Upper Aptian with an apparent surge of warm, Tethyan, water bringing in exotics such as the rudist *Toucasia lonsdalei*, which, in addition to the Habin Bridge and Headley Wood localities, are known from Seend (Casey, 1961), Thame (Ms IGS) and, its most northerly occurrence, Quainton in Buckinghamshire (Casey and Bristow, 1964).

Details

In the south-east of the district, the Pulborough Sandrock is split into two. At Elsted [8422 2093] the upper and lower sandstones are 8m and 10m thick respectively. Near Ryefield to the south-west [7761 2230], the respective thicknesses are 12m and 20m.

The river cliff at Haben (Habin) Bridge [8080 2292] exposes some 3 to 4m of flat-lying, soft, friable, fine-grained sandstone with some iron-cementation, of the Lower Pulborough Sandrock. Some of the beds are richly fossiliferous, with the fossils occurring as clustered moulds. The fauna was listed by Casey (1961, p.557), but additional collecting has expanded the faunal list (see Appendix I). Collectively, the fauna indicates the *Parahoplites cunningtoni* Subzone of the *nutfieldiensis* Zone.

North of the river, the sandrock is exposed in the lane leading to Rogate. The higher beds consist of glauconitic, clayey, fine-grained, friable sandstone; towards the middle of the outcrop [8075 2360], a pebbly horizon was noted within the dominantly fine-grained glauconitic sandstone, but below this level, orange and yellow, fine-grained friable sandstones are present down to the basal beds [8075 2370], which become pebbly and pass down into the Rogate Beds.

South-west of Rogate, the Pulborough Sandrock gives rise to a low scarp along which yellowish brown friable sandstone can be augered. A small outlier west-south-west of Rogate has poor exposures in the sunken lane leading north from the main road [8023 2357].

Low cliffs of sandrock are present on the south side of the Rother as far as Durford Bridge [7825 2330]. The first, degraded, exposure [7983 2310] shows grey glauconitic and orange fine-grained sandstone. About 100m farther west, there is a small outcrop [7973 2314] in a dark grey, glauconitic, fine-grained sandstone. Farther upstream, some 2m of orange-brown, fine-grained sandstone form a cliff at a prominent river bend [7934 2322]. To the south of Wenham Manor Farm, orange-brown, fine-grained sandstone can be seen beneath 1.4m of Alluvium within the meander belt [7891 2333]. An exposure [7868 2319], 400m SW of Wenham Manor Farm, in glauconitic, dark grey, silty fine-grained sandstone lies close to the top of the Lower Pulborough Sandrock. The junction with the Marehill Clay can be seen 270m farther west.

A poor section [7787 2379] on the north side of the main road is in the basal beds of the lower sandrock. About 0.6m of fine-grained, friable sandstone with scattered coarse grains and stringers of coarse grains can be seen. The low hill [773 236] to the north-west of Durford Abbey Farm is formed by the lower sandrock. The top part of the lower sandrock, immediately below the Marehill Clay, is iron-cemented where discernible in the degraded river cliff [7708 2343].

Most of the outcrop of the Upper Pulborough Sandrock is obscured by drift. In augering, the sandstone appears to be identical to that of the lower, although possibly slightly coarser. In the railway cutting [7872 2303] at

West Heath, buff and grey, loose, cross-bedded sands were noted beneath yellowish ironstone which marks the junction with the overlying Upper Marehill Clay.

At the Petersfield Sewerage works [769 229], the upper sandrock was encountered in most of the trial pits and boreholes. There, it consisted of up to 2m of greenish black, fine- to medium-grained clayey sandstone.

Glauconitic, yellowish brown, clayey, fine-grained sand occurs south of the Hospital [762 232]. West of this area, the Upper Pulborough Sandrock passes under drift and appears to die out. North of the Hospital, the Lower Pulborough Sandrock is similarly obscured. The undivided Pulborough Sandrock next reappears in the grounds of Churcher's College [753 238]. The dominant lithology from there, through the Cemetry and around to Steep, is a yellowish brown, fine-grained sandstone. It forms low crags in the old quarry, now built over, on the south side of the Cemetry [7500 2385]. The uppermost bed close to the old railway [7509 2372] consists of brownish yellow-grey, clayey, fine-grained sandstone.

Low crags, dipping 4°SW, crop out the side of the road [745 241] north of Petersfield. Locally, the orange-buff sandstone below the Marehill Clay is iron-cemented, but close by, the uppermost Pulborough Sandrock consists of very glauconitic, clayey, fine-grained sand. Just west of these outcrops is a sunken lane, Dark Hollow, in which Pulborough Sandrock occurs as an inlier partially obscured by drift. Boreholes in the built-up portion of the town indicate thicknesses of 11.89+m at the old Luker's Brewery [7491 2334], 11.28m at the old Amey's Brewery [7413 2330], 9.75m at the Itshide Rubber Co. [7465 2374] and 9.45m at the Laundry [7417 2344].

Between Petersfield and Stroud, there is a largely drift-covered inlier of Pulborough Sandrock. It is at the surface on the south side of the main road [7350 2365], where fine-grained buff and brown sand can be augered, and 350m E of Aldersnapp Farm where the sandrock forms a low rounded hill [7330 2415].

The Stroud Borehole [7224 2360] is the farthest west that the Pulborough Sandrock, 14.63m thick, has been recognized in the Weald.

From Bell Hill [742 243], the Pulborough Sandrock strikes north-eastwards. A borehole [747 244] at Tilmore started in the sandrock and proved 9.14m of 'sand' before entering the Rogate Beds.

Blocks of ironstone with shell moulds on the surface [7438 2456] of the fields to the south of Bedale's School yielded a limited fauna (see Appendix I) indicative of the *cunningtoni* Subzone.

The Pulborough Sandrock forms a low, but prominent, south-eastwards facing scarp from Steep, through Bowyers Common [762 260] towards Prince's Marsh. An old pit [7563 2537] towards the base of the member reveals an upper unit of coarse-grained, ferruginous, cross-bedded, sparsely fossiliferous sandstone (foresets to the south-west), 0.7m, above fine-grained yellowish buff friable sandstone. The only fossil from this pit was the gastropod *Anchura (Perissoptera) robinaldina*. The coarse-grained sandstone is an unusual lithology for the Pulborough Sandrock. It was also noted in the old pit [7607 2519], now largely backfilled, 700m NE. It may have been from this pit at 'Bowyer's Common' that Fitton (1836, pp.157-159) collected the following fauna. Unfortunately, it has not been possible to reexamine this collection, and so the old names have been quoted with their inferred modern names in parentheses: *Corbula striatula* [*Parmicorbula striatula* J.de C.Sow.], *Corbula gigantea* [*?Liopista*], *Cucullaea glabra*? [*Cucullaea cornueliana* (d'Orb], *Cytherea parva* [*Resatrix (R.) parva* (J.de C.Sow.)], *Gervillia aviculoides, Lacuna*? [*Mesolinga*? *cornueliana* (d'Orb.)], *Mya plica* [*Panopea plicata*], *Thetis minor, Trigonia alaeformis* [*Pterotrigonia mantelli* Casey], *T.clavellata* [*Linotrigonia (Oistotrigonia) ornata* (d'Orb.)]. A *cunningtoni* subzone is indicated by this fauna.

A good exposure of up to 6m of basically horizontally bedded, fine-grained, buff-orange, friable sandstone can be seen in the stream bed/?old sunken lane [7530 2532 to 7548 2548] leading north-eastwards from the Harrow Inn. Some of the beds are locally cross-bedded, and there is some iron cementation. A little farther north-east [7555 2555], the uppermost beds of the Pulborough Sandrock comprize a lower unit of buff-brown, fine-grained, friable sandstone passing upwards into a fine-grained, glauconitic, greyish brown, clayey sandstone with thin grey clay beds towards the top. An iron-cemented sandstone occurs immediately below the Marehill Clay. Surface blocks on the

fields [7645 2610 east of Bowyer's Common included moulds of *Pterotrigonia mantelli* Casey and *Yaadia nodosa* (J.de C.Sow.) of late Aptian age.

A disused pit [7668 2635], some 300m NE of the above locality, had a poor exposure of orange, fine-grained friable sandstone.

Around Liss, the Pulborough Sandrock is largely hidden under drift. Small exposures [7727 2725 and 7735 2732] are respectively in fine-grained, grey sand and dark grey, clayey fine-grained sand. Some 400m ESE of these outcrops, the sandrock emerges from beneath the drift to form a low hill [777 271].

Near Liss Forest [784 289], the beds crop out low down in the valley and exposures are poor. Augering reveals yellowish brown, glauconitic fine-grained sands.

At the Greatham Pumping Station [7785 2964 and 7805 2961], thicknesses of 16.76m and 12.85m respectively of fossiliferous, fine-grained sandstone (with pebbles in the latter borehole) are recorded.

In the grounds of the Wylds [795 292], over Longmoor Inclosure [798 298], Weavers Down [806 298] and north of Langley, the Pulborough Sandrock has an extensive outcrop. The dominant lithology is an orange, yellow or buff, fine-grained sandstone. There are numerous small exposures [eg around 798 298] in the cuttings worn by the tanks. Locally, however, on Weavers Down [around 8080 2975], and in the tract north of Langley [around 8100 2935], a glauconitic, mottled orange and grey, sandy clay and clayey sand is present within the sequence of fine-grained sands. This clayey unit is similar to both the Marehill Clay (in this eastern area) above, and the clay in the Rogate Beds below.

Drew (in Topley, 1875, p.11) recorded a section in the railway cutting at Langley [c.8030 2913]. The upper two units of 'drab sand', to which he gave no thickness, he erroneously referred to the Folkestone Beds; this sand, the Pulborough Sandrock, rests on blue, black, green and 'drab' clay of the uppermost Rogate Beds.

Marehill Clay (Member)

The Marehill Clay is characteristically a dark grey, blocky weathering, silty locally glauconitic, clay, which forms a very distinct member, with a sharply defined top and bottom, to the Sandgate Beds. It takes its name from the village of Marehill [TQ 065 185] on the east side of Pulborough where it was formerly well exposed in the old sandpit.

The problems concerning the split into two as the clay is traced westwards has been discussed under the Pulborough Sandrock.

Except in the north, the lithology varies very little over most of the outcrop. To the south of Steep Marsh [around 755 255], there is much included fine-grained clayey sand, and from there north-eastwards, glauconite is much commoner. Marehill Clay of typical lithology is last seen in the banks on either side of the River Rother at Greatham Bridge [around 744 290]. East-north-eastwards from there, the clay content decreases, and the sand content increases, but glauconite is still a very characteristic constituent. In the grounds of The Wylds [792 293] and in Longmoor Inclosure [around 793 296], there is much coarse-grained pebbly sand. Nevertheless, this glauconitic sandy clay forms a mappable unit between the fine-grained Pulborough Sandrock and the generally coarser-grained Folkestone Beds.

The thickness of the Marehill Clay is 6m and 8m for the upper and lower clays respectively at Elsted; 4 and 8m at Ryefield; in Petersfield, thicknesses of 6.7 to 10.67m for the undivided clay are recorded; at Stroud, the most westerly occurrence, it is 23.78m thick; this increases north-eastwards to 36.74m at Flexcombe, and 33.23 and 32.61m at Greatham (Figure 5).

Several samples from both the Alresford and Chicester (317) sheet (Bristow and Wyatt, 1983) areas have been examined for microfossils, but nearly all proved to be barren. The two most western samples (Durford Mill [7802 2318] and at Aldersnapp Farm [7306 2425], east and west of Petersfield respectively) contain the undiagnostic foraminifera *Ammodiscus* sp., *Haplophragmoides* sp. and *Trochammina* sp. This may indicate a passage westwards from ?estuarine conditions in the area of the Chicester Sheet to more marine conditions near Petersfield. If the lithological correlation between the Marehill Clay and

the clay (Group XV) separating the Sandrock, above, from the Ferruginous Sands on the Isle of Wight (Kirkaldy, 1933; Casey, 1961) can be substantiated, then the clay in this latter locality would be expected to yield a more fully marine microfauna. No macrofossil has been found in the Marehill Clay of the Weald or from its supposed correlative in the Isle of Wight. However, in this latter locality, fossils from above and below the Group XV clay, and from the underlying Pulborough Sandrock in the Weald, indicate a zonal position in the *Hypacanthohoplites jabobi* Zone.

Details

In the south-east of the district, the Marehill Clay is split into two. At Elsted [8422 2093], the upper and lower clays are 6m and 8m thick respectively. Near Ryefield to the west-south-west [7761 2230], the respective thicknesses are 4m and 8m. Most of the outcrops lie to the south of the River Rother, although a few tongues and outliers of the Lower Marehill Clay occur to the north. One such occurrence is in the lane [8077 2335] south of Rogate, where glauconitic, dark grey and silty clay occurs in the banks and ditches. Much of the outcrop north-west of Haben Farm is obscured by drift, but locally a small spread [around 8030 2315] is drift-free and there dark grey and silty clay can be augered. A 600m tract bordering the river to the west of Haben Bridge is flanked by low banks of the lower clay capped by River Terrace Deposits. West of this tract, as far as Durford Mill [780 232], the Lower Pulborough Sandrock crops out in the river bed and bank. In the fields higher up, the Marehill Clay is largely covered by River Terrace Deposits, Head and Blown Sand, but it can usually be encountered by augering in the bottom of some of the deeper ditches. For the most part, the lower clay, dark grey and silty, is not glauconitic; at one point [7977 2302], the silty clay was a purplish grey-brown.

The junction of the lower clay and underlying Pulborough Sandrock can be seen in the river cliff [7843 2322] 600m SW of Wenham Manor Farm; there, 0.6m of fine-grained sandy, black and glauconitic clay rests on friable, greyish brown and fine-grained sandstone, 0.3+m thick. A sample from the lower clay at Durford Mill [7802 2318], there about 6m thick, yield a few examples of the foraminifera *Haplophragmoides, Trochammina* and *Ammodiscus*. A degraded section across the lower clay/Pulborough Sandrock boundary can be found in the river

cliff [7708 2343] to the west of Durford Abbey Farm. Above the ferruginous cemented top of the Lower Pulborough Sandrock occurred clay, grey and very silty, succeeded by dark grey, fine-grained, clayey and glauconitic sand; at the top of the bank was found grey and sandy clay.

The Upper Marehill Clay is first seen in the ditches [around 7976 2270] to the east of West Heath, where it consists of dark grey, glauconitic, silty and fine-grained sandy clay. This unit was formerly well exposed in the railway cutting [7850 2305 - 7880 2305] at West Heath. There, a basal bed of ironstone of the Folkestone Beds rests on 3m of dark clay with very little sand, which passes down into 1.6m of more sandy clay, which in turn rests on the iron-cemented top of the Upper Pulborough Sandrock (Topley, 1875, p.135). At places in the cutting, the clay is very silty and glauconitic.

Several sections in up to 3m of the upper clay have been recorded in boreholes and trial pits at the sewerage works [769 229], Petersfield. A typical section [7704 2290] recorded by the site engineer in April 1981 is:

Surface level 48.49m OD	Thickness m	Depth m
River Terrace Deposits		
Rubble, clay and gravel	0.1	0.1
Clay, greyish green, sandy and silty with a 0.2m gravelly base	1.3	1.4
Upper Marehill Clay		
Clay, greenish black, sandy and silty with green sand partings becoming more sandy below 2.9m	2.5	3.9
Upper Pulborough Sandrock		
Sand, medium dense, greenish black, clayey to 4.2m	1.9	5.8

There is an overall southerly dip to the strata over the site. A trial pit [770 228] on the south-east of the site encountered the Marehill Clay at a depth of 4.5m (43.7m OD) beneath Made Ground, River Terrace Deposits and Folkestone Beds.

The upper clay emerges from beneath the drift in the area [76 23] south of the Hospital; there, it consists of clay, dark grey, weathering yellowish brown and glauconitic. The separation of the Marehill Clay into upper and lower units can be followed for a short distance to the west of the Hospital, but then it disappears beneath drift. Where it emerges from beneath the drift to

the north of the Tilmore Brook [around 752 236], the Marehill Clay is no longer split into two. The lithology of this area is dominantly clay, yellowish brown or mottled orange and grey, with relatively minor amounts of silt and glauconite. The basal beds [7509 2368 and 7515 2393] are silts, mottled dark grey and yellowish brown and clayey.

Marehill Clay is present under the northern part of Petersfield. It has been encountered in many wells and sections, and augered in many of the more open spaces. At the former Luker Brewery [7491 2334] on the east of the town, some 4.58m of clay, black, hard and sandy was present beneath either Folkestone Beds or Head, and resting on the Pulborough Sandrock. To the north-west, the well [7465 2374] at the Itshide Rubber Co. commenced in the clay and proved 4.57m before entering the underlying strata. In the railway cutting just north-west of the above well, Drew (in Topley, 1875, p.135) noted, beneath Folkestone Beds: clay, yellow, 0.61m, resting on dark-coloured, sandy clay with pyrites, 3.66+m. At the present day, black, silty and glauconitic clay can be augered in the banks of the cutting; at one point [7455 2375], a spring marks the junction with the Folkestone Beds. Several wells to the south-west of the Station (72 SW/9, 11, 13 and 14) prove thick-nesses between 6.7 and 10.67m of 'dark clay', 'sandy clay' and 'blue clay' of the Marehill Clay. North-westwards from the cutting, grey, glauconitic and silty clay can be traced through the suburbs to Bell Hill [740 245]. To the west of Bell Hill, as far as Aldersnapp Farm [730 243], the outcrop, where not obscured by Head, is rather narrow and presumably this results from a thinning of the member, although a slight increase in the northerly dip could also account for the reduction in outcrop. The lithology for this tract remains unchanged.

At Aldersnapp Farm, a section [7306 2425] revealed the junction between the friable, orange, coarse-grained sandstone of the Folkestone Beds, and the black and silty clay of the Marehill Clay. A sample from this locality yielded rare *Haplophragmoides* and *Ammodiscus*.

South of Aldersnapp Farm there is an extensive low-lying area of Head [around 73 24]. Grey, glauconitic and sandy clay can be augered beneath Head at depths varying from 1.3 to 1.7m in some of the deeper ditches. The Marehill Clay emerges from beneath this Head in the fields [7320 2365] on the south

side of the Winchester Road where it consists of glauconitic yellowish brown clay.

The Stroud Borehole [7224 2360] is the furthest west that the Marehill Clay has been proved in the Weald. There, it is 23.78m thick and is described as silty clay, olive grey, locally greenish and with a very minor sand content.

From Bell Hill, the outcrop of all the Lower Greensand beds strikes north-eastwards as it swings round the western end of the Fernhurst Anticline. At Bedales School [7428 2493], the Marehill Clay, according to the driller's log, comprises only 1.83m of 'black clay', but this presumably is in error as there is a fairly wide outcrop close by of yellowish brown, grey, and mottled orange and grey, locally glauconitic, silty clays.

Dark grey clay and clayey silts can be augered in the lane banks [7495 2515] east of Bedales School. Between Steep and Bowyer's Common, the junction between the Marehill Clay and Pulborough Sandrock is difficult to pinpoint as the former is quite sandy, and the latter has many small clay lenses and streaks. The sandy nature of the Marehill Clay is well demonstrated in the lane [755 255 - 7549 2566] leading to Steep Marsh Farm. In the southern part of the lane, the basal beds consist of grey, glauconitic, silty clay; some 60m northwards, a similar lithology is encountered, but with a content of fine-grained sand; a further 40m north, glauconitic grey sandy clay can be found in the banks; immediately to the north of this last occurrence, glauconitic fine-grained yellow sand is present. These fine-grained sands are considered as the uppermost bed of the Marehill Clay; they are overlain by the coarse-grained, yellowish orange sands of the Folkestone Beds.

North-east of Bowyer's Common, the Marehill Clay is a greenish yellow sandy clay. Surface indications are of a glauconitic grey, yellow and brown sandy clay in the area north-east of Flexcombe [77 27]. In the Flexcombe Borehole [7684 2692], the Marehill Clay comprizes 36.74m of dominantly olive-black clay, with only a minor sand content. This is the thickest record of the Marehill Clay.

Surface indications in the area from Flexcombe north-eastwards towards Liss are of a highly glauconitic, grey, yellow and brown sandy clay. River bank

exposures [7721 2697 and 7731 2713] east of Flexcombe are in micaceous dark grey, fine-grained, sandy clay. On the opposite side of the river, glauconitic black silty clay can be found at the bottom of a deep ditch [7715 2747 and 7721 2742]. From these points northwards, glauconitic grey or yellowish brown clay can be augered as far as West Liss [774 283]. Farther north, the outcrop of the Marehill Clay is obscured by Older Head. It reappears in the banks on either side of the River Rother [around 774 290] to the north-east of Burgates, where it is seen as a glauconitic grey clay. The last occurrence of a dominantly clayey lithology is to the south of Goleigh Farm House, where grey clay was found at 1m [7765 2955] beneath clayey gravel in a ditch. A line of springs north-west of this point presumably mark the junction with the Folkestone Beds. East of the north-south flowing stream which flows from Greatham, the Marehill Clay becomes less clayey and more sandy; glauconite is still a common component, but locally the beds are pebbly and resemble the underlying Rogate Beds.

Boreholes at the Greatham Pumping Station [7785 2964 and 7805 2961] proved thicknesses of 33.23m and 32.61m respectively of the Marehill Clay. Although the thicknesses are similar, the lithologies recorded in these two closely spaced borehole differ significantly (see pp. 82-7). In the latter, considerably more sand and sandstone appears in the log; the thicknesses quoted for the individual sands and sandstones are probably exaggerated. Glauconitic mottled orange and grey clay was augered at one point [7796 2948] to the south-east of Goleigh Farm House. The cuttings for the old military railway [7825 2940 - 7840 295] are in dark grey clayey fine-grained sand and sandy clay at the bottom. To the south of the cutting, glauconitic yellowish grey sandy clay was augered beneath 1m of coarse-grained sandy downwash in a ditch [7832 2926] alongside the Army Training Ground and in the grounds [784 290] of a private house.

In the grounds of The Wylds, an outlier [796 293 - 805 297] of very glauconitic yellowish brown pebbly clay of the Marehill Clay occurs. To the north-west, in Longmoor Inclosure, the dominant lithology is of a glauconitic clayey coarse-grained sand or glauconitic sandy clay. There are numerous small exposures in the sunken tracks worn by the tanks.

Folkestone Beds

The Folkestone Beds crop along the south-west to north-east tract between Petersfield and Langley, and on the south side of the anticline between Petersfield and just south of Rogate.

The dominant lithology is a medium- to coarse-grained, cross-bedded, yellow and orange friable sandstone. Thin (less than 10mm) white, grey or lilac clay seams are common in the upper beds, particularly in the western part of the outcrop. The cross-stratified units are up to 5m thick. Allen and Narayan (1964) described various aspects of cross stratification from the Folkestone Beds in the West Heath sandpit [785 228]. They recognized two main units; Type 1, which lacks silt bands, is characterized by straight foresets which meet the bases of the units at sharp angles; the foresets are mainly inclined between 25 and 30° (see their fig.2). Within such a unit, there is a basal layer of coarse grains; each foreset layer is bounded by sharp surfaces and individual foresets grade upwards from fine to coarse. The cross-stratified units of their type IIb have silt bands between groups of foresets and bottomsets, and with foreset layers which pass down into the bottom sets and meet the bases of the units tangentially (see their fig.7). Unlike their Type 1, there is rarely a basal layer of coarse sand. Where a band of silt overlies a group of sandy bottomsets, the upper surface of the underlying bottomset is moulded into small-scale asymmetrical ripples with crests 5 to 12cm apart (see their figs.9 and 11).

A study of the cross stratification by Narayan (1971) showed that vector mean azimuths of the palaeocurrents are dominantly from the north-west, not only for the Folkestone Beds of the Alresford district, but for much of the rest of the Weald. Narayan (1963; 1971) concluded that deposition of the Folkestone Beds took place by the lateral migration of sand waves in a shallow sea, possibly under tidal conditions. He concluded that the London Platform did not form a physical barrier between the Wealden basin of deposition and that of the southern Midlands during the deposition of the Folkestone Beds. There was, however, no deposition at that time in the vicinity of the former platform, and Padgham (in Middlemiss, 1976) suggested that the London Platform was still present, but submerged to a shallow depth, and thus allowed transport of sediment across it, but without deposition on it.

Wood (1957), in a study of the heavy minerals of the Lower Greensand, noted a significant increase of kyanite in the Folkestone Beds and suggested Armorica as a possible source area. Such a source direction, however, conflicts with Narayan's (1963; 1971) conclusions as to direction of transport, and it is more probable that 'Scoto-Scandinavia' provided the source of the kyanite as suggested by Juignet et al. (1973).

No fossil, other than wood, has been found in the Folkestone Beds of this district. On general consideration, the Folkestone Beds are thought to span the Upper Aptian/Lower Albian boundary.

The thickness of this formation varies from just over 10m at Stroud [7225 2360] and Flexcombe [7684 2692], to 30m at Ryefield [7761 2230], to 54m at Elsted [8422 2093].

Details

South-east of Rogate, the Folkestone Beds are 54m thick in the Elsted Borehole [8422 2093]. South of Rogate, just beyond the present district, there are excellent roadside exposures [8068 2248 to 8055 2238] and old quarry sections near Sandhill Farm. Up to 10m of cross-bedded (foresets dipping south) of fine-, medium- and coarse-grained buff sandstone can be seen. The foresets show fining upwards over one to two centimetres from a basal coarse-grained sand, and thus differ from the occurrences at West Heath (see below) described by Allen and Narayan (1964).

West of Rogate, there are good exposures of Folkestone Beds in the West Heath Sandpit [785 228]. There, up to 25m of cross-bedded, yellow, buff and locally pink, medium- to coarse-grained sands, with an overall dip of about 4°S, are exposed. On the west side of the pit, close to the entrance, large-scale cross beds in units up to 3m thick, with foresets which dip at 28°S, typify much of the exposures. On the south side of the pit, the uppermost beds consist of 6m of tabular units, each about 10cm thick, of buff and brown, medium- to coarse-grained friable sandstone, separated by thin (up to 10mm) beds of buff and grey clays. These tabular beds overlie the cross-stratified beds described above, at the top of which large pieces of ferruginized wood can be found. Details of some of the sedimentary structures in this pit have

been described by Allen and Narayan (1964). The junction of the Folkestone Beds with the underlying Marehill Clay could formerly be seen in the railway cutting to the north (see p.35).

South-west of this pit, the Ryefield Borehole [776 223] proved that the Folkestone Beds are 30m thick. In the fields [around 774 226] near Ryefield, medium- to coarse-grained sand can be augered.

The Folkestone Beds are next seen on the outskirts of Petersfield in the vicinity of Heath Pond. A poor exposure [7546 2285] on the east side of the pond showed up to 1m of finely stratified, coarse-grained, orange-yellowish brown, friable sandstone.

Much of the southern part of Petersfield is underlain by the Folkestone Beds. An old pit [7410 2315] at Borough Hill has now been built in; a small exposure [7405 2310] on the west side still shows up to 3m of coarse-grained, buff, cross-bedded friable sandstone with the foresets dipping at 26°S.

North of the railway line, up to 2m of coarse- to very coarse-grained, cross-bedded, yellow sandstones can be seen in the banks [around 7446 2380] of Tilmore Road. A temporary exposure [7442 2366] to the south-south-west of the above was in coarse-grained greenish yellow sand. Greensand, 6.4m thick, is recorded at the top of a borehole [7417 2245] at the Jolly Sailors to the south of Petersfield.

On the west side of the town, exposures [around 736 235] revealed up to 2m of medium- to coarse-grained yellowish brown, and locally green, sand. West of this locality, the Folkestone Beds are largely obscured by drift, but they were proved by augering in the bottom of some of the deeper ditches and seen in some temporary exposures [7347 2308].

At Stroud, the sand was formerly extracted from a number of old pits [725 236, 7244 2370, 7255 2405 and 7277 2430] which represent the farthest west that the Folkestone Beds are exposed in the Weald. The Gault/Folkestone Beds junction was recorded by White (1910, p.19) at the first of the above pits:

	Thickness (m)
Soil and brown stoney loam	0.30
Gault	
Clay, brown, sandy	0.61
Clay, stiff, sandy, dark greenish grey (weathering rusty brown) with small pebbles of quartz and other material	0.46
Sand greyish brown, slightly loamy with an irregular seam (25 to 75mm) of quartz pebbles at the base	0.68
Folkestone Beds	
Sand, yellow and white, cross-bedded with lenticles of grey clay and iron-cemented sandstone at the top; wood fragments	2.13

Another section across the Gault/Folkestone Beds boundary can still be seen in the pit [7727 2430] 200m WNW of Aldersnapp Farm. This may be the pit referred to by Topley (1875, p.142) 'at the south corner of Steep Common'. The section given below is a combination of that seen by White (1910, p.15) and that recorded by the author in 1981:

	Thickness (m)
Head and Topsoil	
Dark loamy soil and wash with gravelly seams and scattered phosphatic nodules in the lower part, resting unevenly on	1.22
Gault	
Clay, grey, sandy	
Clay, glauconitic, ferruginous, sandy with white phosphatic nodules and some flaggy ironstone at the base	0.15
Sand, mottled greyish brown, coarse-grained, loamy with scattered quartz and other pebbles up to 25mm, and irregular phosphatic nodules up to 5cm	0.30
Sand, greyish brown, pebbly, with a well-marked seam of pebbles and phosphatic nodules at the base; some iron cementation	0.51
Ironstone band	
Folkestone Beds	
Sandstone, medium- to coarse-grained, micaceous, thinly bedded with thin (5mm) grey clay drapes and wisps; some burrows 8mm diam and up to at least 3cm long	1.00+
Sandstone as above, with fewer, but thicker (up to 12mm) clay beds; some carbonaceous material. Beds show multiple, assymetrical, cross-cutting channels up to 0.25m deep, filled predominantly from the north and east	1.50+

A thin section of the basal Gault pebble bed was examined by Messrs R Sanderson and R J Merriman who describe it as a nodular, glauconitic clayey

sandstone. The roughly spherical pale nodules, up to 5 to 6cm diameter, show a porous friable core and an incomplete, more coherent, rim of variable width up to 1cm thick. The nodules are composed of poorly sorted angular to rounded strained quartz, smaller limonite and common glauconitic grains up to 1.4mm across, within a variable pale brownish clay matrix composed dominantly of carbonate apatite, together with 1Md mica, random mixed-layer mica/smectite, discrete smectite and kaolinite. The rock in which these nodules are set has a similar lithology, but the matrix is richer in glauconite (*sensu lato*) and the carbonate apatite is absent.

Some 300m ESE of this pit, a section [7304 2425] behind Aldersnapp Farm exposed the junction of the Folkestone Beds and the Marehill Clay. Both there, and in the above pit, the junction was virtually horizontal. The combination of low dip and narrow outcrop in this vicinity suggests that the Folkestone Beds are here much thinner than along the crop east of Petersfield. Confirmation is provided by the Stroud Borehole [7225 2360] where the Folkestone Beds are only 10.37m thick (p. 90-1).

In the road cutting [7295 2445] north of Aldersnapp Farm, up to 1.5m of buff, medium- to coarse-grained, thinly bedded, friable sandstone can be seen. Poor exposures of coarse-grained, buff-brown, friable sandstone occur in the sunken lane to the south [7332 2446] and east [7372 2465] of Collyers.

At Steep, there is a partially regraded and overgrown pit [747 251]. The face is unfortunately inaccessible, but up to 2m of angular flint gravel set in a clay matrix [Older Head] overlies 8m of yellow, cross-bedded, friable sandstone. A roadside pit [747 252] north of the above pit is in a very coarse-grained friable sandstone; the constituents are sub-rounded quartz grains.

A section [7517 2581] formed by a waterfall 500m SW of Steep Marsh exposes some 6m of coarse-grained, buff-brown, friable, soft, well-bedded sandstone. The bedding planes are picked out by thin ironstone beds and dark grey silty clays. The clay beds are individually up to 3cm thick, but collectively they occur in units up to 12 cm thick, with thin sand partings. The clay beds were examined for microfossils, but proved to be barren. A similar sequence of thin interbedded sands and clays occurs just below the base of the Gault in

the stream bed [7519 2590] 150m NNE. In another stream section [7510 2588], buff coarse-grained sandstones of the uppermost Folkestone Beds, form a low waterfall.

Folkestone Beds, consisting of fine- to medium-grained, yellowish buff sandstone with thin grey clay seams, forms the floor of the barn [7617 2635] at Gardner's Farm.

In the Flexcombe Borehole, the Folkestone Beds are 10.77m thick. North of Flexcombe, much of the outcrop of the Folkestone Beds is obscured by Older Head. Coarse-grained, yellowish brown sand can be augered in the bottom of ditches and in the stream bed to the north-east of Flexcombe [around 769 274]. At one point [7695 2748], the sands are associated with dark grey silty clays. In the fields to the west [around 77 28] and north-north-west of Liss [around 768 295], orange-brown, coarse-grained sands are consistently augered.

White (1910, p.85) recorded a section in a pit '400 yards south-south-west of Liss Church' [7690 2837?] where, beneath 2.4m of soil and 'wash', 3.8m of white and yellow, cross-bedded, micaceous sand with seams of brown and grey clay occurred.

East of the River Rother, the coarse-grained sands of the Folkestone Beds can generally only be proved on the valley sides, as the interfluves are covered with Older Head, Head and River Terrace Deposits.

An old pit [7795 2968] in the woods to the north of the water works at Liss Forest, still reveals 1.5m of orange, coarse-grained, cross-bedded friable sandstone. The beds in the upper part have shallow dipping foresets to the south-east, and overlie beds with steeper dipping foresets to the south-west.

Much of the Army training ground to the east is underlain by Folkestone Beds, but exposures are rare. The humus-free topsoil of much of this area consists of bleached-white coarse-grained sand. A shallow exposure [786 293] along the southern boundary fence is in yellowish orange, coarse-grained, friable sandstone; close by, however, the Folkestone Beds comprise buff-brown fine- to medium-grained, slightly clayey sand [7865 2930]. Farther east along this same boundary, greyish brown, fine- to medium-grained sand is interbedded with

layers of coarse-grained pebbly sandstone [7895 2935]. Another 35m eastwards, thin clay seams are interbedded with yellow, coarse-grained sand [7898 2935].

An old quarry [7897 2995] on the north side of Longmoor Inclosure is situated close to the base of the Folkestone Beds. There, about 2m of thinly bedded tabular units of fine- to medium-grained, buff-yellow, friable sandstone and thin (up to 10mm) grey clays occur. The clays are concentrated into beds 0.4m thick, with thin sand beds and partings.

Gault

General

The Gault crops out over a roughly south-west to north-east tract from just west of Petersfield [around 72 23] to south-west of Creatham [around 765 300]. Within this area, there is no good exposure of the Gault, apart from the basal beds. The clay has been worked for bricks at several localities, but the pits are poorly documented and no fossil from them is preserved. No cored borehole penetrates the whole of the Gault. Consequently, the stratigraphy and zonal sequence of the Gault in this area is poorly known. Dominantly, the lithology consists of dark grey silty clay with scattered phosphatic nodules.

Owen (1971) had demonstrated that the Gault of the Alresford district lies on the northern flank of a 'high' which affected sedimentation during the Lower Albian and earliest Middle Albian. The basal beds, such as those seen at Stroud, of probable Lower Albian *Douvilliceras mammilatum* Zone age (White 1910, p.17), are absent over the 'high' to the south-east where the 'Iron Grit' is developed at the base of the Gault. Similarly, the lowest subzones (*Hoplites* (*Isohoplites*) *eodentatus* and *Lyelliceras lyelli*) of the Middle Albian, which, although probably present, have not been recognized within the district, and only poorly so farther south-east (Owen, 1971, p.34), may also be absent over the 'high' (Owen, 1963, p.45).

From the evidence to the south, the Gault appears to range from 86m (at Little Langleys, Steep [7441 2608]), to 106m (near Petersfield [7354 2126]). A section recorded by Owen (1963, p.44) at Nyewood [8000 2180] on the adjacent Fareham (316) Sheet showed 8.2m of grey, silty and marly clay with phosphatic

nodules. The ammonite fauna indicates the Middle Albian *Hoplites dentatus* Zone (*spathi* Subzone). From nearby boreholes, it is calculated that about 16m of Gault underlie the recorded section, some of which may correspond to the *lyelli* and *eodentatus* subzones of the *H. dentatus* Zone. Clay of *dentatus* Zone age was worked in the pits at Stroud [721 235], Steep Marsh [751 260, 752 262 and 756 262] and West Liss [759 286].

Specimens from 'Petersfield' of the succeeding *intermedius* Subzone ammonite *Anahoplites osmingtonensis* in the British Museum (Natural History) may have come from the old Causeway brickyard [745 225], Petersfield. There, there is approximately 25 to 30m of Gault above the Folkestone Beds, and thus beds younger than those at Nyewood were probably formerly exposed.

No detail is available for the higher subzones and zones of the Middle Albian, nor of the basal subzones of Upper Albian *Mortoniceras* (*M.*) *inflatum* Zone, to which the highest clay of the Gault of this area can probably be assigned. Owen (1975, p.490) has shown that the basal beds of the overlying Upper Greensand are of *Callihoplites auritus* Subzone (topmost subzone of the *inflatum* Zone) age.

Details

Details of the basal Gault, of probable *mammilatum* Zone, in the Stroud area have been given under the Folkestone Beds (p.42).

In 'Mr Gammons' pit [721 235] at Stroud, calcareous blue clay with nodules of 'race', brown iron-ore and phosphate was formerly exposed (White, 1910, p.19). A few fossils were found which were identified as '*Inoceramus concentricus*, *Hoplites interruptus* and *Cardita tenuicostata*'; they indicate the *dentatus* Zone.

In the western pit [752 262] at Steep Marsh, White (1910, p.19) recorded dark grey silty clay with '*Hoplites interruptus*'. The same fossil was found in the eastern pit [756 262], where up to 1.8m of dark grey clay with selenite and phosphatic nodules could be found.

A somewhat deeper section at West Liss [759 286] was in 4.5m of poorly stratified, stiff, bluish grey, calcareous clay with a few phosphatic nodules. At the southern end of the pit, the Gault was more silty, micaceous and greyish brown with small phosphatic nodules. Fossils from this pit include '*Hoplites interruptus, Inoceramus concentricus* (common), *Lima* (*Mantellum*) *gaultina, Pecten* (*Syncyclonema*) *orbicularis* and *P.* (*Neithea*) *quinquecostatus*' and indicate the *dentatus* Zone (White, 1910, pp.19-20.

Upper Greensand

General

The Upper Greensand is dominantly a buff-grey, bioturbated, clayey siltstone; only locally does it become a fine-grained sand. In weathered exposures, it is seen as a white, well-bedded and jointed stratum. It is sufficiently hard to form a prominent scarp above the Gault. In places, such as at Langrish and Hawkley, it gives rise to long dip slopes over 1km in length. These slopes are traversed by many sunken lanes which provide excellent exposures. The maximum thickness of the Upper Greensand is about 30m. Fossils, including ammonites, locally abound; in the Petersfield area, the Upper Greensand corresponds to the uppermost *auritus* Subzone of the *inflatum* Zone and the whole of the succeeding *dispar* Zone of the Upper Albian (Owen, 1975, pp.476, 490). There is much landslipping at the Upper Greensand/Gault boundary.

Details

At Ramsdean, there are good roadside exposures [7124 2243 - 7134 2250] in white blocky, weathering buff and grey bioturbated clayey siltstone. There are exposures [706 225 - 709 227] of similar lithology in the lane leading north-eastwards from Barrowhill Farm.

It was somewhere in this vicinity that Barrois (1876, p.36) recorded a bed of 'green sand' within the Upper Greensand. This has not been observed during the present survey. He also collected the ammonite '*Schloenbachia rostrata*' and bivalve '*Pecten orbicularis*'.

It is difficult to estimate the thickness of the Upper Greensand in the area between Ramsdean and Langrish - it is probably between 20 and 30m. Around Langrish [710 236], it forms very large dip surfaces which dip gently westwards (c.2 to 3°) in the south, and north-westwards near the village. Blocks of buff and grey bioturbated clayey siltstone are common on the surface of the fields. However, from Langrish Manor Farm [712 240] north-eastwards towards Steep, the outcrop is much narrower. This may be a result of a steepening of dip, as in an old quarry [7194 2476], the hard buff siltstones were dipping 20° to the north-west. Blocks of buff and grey siltstones are common on the surface of the fields. West of Stonerwood Park, the dip is calculated to about 8° NW [728 252].

The barn [7323 2549] at Ridge Farm is built in an old quarry; about 8m of blocky weathering buff siltstone is exposed. North-eastwards, the outcrop begins to widen. North of Steep, there are laneside exposures [around 7380 2593 and 738 261] of up to 2.5m of buff clayey siltstone. South of Ashford Farm, there is a small section across the Lower Chalk/Upper Greensand boundary [7442 2647]. This shows that the upper surface of the Greensand is burrowed and infilled with glauconitic pebbly sand of the Glauconitic Marl.

The sunken lane [7517 2690 - 7532 2683] from Steep Marsh to Hawkley has intermittent poor exposures of blocky, buff and grey, bioturbated, clayey siltstone. In the old quarry [7518 2691] in the road angle, White (1910, p.25) noticed that the beds contain a proportion of fine-grained quartz sand as well as fine-grained glauconite. Blocks of buff and grey siltstone are common on the surface of the field [754 270] to the east.

From Wheatham Farm [751 273] northwards, the outcrop widens from about 250 to 300m, to well over a kilometre in the Hawkley area [745 295]. In this latter area, the dip is about 2° west or west-north-west. White (1910, p.25) recorded a rough-faced bluish bed similar to, and at the same horizon as, a bed at Selborne in the lane [c.744 279] east of Middle Oakshott Farm. The Upper Greensand forms a large slope dipping at about 3° south-west in the fields north of this lane [747 282]; blocks of buff and grey, clayey, bioturbated siltstone are stewn across the surface of the fields. Springs mark the base of the Upper Greensand along the north side of these fields, in an area where the Upper Greensand/Gault boundary is free of landslips.

There are good exposures of some 2 to 4m of blocky weathering buff and grey siltstones in the lane [7400 2876 - 7430 2892] leading south-westwards from Hawkley. Blocks of Upper Greensand are common on the fields [743 286] south of this lane. An old quarry [7495 2870] still reveals some 2 to 3m of blocky buff and grey clayey siltstone in beds up to 1m thick.

On the fields east of Uplands [around 755 296], there are many blocks of buff, grey and cream fine-grained sandy siltstone on the dip slope which is inclined at about 4° NW.

Lower Chalk

The base of the Chalk is everywhere readily identified by the basal Glauconitic (formerly Chloritic) Marl, consisting of about 1-2m of glauconitic, clayey silt of fine-grained sand, with scattered phosphatic pebbles. It rests on a board surface of the Upper Greensand. Above comes the Chalk Marl, generally a whitish grey chalk, commonly marly; the Chalk Marl is succeeded by blocky, less marly, chalk, at the top of which is the Plenus Marls, a succession of dark grey laminated marl, and off-white marly chalk about 1 to 2m thick. The total thickness of the Lower Chalk is about 55m. Fossils, are locally common, and traditionally allow the Lower Chalk to be divided into two zones: the *varians* Zone below and the *subglobosus* Zone above. More recently, ammonites have been used to erect a more detailed zonal scheme. The succession in ascending order comprizes the *Mantelliceras mantelli*, *M. dixoni*, *Acanthoceras rhotomagense*, *A. jukesbrownei*, *Calycoceras guerarngeri* and *Metoicoceras geslinianum* zones. In terms of the old nomenclature, the *varians* Zone includes the first two, and part of the *rhotomagense*, zones, the *subglobosus* Zone includes part of the *rhotomagense*, and the two succeeding zones. The last zone corresponds to the Plenus Marls.

Details

Lower Chalk

A very glauconitic clayey silt of the Glauconitic Marl was augered at one point [7012 2257] on the north side of Barrow Hill, in the floor of Pidham Lane [6972 2200], and at a depth of 1m below grey chalky silty clay [6978

2231] in this same lane on the west side of Barrow Hill. Farther north-east, in the banks of the main road [6986 2271], the basal bed of the Chalk is a very glauconitic siltstone. It was presumably at this locality where Barrois (1876, p.36) noted that the Glauconitic Marl consisted of marly limestone with numerous dark green grains of glauconite and brown phosphatic nodules. Glauconitic greyish brown silty clay was augered in the field [6996 2293] 250m NW of the road bank occurrence. North-eastwards from this point, as far as Langrish Church, the Chalk/Upper Greensand contact coincides with the valley bottom and the actual contact is hidden beneath Head. Barrois (1876, p.36) noted bluish marl with '*Rhynchonella mantelliana*' and '*Ammonites* [*Schloenbachia*] *varians*' in the foundations of a house near the church [?c.703 239]. Some 250m NW of the Church, there are several large chalk pits [7007 2398, 7014 2390, 7020 2405]. The first two are now overgrown, but White (1910, p.36) suggested that they might have been the source of '*Turrilites costatus*', '*Ammonites* [*Acanthoceras*] *rotomagensis*', '*Baculites* [*Sciponoceras*] *baculoides*' and *Inoceramus striatus*' recorded by Barrois (1876, p.36) and indicative of the *varians* Zone [=*rhotomagense* Zone, *costatus* Subzone]. The third pit, which was worked during White's time, still exposes some 10m of blocky weathering, firm, off white chalk. The limited fauna of '*Holaster trecensis*', '*Pecten beaveri*' and '*Mantelliceras mantelli*' together with fish teeth was thought by White to indicate of the *Holaster subglobosus* Zone, but the presence of *M. mantelli* places it within the *varians* Zone [*mantelli* Zone].

Glauconitic buff silty clay and silty marl were augered in the fields east-north-east of Langrish Manor Farm [7127 2405 and 7138 2410], and to the north of Stonerwood Park [7325 2558]. It was in the track [c.7325 2575] to the north of this locality that Jukes-Browne and Hill (1903, p.62) observed the Plenus Marls at the top of the Lower Chalk. A yellowish massive chalk with a few small greenish concretions and yielding '*Serpula ampullacea*', '*Pecten quinquecostatus*' and fragments of an ammonite' ?*Metacanthoplites cenomanensis*' was recorded by White (1910, p.35) in an old pit [7350 2594]. Some 200m E, very glauconitic silt at the base of the Chalk can be augered in the road bank [7370 2591], and at a point [7366 2626] 350m N of this last occurrence. Similarly, in the field north of Ashford Chase, highly glauconitic sandy clay was found in two places [739 264 and 7397 2643], and also in a field north-east of the house [7411 2656 and 7428 2656]. A small exposure [7442 2647] on the Lower Chalk outlier 400m ESE of the Chase, reveals the contact between the

Chalk and the Upper Greensand. The upper surface of the greensand is burrowed and infilled with glauconitic pebbly sand of the Glauconitic Marl.

Continuing eastwards, glauconitic grey clay can be augered on the north side of the minor lane [745 267, 2462 2672 and 2428 2677]. The last locality is alongside a shallow pit, and it is possible that the Glauconitic Marl was there hard enough to have been worked as a local stone. Glauconitic clay is next seen at a point [2700 2687] some 200m ENE, and from there, it can be followed almost continuously for 400m. Close to Wheatham Farm, the clay is pebbly [7511 2717]. To the west, and some 30m topographically higher, is an old pit [7490 2704] in which the succession was described by Jukes-Browne and Hill (1903, p.59) as follows:

	Thickness (m)
Soil	0.61
Chalk, greyish (wet), rather marly	3.96
Chalk, greyish, rather marly, mottled with large patches of bluish grey	2.44
Chalk, sandy, hard grey with '*Terebratulina biplicata*'	0.61
Chalk, softer, mottled with large patches of bluish grey	1.83
Chalk, hard, grey with *Acanthoceras rotomagensis*	0.30
Chalk, bluish grey, marly, passing down into greyer chalk	1.22
Chalk, firm, grey, slightly mottled with bluish grey	1.22
Chalk, massive, firm, marly, mottled with patches of bluish grey	4.57

White recorded a dip of about 10° NW in this pit, together with the following fauna indicative of the *varians* [*rhotomagense*] Zone: '*Lima globosa*', '*Panopaea mandibula*', '*Pleurotomaria*' sp., '*Scalaria fasciata*', '*Baculites baculoides*', '*Metacanthoplites* [*Acanthoceras*] *rotomagensis*' and '*Lamna appendiculata*'. The ammonite *rotomagensis* was abundant in fallen blocks from the upper part of the quarry.

Northwards from this quarry, the Glauconitic Marl can be readily found in the fields and lane banks as far as the east side of Oakshott [7452 2785]. A sample from the roadbank [7465 2780] was examined by Mr R J Merriman who reports that it is a friable glauconitic marl. It consists of sand-grade glauconite grains, up to 15% quartz (mostly fine-sand grade), and accessory amounts of muscovite and feldspar in a poorly cohesive matrix of calcite and clay minerals. Matrix clay minerals make up 15% of the marl, and consist of smectite with subordinate random mixed-layer mica/smectite. Dark green

glauconite grains form up to 25% of the sample, and range in size from 0.4 to 0.03mm. They are composed of 1Md mica with 10-20% random interlayers of smectite.

The junction of the Glauconitic Marl with the Upper Greensand can be fixed with precision in a number of the sunken lanes [7452 2784, 7410 2786, 7402 2802, 7404 2811] hereabouts, and the marl can be traced almost continuously, except where locally hidden beneath Head [around 736 288 and 740 294], to the limit of the present mapping [74 30].

White (1910, p.32) recorded a section [c.74 29] at the southern termination of Farrow Hill. The quarry, some 20m deep, was talus-covered except for the top 5 to 6m. The upper beds, probably belonging to the *subglobosus* Zone, consisted of yellowish grey to white, jointed, unfossiliferous chalk. The underlying beds are composed of harder sub-nodular greyish brown marlstone. Quite an extensive fauna indicative of the *varians* Zone was obtained from these lower beds.

Middle and Upper Chalk

These two formations crop out on the 1:10,000 SU72SW sheet, but have not been resurveyed, and their boundaries are taken from the existing six-inch maps. They are not discussed further in this report.

3. STRUCTURE

The south-east corner of the district lies at the western end of the Vale of Fernhurst, coincident with the Harting Combe Anticline of Thurrell, Worssam and Edmonds (1968, pl.2).

Casey (1961, p.490) noted various localities in the Weald where local unconformities at the base of the Atherfield Clay indicate small-scale, pre-Aptian, folding. However, Holmes' (1959) record of a major unconformity at the base of the Lower Greensand in the Vale of Fernhurst is now known either not to exist, or to be a much less important event than claimed.

Evidence of inter-Aptian (*nutfieldiensis* Zone, *subarcticum* Subzone) movements, which only indirectly affect the present area, are provided by the pebbly Bargate Beds and their partial correlative, the Rogate Beds. In the Guildford area, derived Jurassic ammonites have led various authors (e.g. Arkell, 1939) to suggest inter-Aptian faulting in the region of the Hog's Back. In this area, erosion of the underlying beds also took place prior to the deposition of the Bargate Beds. Additionally, the indigenous fauna of the Bargate Beds represents a warm-water invasion from the south caused by a minor subsidence of the Armorican Massif to the south. This permitted a short-lived connection between the Weald and the Tethyan Basin. A similar warm-water incursion took place during the deposition of the Pulborough Sandrock *nutfieldiensis* Zone *cunningtoni* Subzone).

Temporary shallowing of the Lower Greensand sea is indicated by the Folkestone Beds deposited in a shallow sea under tidal conditions. The marked variations in thickness of the Folkeston Beds may represent either variable deposition in structurally-controlled basins, or post-depositional erosion, also structurally controlled.

The next event which controlled sedimentation was the emergence of a Lower Albian to earliest Middle Albian high to the south and south-east of the Alresford district, over which sediments were either absent or thin and subsequently removed by erosion.

All these Cretaceous movements were relatively slight and were probably no more than slight up or down movements of land and shallow sea. Within the area studied, there are no folds or faults which can unequivocally be assigned to these movements.

The main structures affecting the Weald are thought to have taken place during the Miocene. The resultant structure in the western Weald is a broad gentle anticline with low dips (less than 4°) to the south, variable dips (up to 20°) to the west or north-west, and a gentle plunge west-south-westwards (Figure 1). A local shallow east-west syncline affects the Upper Greensand and Chalk in the Wheatham Hill area [75 27].

Details

Details of the structure of the present district are summarized in Figure 1. Only rarely has it been possible to measure dips in the field, as the dips are very low and many of the surface exposures are disturbed by weathering, creep or cambering. In general, a more reliable picture can be built up by the regional inclination of the well-developed dip slopes of the Hythe Beds and Upper Greensand. Additionally, in areas to the north-east and south-south-east of Rogate, just outside the present district, the dip has been calculated from borehole evidence at 3° just west of south, and 5°S respectively.

4. DRIFT DEPOSITS

Clay-with-flints

General

This unit occurs on the 1:10,00 SU72SW sheet, but it has not been surveyed in detail, although the boundary has been locally modified from the existing six-inch map. It is dominantly a reddish brown clay with a variable proportion of angular brown flints and may be quite gravelly. It is not discussed further in this report.

Older Head

Patches of Older Head, consisting of grey flinty, locally chalky, clay where present over Gault, or brown sandy and flinty clay over the Lower Greensand, occur on the low-lying ground in front of the Upper Greensand escarpment. They are most extensive in the area west of Petersfield and north-west of Liss. In the latter area, where they are at their thickest and most extensive, they occur opposite the gap in the Upper Greensand escarpment cut by the Oakshott Stream.

The upper surface of the deposits is smooth and featureless and there is no topographic feature which delimits the Older Head. The upper surface falls away from the scarp at about 3° and 4°.

The Older Head is thought to have originated as solifluction lobes at the scarp of the Upper Greensand during periglacial freeze/thaw action, and it is presumably related to some of the earlier mass movements and landslipping (see p.67-8) that took place along the scarp. Unlike the landslips, there is no evidence of recent movement of these deposits, and they have probably been stable throughout the Holocene. Present-day stream erosion has dissected what were presumably once continuous sheets.

West of Liss, there is much chalk debris in the Older Head. This may have been brought in either by the proto-Oakshott Stream, or possibly by a separate

solifluction lobe which originated on the Chalk surface and followed the line of the present Oakshott Stream.

The thickness of the deposit is unknown, but it probably reaches a maximum of 3m.

Details

Dissected patches of Older Head occur at Stroud. The surface of the largest, [721 240] on the west of the valley, slopes from about 115m to 85m OD over a distance of 800m. It consists for the most part of more than 1m of flinty grey clay with a gravelly base. On the east side of the valley, the surface slopes from about 95m to about 70m, and the deposits spread across the Gault onto the Folkestone Beds. There is a change of lithology along the outcrop from a flinty clay on, or close to, the Gault, to a yellowish brown coarse-grained sandy clay on the Folkestone Beds.

West of Petersfield, the Older Head spreads from the Gault, across the Folkestone Beds, Marehill Clay and on to the Pulborough Sandrock. As noted above, there is a change from flinty clay close to the Gault to a sandy clay, or clayey sand, over the Lower Greensand.

Near Bedales, small spreads of coarse-grained sandy clay and clayey sand overlie the Folkestone Beds. In the sand pit [746 251] on the east side of Bedales, up to 2m of angular flint gravel set in a brownish grey clay matrix overlies the Folkestone Beds. A thin skin of clayey gravel, too thin to map separately, occurs on the surface of some of the nearby fields [e.g. 739 254, 740 255, 744 255, 746 255].

A very gravelly patch of Older Head caps the hill [752 257] to the east-north-east of Steep Farm. Around Steep Marsh [755 263], the surface of the Gault and Folkestone Beds is drift free, but farther north-east, between Flexcombe and the area north of Burgates, there are extensive spreads of soliflucted material. Dominantly, the lithology is a flinty grey clay, but this becomes more sandy over the Lower Greensand. Locally [766 271], the deposit is glauconitic. The spread which descends south-eastwards from 85m at Barefoots Farm [757 282] to 65m to the west of Liss, is very chalky and with much Upper

Greensand material. Where Older Head overlies Folkestone Beds around Burgates [770 285], and west of Goleigh Farm House [775 295], the lithology is primarily a brown sandy flinty clay. White (1910, pp.85-86) recorded a section on "the north side of the road to Hurst Gate" [?7690 2837], West Liss, as follows:

	Thickness (m)
Soil, loamy	0.3
Older Head	
Sandy and loamy sand, fine-grained, grey and brown with scattered flints passing into	0.9-2.1
Gravel, loamy, light brown with piece of malmstone [Upper Greensand], bleached flints, ironstone, quartz pebbles etc. resting unevenly on	1.2
Folkestone Beds	
Sand, white and yellow, cross-bedded, micaceous and seams of grey and brown clay	3.8+

Head

General

Heterogenous deposits which do not fall into a specific genetic division have been grouped under the term Head. They represent the downhill movement by solifluction of the weathered surface material from a variety of lithological units, but especially form the Rogate Beds. Soil creep and minor mass movements probably still continue the processes which were initiated under freeze-thaw periglacial conditions. The lithological variation of the Head reflects the source material upslope. For example, Head in front of the Chalk scarp on the Gault has a dominantly clay matrix, but with a significant content of chalk, either as pebbles, or finely disseminated, and flints; material derived from the Rogate Beds is dominantly clayey. In many cases, it is almost impossible to distinguish Head satisfactorily from its parent body. This is particularly so in the case of Head derived from the Folkestone Beds. The thickness of the various Head deposits varies, but it probably nowhere exceeds 3m. The major period of Head formation appears to have taken place after the formation of the Second River Terrace Deposits, as these units are covered by an extensive sheet of Head in the area west of Rogate.

Details

Head

Head is extensive on the north side of the River Rother to the west of Rogate. Small tongues of sandy Head extend along the steep-sided valleys draining the dip slope of the Hythe Beds. Where the valleys cross on to the Rogate Beds, the ground surface flattens out, the valleys merge and become broader, and the Rogate Beds, which appear particularly susceptible to solifluxion and downwashing, contribute much clayey debris to the Head deposits. Over most of this tract, the Head consists of yellowish or orange-brown sandy clay with minor amounts of gravel.

At Sheet, a shallow valley [753 244] leading to the Ashford Stream is flanked by Rogate Beds and its valley sides are masked by yellowish brown sandy clay. The ground south-east of Churcher's College [755 236] occupies a slight depression filled with brown clayey sand, locally coarse-grained and gravelly. The valley which crosses Heath Common [755 230] is mantled by coarse-grained dirty brown, bleached white at the surface, sand derived from the Folkestone Beds. The Head is at least 3.2m thick at Petersfield [7417 2344].

Around the School [7455 229] south of Petersfield there is at least 1.4m of grey chalky clay (probably Alluvium), overlying clayey coarse-grained grey sand and clayey gravel which mantles the lower valley slope.

West of Petersfield, there is a large low-lying area [around 73 24] over the Sandgate Beds into which a number of streams drain. The largest of these, on the west side, originates at the foot of the Chalk escarpment. The Head in the upper part of this tributary valley consists of a grey chalky silt, but lower down, where the Head merges with that from the other valleys, it consists of up to at least 1.3m of greyish brown, coarse-grained, sandy and flinty clay.

Chalky silt and clay can be found in the valley bottom [734 253] to the north-east of Stonerwood Park; lower down this valley, the Head passes into a brown sandy and flinty clay.

North of Church Common, chalky silt and clay can be found on the south side [745 258], and in the bottom of the valley upstream [e.g. 737 263] of the streams draining the Chalk to the north of Ashford Chace. Similarly, chalky silt occurs in the bottom of the valleys near Oakshott and farther north [e.g. 7372 2878, 7388 2841, 7410 2933].

Orange and brown sandy clay and clayey sand, locally gravelly, occupies the valley bottom and lower slopes of the north-east trending valley at Bowyer's Common [around 76 26]. Farther north-east, there is a wide mantle of Head on either side of the River Rother. That on the west side consists mostly of orange and brown sandy clay with scattered flints; that on the east has a clearly identifiable component from the pebbly Rogate Beds.

At East Liss, there is much colluvial peaty sand which originates at a series of springs arising within the Rogate Beds [7839 2787, 7855 2798, 7859 2812].

There is a broad boggy tract of dirty brown, coarse-grained, sandy peaty clay in the valleys which passes through the grounds of The Wylds [796 290]. A similar, but wider, tract of boggy ground occurs along the valley of Longmoor Inclosure [790 298]. The deposit there consists principally of coarse-grained sand, derived from the Folkestone Beds, together with a high organic content. Much of this area is low-lying, and some of the Head may include water-lain Alluvium. Another boggy tract can be found north-west of Liss Forest [around 78 29]. There, the Head, which may be a degraded River Terrace Deposit, is mostly a coarse-grained clayey sand, locally with much organic debris.

North of Langley [around 810 297], there is a broad valley mantled with coarse-grained, clayey, gravelly sand. There are numerous large blocks of pebbly carstone derived from the Folkestone Beds on the surface. Some of the Head in this vicinity may represent degraded and reworked River Terrace Deposits. Many large blocks of pebbly carstone are scattered over the surface to the north-west [804 297 and 807 299] of the above occurrences.

Terrace-like spreads of mottled orange and grey sandy clay and clayey sand, locally gravelly, are present on the Weald Clay [around 810 266] to the south-east of Rake.

River Terrace Deposits

General

Undifferentiated

Patches of high-level River Terrace Deposits are found principally near Langley [around 81 29] close to the watershed of the River Rother and Godalming Way, in Longmoor Inclosure where they cap the hills [between 781 295 and 796 299], and north of Rogate [around 802 256] on the Hythe Beds. At Langley, they occur at heights of 115 to 120m OD and consist of slightly clayey, coarse-grained sand with a variable pebble content. The pebbles are mostly angular brown flints, but there are scattered cherts and, on the surface of some of the deposits, large blocks of pebbly carstone derived from the Folkestone Beds. It is not known, however, whether these blocks are superficial soliflucted debris or whether they are weathering out of the terrace deposits. In Longmoor Inclosure, much of the terraces is composed of coarse-grained sand derived from the Folkestone Beds, together with a significant content of angular brown flints. The deposits here range from 85 to 110m OD.

Farther south, near Tullecombe, patches of gravel are at about 150m OD, about 110m above the present river level.

Fifth River Terrace Deposits

Deposits of this terrace are only found on the north side of the River Rother between Durford Wood [776 247] and Rogate [806 244] at heights between 90m OD in the west and c.76m in the east, some 40 to 45m above the present day Alluvium. The dominant lithology is a gravel composed of angular brown flints.

Fourth River Terrace Deposits

Fourth Terrace Deposits are found in the same general area as the Fifth, on the north side of the River Rother at about 30m above river level. In the west, the top is about 77m OD, declining eastwards to c.70m OD near Rogate.

The lithology ranges from a coarse-grained sand to a gravel, variably composed of angular and sub-angular brown flints, chert and siliceous sandstone.

Third River Terrace Deposits

Deposits of this stage are more extensive than the preceding ones and are found principally on the south side of the Rother at heights which decline only slightly downstream from 65m OD around Petersfield, to 60m near Rogate. The lithology is dominantly a coarse-grained sand with a relatively minor gravel content; gravel forms the base of the deposit at West Heath [787 229].

Second River Terrace Deposits

These are the most extensive of all the terraces, and are found on both sides of the Rother at height of 6 to 8m above the river level. Much of the Second River Terrace Deposits is obscured by soliflucted dark brown clayey sand or sandy clay, and as a consequence, little is known of their lithology. On the margins of the terraces, where erosion has cut through the Head and the terraces, the indications are of a gravelly base. Springs commonly issue from this basal bed, particularly where the terraces overlie the Marehill Clay [e.g. on either side of the river, around 803 227, and on the west side of the Rother to the west of Durford Abbey Farm, around 769 236]. The maximum thickness within the district appears to be the 3m noted at the Petersfield Sewerage works [770 229].

First River Terrace Deposits

On the adjacent Haslemere (301) Sheet, the First River Terrace of the Rother has a top some 2m higher than the present river. Within the present district, two flat-lying areas can be recognized within this height range: a lower, up to 1m above Alluvium level, and a higher, some 1 to 2m above the Alluvium. They have been distinguished as 1a and 1b respectively on the maps.

Most of the occurrences of these spreads are of limited extent. The dominant lithology appears to be a coarse-grained, locally gravelly, sand with a gravelly base.

Details

Undifferentiated River Terrace Deposits

For the most part, the high-level, undifferentiated river terraces to the north and north-east of Liss Forest [7815 2955, 784 294, 7847 2930, 7850, 2915, 787 292, 7905 2944, 794 297, 796 299] appear to be composed of angular brown or white flints set in a coarse-grained sandy matrix. On Warren Hill, a small exposure [7863 2921] in the lane bank showed 1m of such a lithology, overlying Folkestone Beds. Farther north-east, sections in the tracks worn by the tanks show up to 1.2m of angular flint gravel festooned into medium- to coarse-grained orange sands [7953 2987 and 7961 2990], also part of the terrace deposits. Similar patches of coarse-grained sand with scattered flints occur north-east of The Wylds [802 295 and 802 300]. At the latter locality, there are many blocks of pebbly carstone on the surface.

A larger spread, now dissected by the railway cutting, occurs west of Langley [805 290]. The southern part consists of coarse-grained pebbly sand, locally clayey, with scattered angular brown flints. This was 1.5 to 2m thick in the sunken lane [8030 2846] north of Rake, and the deposit is reputed to have been worked to a depth of 3m in an old pit [8039 2874], now backfilled, some 300m NNE of the lane section. North of the railway, the gravel has been worked in a number of old pits [8062 2940 and 8066 2942], but no section remains. A small exposure [8062 2952] a little farther north showed blocks of pebbly carstone embedded in a medium- to coarse-grained pebbly sand. Large, up to 0.3m diameter, blocks of pebbly carstone are common on the surface of the fields [8075 2945] to the east.

The most north-easterly patch of undifferentiated terrace deposits forms a low gravelly mound [8120 2985]. Some 200m S of this, the lithology is a coarse-grained pebbly sand, locally gravelly; sand and gravel was formerly extracted from a small pit [8122 2969]. Coarse-grained pebbly sand and gravel underlies the grounds of Langley Court [811 289]. A well [8112 2893] at the Court proved 3.9m of 'sand and gravel', above Folkestone Beds. Two small patches [808 285 and 811 284] of coarse- to very coarse-grained gravelly, locally clayey, sand are present south of Langley Court.

North of Rogate, coarse-grained sand and gravel has been worked in a number of shallow pits [around 8140 2547 and 8150 2553]. Some 500m NW [800 258], a very gravelly spread of terrace caps the watershed.

Fifth River Terrace Deposits

Two spreads of angular brown flint gravel [776 248 and 788 247] occur at altitudes of 85 to 90m OD north-west of Rogate. A third spread can be found north of Rogate [8065 2440] where it consists of very coarse-grained sand and gravel. The central spread has been worked for local farm use.

Fourth River Terrace Deposits

Deposits of the Fourth Terrace have been noted at five localities [778 242, 788 242, 802 239, 808 240 and 810 242] at between 75 and 80m OD. The most easterly occurrence appears to have incorporated many blocks of chert and siliceous sandstone from the Hythe Beds. North of Rogate, the deposit consists of a coarse-grained ferruginous sand with a minor flint content. West of Rogate, the terrace caps a long narrow hill [802 239]; it is particularly gravelly judging from the surface deposits, and has a high content of non-, or poorly rounded, siliceous sandstone and chert, and a relatively small proportion of angular brown flints. Farther west, a low hill [788 242] is also capped by gravel, but there, flints appear to be dominant. The fifth area [778 242] is again a low hill capped by gravel.

Third River Terrace Deposits

Deposits of the third terrace can be found south-west of Rogate [805 232], north of the River Rother, and at West Heath [787 229] and around Heath Pond, Petersfield [75 23] at heights between 60 and 65m OD.

The eastern deposits consist of medium- to coarse-grained, locally gravelly, sand with pebbles of angular and sub-angular flints, and sub-angular carstone. At West Heath, the terrace is composed of up to 2m of coarse-grained yellowish brown sand with scattered flints and has a gravelly base. In the area around Heath Pond, coarse-grained brown sand, locally clayey, with scattered flints

occurs. At the western end of this spread, a borehole [7497 2272] proved 1.37m of brown and white, medium- to coarse-grained sand above Gault.

Second River Terrace Deposits

In the east, no good section has been seen in the Second River Terrace Deposits, but surface indications are of a clayey, coarse-grained sand with gravel. Springs are common from the basal gravel on both sides of the river to the west of Habin Bridge, but especially on the north. The springs on the north side give rise to boggy tracts of Head and Peat. An auger hole [7947 2336] close to the margin of the terrace on this northern tract proved 0.7m of brown sandy clay [Head], above 0.5m of medium- to coarse-grained sand, which in turn rested on gravel. Another auger hole [7914 2351] proved 0.6m of brown sandy clay [Head], above 0.4m of medium- to coarse-grained clayey sand, on gravel. Away from the terrace margin, it was not possible to penetrate the Head which was at least 1.2m thick. South of the river, the deposit appears to consist of coarse-grained sand with a minor gravel content. The base was gravelly to the south of Wenham Manor Farm [around 789 231]. Continuing westwards, there was about 1m of sand and gravel, above Marehill Clay, in a pit [7801 2313] at Durford Mill. About 2m of gravel were proved in a ditch [7783 2317] 200m W of the above pit. Springs issue from the base of the terrace deposits in the tract of ground on either side of the ditch. Some 200m SSE, at least 1.2m of clayey gravel was proved in ditches [around 779 230], whereas Marehill Clay was encountered beneath gravel at 0.8m and 1.2m in ditches [7779 2289 and 7779 2282] a farther 150m SW.

The terrace forms a 400m wide flat north-west of the sewerage works, Petersfield [770 229]. There, up to 3m of soft to firm, yellowish grey, slightly sandy silty clay with some flint gravel were recorded in trial boreholes. Springs issue from the base of this terrace spread.

On the north side of the river, a similar line of springs [7616 2409 - 7700 2385] gives rise to a boggy tract of Head. Angular brown flints are common on the surface of the margin of the terrace.

North of Liss [776 294], there is a flat area of medium- to coarse-grained brown sand, some 1 to 2m higher than the First Terrace.

First River Terrace Deposits

A small remnant of the lower First Terrace (1a), about 1m higher than the Alluvium, is present [8110 2313] north-east of Habin Bridge. The deposit, about 0.6m thick, consists of poorly sorted flint gravel. The two components of the First Terrace (1a and 1b) are in juxtaposition [792 233] south-east of Wenham Manor Farm. The height separation between both terraces, and the Alluvium, is about 0.8m respectively. South-west of the farm, the upper First Terrace (1b) has a very gravelly margin [7870 2325].

South-east of West Heath on the adjacent Fareham (316) Sheet, a spread of the upper First Terrace (1b) occurs [795 225]. A small section [7970 2233] revealed 1.5m of buff and brown medium- to coarse-grained sand with scattered flints, above the Folkestone Beds.

Only very small patches [760 248, 766 255, 767 257] of First Terrace Deposits are present along the Rother as far as Liss. At this latter locality, remnants of a low terrace occur close to the junction of two tributaries with the Rother [around 780 285]. They are about 7m higher than the Alluvium, and consist of yellowish brown, medium- to coarse-grained, locally clayey sand and with scattered flints.

Alluvium

General

Alluvium is present principally along the floodplain of the Rother and some of its west bank tributaries. Within the district, the floodplain widens from about 50m in the north [767 300] to about 100m in the south-east [79 23]. The lithology is dominantly a greyish brown, locally organic, silty and sandy clay with minor amounts of gravel. There is, at least locally, a gravelly base. The maximum thickness recorded is 3.5m near Petersfield [7220 2348].

Details

The alluvial tract of the River Rother in the east of the district is about 100m wide. At one point [7891 2333] to the south of Wenham Manor Farm, there

is 1.4m of greyish brown sandy clay with a gravelly base, resting on Pulborough Sandrock. Farther upstream [7831 2328], 1m of mottled orange and grey clayey sand overlies 1.2m of grey sandy clay.

The 1.4m of grey chalky clay at the top of a ditch [7415 2298] on the south side of Petersfield is probably alluvial, although it may be soliflucted. Some 200m WSW, some 1.8m of greyish brown sandy clay was proved [7397 2290] on the south side of the flood plain. A borehole [7220 2348] close by proved over 3.5m of Alluvium, beneath 0.76m of Made Ground. The Alluvium is described as mottled yellow and grey, slightly silty clay, becoming yellowish brown and stiffer with depth. Near Stroud, another borehole [7280 2352] proved 1.5m of firm to soft, yellowish brown mottled clay with some angular flint gravel, especially towards the base, resting on yellowish brown clayey sand [?Folkestone Beds].

The Alluvium of a west bank tributary to the Rother near Liss consists of at least 1.2m of greyish brown sandy clay [around 770 273].

Peat

Peat is generally associated with springs issuing from the base of the River Terrace Deposits and is of limited extent. The thickness of the various spreads is unknown, but they exceed 1.5m. The Peat, which appears to be still forming at the present day, probably commenced formation at the beginning of the Holocene.

Blown Sand

General

East of West Heath, there is a tract [around 792 228] of hummocky ground composed of coarse-grained sand irregularly mantling the Folkestone Beds, Marehill Clay and Pulborough Sandrock. It is most extensive over the Marehill Clay, and as a consequence, water collects in the hollows between the hummocks giving rise to boggy, poorly draining ground. The overall aspect is that of wind-blown deposit with material transported from west to east. The Folkestone Beds presumably provided the source material, although possibly

River Terrace Deposits were a contributory source. The deposit is thought to have originated under periglacial conditions. Under such a climatic regime, West Heath Common would probably have been free of vegetation, and the relatively uncemented sands of the Folkestone Beds would thus be subject to removal by wind. Possibly, impeded drainage over the Marehill Clay gave rise to pools, or wet areas supporting plant life, in, or amongst which the wind-blown sand was trapped. Although the heath supports only sparse vegetation, it is sufficient to prevent wind ablation at the present day and dune formation is no longer taking place. The thickness of the blown sand probably does not exceed 2m.

Details

Areas of coarse-grained sand giving rise to hummocky ground occur on the east side of West Heath Common, roughly along the line of the old railway [789 230 - 795 228]. In augering, generally a buff of brown medium- to coarse-grained sand is all that is proved; in some of the boggy hollows, the sand is organic. Locally [e.g. 790 229], the thickness of the sand does not exceed 1m, and the underlying Marehill Clay can be proved in most auger holes; it is this latter deposit which is shown at the surface on the present map.

Landslips

General

Landslips are an ubiquitous feature of the Upper Greensand/Gault contact along most of the outcrop of the area mapped. They extend considerably to the north of the present mapped limit (White, 1910, pp.75-76), and also occur along part, at least, of the southern crop of these two formations on the adjacent Fareham (316) Sheet.

The slips presumably result from a combination of spring-head erosion by springs issuing from the base of the Upper Greensand and producing steep slopes, and high moisture content and pore pressures. The resultant landforms, presumably composites of succession rotational slips and slab slides, are quite striking, with fault-like back scarps up to 30m high, ponds trapped between the scarp and the back of the slip, and vast acreages of

hummocky ground which commonly have a prominent toe separating them from the smooth topography of the undisturbed Gault surface. In many places, a hedge has developed along the foot of the toe.

The age of the slips is uncertain; almost certainly they were initiated under periglacial conditions and may well have originated at the same time [during the penultimate glaciation] as the equally spectacular slips affecting the Upper Greensand/Gault in the Shaftesbury area (Gostelow in Bristow, 1989) and the Lower Greensand/Weald Clay on the north side of the Weald in the Sevenoaks area (Skempton and Weeks, 1976). Although their topography is remarkedly fresh, and despite Gilbert White's (Natural History of Selborne, letter 87) graphic account of one such slip involving about 50 acres of land in 1774, movement at the present day appears to be minimal. In places [Coldhayes, 757 270], substantial country houses are built on slips and appear to be without obvious structural damage due to movement. Inevitably, much of the affected land is wooded, or under pasture; clearance and changing land use could affect the stability of what, at the present day, is only tenuously stable.

Details

There are many small landslips in the Langrish area; most of them are under 300m in length and do not extend far from the scarp. Some, such as those on either side of North Stroud Farm [71 23 and 7150 2325], appear to be separated by a narrow strip of undisturbed ground.

The slip [709 226] east-north-east of Barrowhill Farm is about 200m long with a maximum width of 50m. Springs occur both at the back margin and at the head of the valley where the slip starts. Another slip [708 228], 350m x 40m north-east of Barrowhill Farm, has a prominent north-facing scarp and toe. At the western end, the slip passes into Head. On the north side of the valley which marks the axis of the Fernhurst Anticline there is a larger slip, 600m x 100m [71 23] with a prominent scarp in the east, and a clearly defined toe along its whole length. Springs issue from the toe in the east [7117 2303 and 7114 2304]. A little further to the east-north-east, the toe readily identifies another small, 200m x 60m, slip [7150 2325].

Some 500m south-east of Langrish Manor Farm, a somewhat larger slip, 400m x 200m [714 236] occurs. The back scarp is well developed along most of the length of the slip; between the scarp and the toe is an area of characteristic hummocky ground.

The slip [718 242] east of Langrish Manor Farm is problematical. There is an area of hummocky ground, 300m x 60m [around 7190 2415], separated by a smooth-surfaced field of Gault [around 7190 2425] which is backed by a 20m scarp of Upper Greensand. This scarp has the appearance of a landslip scarp and so the smooth-surfaced field below it is regarded as part of the slip.

From this point north-eastwards, there is a 3km tract which appears to be slip free. From Oakhurst Farm, Steep [743 259], there is then a 5km belt of almost unbroken large landslips. Bush Hill [747 264] has a south-south-eastwards facing scarp formed of Upper Greensand, with an area 250m wide below it of undulating and hummock rough pasture. Ponds [e.g. 7459 2619] occur on this irregular surface, whilst the toe is clearly evident by the 1 to 2m topographic difference of either side of what is now a bounding hedge. This area of slipping is separated by 120m of apparently stable ground from the next slip on which Coldhayes, mentioned above (p.68), is situated. The back scarp over much of its length is somewhat degraded, but the undulating ground in front, and the toe, are unmistakeable. One field which straddles the slip and the undisturbed Gault has been ploughed and, in addition to the topographic demarcation, the toe is readily discernible by the change in colour from the light grey soil developed on the slip, to the greyish brown Gault soil [around 7580 2677]. To the north of Coldhayes, a small hillock [7559 2723] appears to be a slip-detached block of Upper Greensand. Continuing northwards, the ground is spectacularly hummocky [around 755 275] with a several metre difference on either side of the hedge which follows the toe. On the west side of the road, there is a prominent hillock [7540 2775] capped by Upper Greensand, but separated from the main scarp by a low col. It is presumed to have formed by rotational slipping (see White, 1910, fig.13). The prominent toe of this slip, some 300m from the scarp within a pasture field, appears remarkedly fresh. It was presumably this same slip which White, writing in 1910, described as "of fresh appearance".

To the east of Oakshott, the Upper Greensand scarp is deeply dissected by a number of streams, and the areas of landslipping are not continuous. It is not known whether this is fragmentation due to erosion, or an original feature. The Oakshott Stream provides one of the few examples in this district where the slips are actively being eroded. Slips occur on both sides of the stream, but that on the south [7490 2825] is quite small. On the north side, the toe and the stream coincide over about 700m [7467 2847 - 7520 2823]. The ground is undulating above the stream, whilst the back scarp, Combe Hanger, is about 20m high.

Northwards from the Oakshott Stream, the Upper Greensand scarp strikes north-eastwards. The landslips along the scarp are continuous with the one described above, and form an unbroken tract 2km long x 400m wide. Their extent in this area can be recognized with a fair degree of precision from the 1:10,000 topographic map - the back scarp (Farewell Hanger and The Slip), up to 30m high, is almost vertical in places and the contours are correspondingly crowded together; the main mass of the slip has irregular wavy, evenly spaced (5m interval), contours about 50m apart, whereas on the undisturbed Gault, the 5m contour interval is between 100 and 200m apart. Large ponds [7547 2935] are shown trapped between the scarp and the slip; detached Upper Greensand-capped hills [756 294] occur, and the toe of the slip is marked by a hedge over most of its length. Part of this tract is the Hawkley Slip of Gilbert White which took place in March 1774. He noted that January and February 1774 were remarkable for the 'great melting snows and vast gluts of rain', and that by the end of February many of the springs were flowing. He observed the 'high free-stone [Upper Greensand] cliff, naked and bare' which formed at the back of the slip. It is interesting that he recorded a 9 to 12m, apparently *vertical*, drop of the ground, as witnessed by upright gate posts, and he stated quite clearly that the cliff so formed was not a result of the ground falling forward, as the area in front of scarp was free of debris. Presumably rotational slipping took place; to account for the vertical gate posts there must have been some subsidiary movement(s) of the main slip. The reader is recommended to Gilbert White's letter (No.87) for further details of this slip. As White calculated that only 50 acres of ground were involved in this particular slip, it is clear that this huge tract of slipping is the result of a succession of slips.

In the re-entrant valley north of Uplands, there is another slip [753 298] with all the attendant features of back scarp, 15 to 20m high, and undulating ground with ponds and springs in front. The toe is being eroded by a northward-draining stream.

5. REFERENCES

ALLEN, J.R.L. and NARAYAN, J. 1964. Cross-stratified units, some with silt bands, in the Folkestone Beds (Lower Greensand) of Southeast England. *Geologie en Mijnbouw*, Vol.43, pp.451-461.

ALLEN, P. 1976. Wealden of the Weald: a new model. *Proceedings of the Geologists' Association*, Vol.86, pp.389-437.

ARKELL, W.J. 1939. Derived ammonites from the Lower Greensand of Surrey and their bearing on the tectonic history of the Hog's Back. *Proceedings of the Geologists' Association*, Vol.50, pp.22-25.

BARROIS, C. 1876. Recherches sur le Terrain Crétacé Supérieur de l'Angleterre et de l'Irland *Memoire Societé géologique* Nord, Vol.1.

BRISTOW, C.R. 1989. Geology of the East Stour - Shaftesbury district (Dorset). *Geological Survey Technical Report* WA/89/58.

BRISTOW, C.R., MORTER, A.A. and WILKINSON, I.P. 1987. The stratigraphy and palaeontology of the Lower Greensand of the Hoes Farm Borehole, near Petworth Sussex. *Proceedings of the Geologists' Association*, Vol.98, pp.217-227.

BRISTOW, C.R. and WYATT, R.J. 1983. Geological notes and local details for 1:10 000 sheets TQ 01 NW, NE, SW and SE (Pulborough and Storrington). Keyworth: Institute of Geological Sciences.

BUCHAN, S., ROBBIE, J.A., BUTLER, A.J., HOLMES, S.C.A. and MORRIS, L.S.O. 1942. Water supply from underground sources of Reading - Southampton district. *Wartime Pamphlet Geological Survey of Great Britain* No.15, part V. Well-catalogues for New Series One-inch sheets 285 (Aldershot), 300 (New Alresford) and 301 (Haslemere).

CASEY, R. 1961. The Stratigraphical Palaeontology of the Lower Greensand. *Palaeontology*, Vol.3, pp.487-621.

CASEY, R. and BRISTOW, C.R. 1964. Notes on some Ferruginous Strata in Buckinghamshire and Wiltshire. *Geological Magazine*, Vol.101, pp.116-128.

DINES, H.G. and EDMUNDS, F.H. 1929. The geology of the country around Aldershot and Guildford. *Memoir Geological Survey of Great Britain.*

DINES, H.G. and EDMUNDS, F.H. 1933. The geology of the country around Reigate and Dorking. *Memoir Geological Survey of Great Britain.*

EDMUNDS, F.H. 1928. Wells and Springs of Sussex. *Memoir Geological Survey of Great Britain.*

FITTON, W.H. 1824. Inquiries respecting the geological relations of the beds between the Chalk and the Purbeck Limestone in the South-east of England. *Annals of Philosophy*, Vol.24. N.S. 8, pp.365-458. (Reprinted in 4to in 1833).

FITTON, W.H. 1836. Observations on some of the strata between the Chalk and the Oxford Oolite in the South-east of England. *Transactions of the Geological Society*, (2), Vol.4, pp.103-390.

FLATT, A.G., HEARSUM, P.G. and others 1976. Records of wells in the area around Alresford. *Well Inventory Series* [Metric Units]. *Institute of Geological Sciences.*

HOLMES, S.C.A. 1959. *In Summary of Progress of the Geological Survey* for 1958, p.28

HUMPHRIES, D.W. 1957. Chert: its Age and Origin in the Hythe Beds of the Western Weald. *Proceedings of the Geologists' Association*, Vol.67 (for 1956), pp.296-313.

HUMPHRIES, D.W. 1964. The Stratigraphy of the Lower Greensand of the Southwest Weald. *Proceedings of the Geologists' Association*, Vol.75, pp.39-59.

JUIGNET, P., RIOULT, M. and DESTOMBES, P. 1973. Boreal influences in the Upper Aptian-Lower Albian beds of Normandy, northwest France. In *The Boreal Lower Cretaceous*, ed. R. Casey and P.F. Rawson, *Geological Journal Special Issue* No.5, Seel House Press, Liverpool, pp.303-326.

JUKES-BROWNE, A.J. and HILL, W. 1903. The Cretaceous Rocks of Britain. Vol.2: The Lower and Middle Chalk of England. *Memoir Geological Survey of Great Britain.*

KIRKALDY, J.F. 1932. The Geology of the Country around Hascombe, Surrey. *Proceedings of the Geologists' Association*, Vol.43, pp.127-151.

KIRKALDY, J.F. 1933. The Sandgate Beds of the Western Weald. *Proceedings of the Geologists' Association*, Vol.44, pp.270-311.

KNOWLES, L. and MIDDLEMISS, F.A. 1959. The Lower Greensand in the Hindhead Area of Surrey and Hampshire. *Proceedings of the Geologists' Association*, Vol.69 (for 1958), pp.205-238.

MANTELL, G. 1822. *The fossils of the South Downs.* London.

MARTIN, P.J. 1828. *A Geological Memoir on a Part of Western Sussex.* London.

MIDDLEMISS, F.A. 1962. A Fauna from the Puttenham Beds (Lower Greensand) of Hampshire. *Proceedings of the Geologists' Association*, Vol.72 (for 1961), pp.455-459.

MIDDLEMISS, F.A. 1976. Studies in the sedimentation of the Lower Greensand of the Weald, 1875-1975: a review and commentary. *Proceedings of the Geologists' Association*, Vol.86 (for 1975), pp.457-473.

MURCHISON, R.I. 1826. Geological Sketch of the North-western Extremity of Sussex and the adjoining Parts of Hants and Surrey. *Transactions of the Geological Society* (2), Vol.2, pp.97-107.

NARAYAN, J. 1963. Cross-stratification and palaeogeography of the Lower Greensand of South-east England and Bas-Boulonnais, France. *Nature*, Vol.199, pp.1246-1247.

NARAYAN, J. 1971. Sedimentary structures in the Lower Greensand of the Weald, England, and Bas-Boulonnais, France. *Sedimentary Geology*, Vol.71, pp.73-109.

OWEN, H.G. 1963. Some sections in the Lower Gault of the Weald. *Proceedings of the Geologists' Association*, Vol.74 pp.35-53.

OWEN, H.G. 1971. Middle Albian Stratigraphy in the Anglo-Paris Basin. *Bulletin of the British Museum (Natural History)* (Geology) Supplement, 8, pp.1-164.

OWEN, H.G. 1975. The stratigraphy of the Gault and Upper Greensand of the Weald. *Proceedings of the Geologists' Association*, Vol.86 (for 1975), pp.475-498.

THURRELL, R.G., WORSSAM, B.C. and EDMONDS, E.A. 1968. Geology of the Country around Haslemere. *Memoir Geological Survey of Great Britain.*

TOPLEY, W. 1875. The Geology of the Weald. *Memoir Geological Survey of Great Britain.*

WHITAKER, W. 1910. The Water Supply of Hampshire. *Memoir Geological Survey of Great Britain.*

WHITAKER, W. 1911. The Water Supply of Sussex from Underground Sources (Supplement). *Memoir Geological Survey of Great Britain.*

WHITAKER, W and REID, C. 1899. The Water Supply of Sussex from Underground Sources. *Memoir Geological Survey of Great Britain.*

WHITE, H.J.O. 1910. The Geology of the Country around Alresford. *Memoir Geological Survey of Great Britain.*

WOOD, G.V. 1957. The Heavy Mineral Suites of the Lower Greensand of the Western Weald. *Proceedings of the Geologists' Association*, Vol.67 (for 1956), pp.124-137.

WOOLDRIDGE, S.W. 1928. Report of the Weald Research Committe. *Proceedings of the Geologists' Association*, Vol.39, pp.223-237.

WOOLDRIDGE, S.W. 1947. Whitsun Field Meeting to the Central Weald. Haslemere and Midhurst. *Proceedings of the Geologists' Association*, Vol.58, pp.73-76.

APPENDIX 1

The palaeontology of the Pulborough Sandrock of the Petersfield district by A.A. Morter.

a. Habin Bridge

River cliff just E of Habin Bridge on south side of River Rother, 800m S of Rogate, Sussex [8092 2298].

Specimens collected: WA 3644-4059 E.A. Andrews and Dr R. Casey 1960; Zm 5848-5874 A.H. Gunner, presented 1961; BRI 391-405 Dr C.R. Bristow, collected June 1981.

Shelly material was collected from friable ochre/brown ironstones and red-brown ironstones and include the following:

Plants
Weichselia sp. fronds
wood fragments

Annellida
Parsimonia sp.
Propomatoceras sulcicarinata Ware

Brachiopoda
Cyclothyris deluci (Pictet)
Lamellaerhynchia cf. *caseyi* Owen
Lamellaerhynchia sp.
rhynchonellids indet.

Bivalvia
Astarte cf. *cantabrigiensis* Woods
Astarte sp.
Ceratostreon sp.
Cucullaea cornueliana d'Orbigny
Gervillella sublanceolata (d'Orbigny)
Gervillia (*G.*) *forbesiana* (d'Orbigny)
Mesolinga? *cornueliana* (d'Orbigny)
Mesosacella sp.
Mimachlamys robinaldina (d'Orbigny)
Neithea sp.
Nucula (*Leionucula*) *meyeri* Gardner
Nucula (*Leionucula*) sp.
Oxytoma pectinatum (J de C Sowerby)
Palaeomoera inaequalis (d'Orbigny)
Panopea plicata (J de C Sowerby)
Parmicorbula striatula (J de C Sowerby) abundant
Phelopteria rostrata (J de C Sowerby)

Pleuriocardia (*P.*) cf. *cottaldina* (d'Orbigny)
Pleuriocardia (*P.*) cf. *ibbetsoni* (Forbes) very common
Pterotrigonia mantelli Casey common
Resatrix (*R.*) *parva* (J de C Sowerby) very common
Senis wharburtoni (Forbes)
Thetis minor J de C Sowerby common
Toucasia lonsdalei (J de C Sowerby)
Venilicardia sowerbyi Woods
Vnigriella? cf. *scapha* (d'Orbigny)
Yaadia nodosa (J de C Sowerby)

Gastropoda

Acmaea sp.
Anchura (*Perissoptera*) cf. *carinella* (d'Orbigny)
Anchura (*Perissoptera*) *robinaldina* (d'Orbigny) common
Anchura (*Perissoptera*) cf. *parkinsoni* (Mantell)
Anchura (*Perissoptera*) spp.
Bathraspira shanklinensis Abbas
?Eulima sp. juv.
cf. *Gyrodes gentii* (J. Sowerby)
Ovactaeonina forbesiana (d'Orbigny)
Rhabdocolpus? forbesianum (d'Orbigny)
Ringinella albense (d'Orbigny)
Tessarolax moreausianum (d'Orbigny)
Tessarolax sp.
fish remains

This is essentially the macrofauna described by Casey (1961, p.557), with, however, some additions and some species not observed. As Casey observed, this large shelly fauna compares with that in Group XIV at Shanklin, and the ironstone nodule faunas of Park Lane, Pulborough, Muttons Lane near Ashington, and Parham Park (Kirkaldy, 1937). The fauna may also be compared with Headley Wood Farm (Hampshire) (Middlemiss, 1962) where 'Puttenham Beds' yielded ammonites of the *Parahoplites cunningtoni* subzone. Some differences in faunal content should be noted, however, which probably reflect local palaeoecological conditions.

The rare rudist bivalve *Toucasia lonsdalei* links all these localities and appears to be confined to the *cunningtoni* subzone of the Late Aptian.

b. Stodham Park; blocks on surface of pasture 600m W of Stodham Park, Liss, Hampshire. [7645 2610]. Specimens collected BRI 1195-1201.

Ironstone nodules yielded a limited bivalve fauna of *Pterotrigonia mantelli* Casey and *Yaadia nodosa* (J de C Sowerby). These two bivalves are fairly long ranging and only indicate the Late Aptian; they are common in the *Parahoplites cunningtoni* Subzone ironstone nodules, and nodules in the early part of the *jacobi* Zone in the Folkestone area. Thus an age of late *P. nutfieldiensis* Zone, *P. cunningtoni* Subzone, or early *Hypacanthoplites jacobi* Zone may be presumed.

c. Steep Marsh; old quarry 1km SSE of Steep Marsh Farm, Steep, Hampshire. [7560 2538]. Specimen BRI 1202.

One gastropod, *Anchura* (*Perissoptera*) *robinaldina* (d'Orbigny) collected in soft ochreous ironstone.

This very limited faunal evidence indicates an horizon no later than *P. nutfieldiensis* Zone (see Casey, 1961, fossil lists). *Anchura* (*P.*) *robinaldina* is common in *P. cunningtoni* subzone ironstones (see Habin Bridge above).

d. Steep House; surface blocks, 300m SE of Dunhurst (school), Steep, Hampshire. [7438 2456]. Specimens collected: BRI 1203-1217.

A shelly fauna in ironstones was collected as follows:

Bivalvia
Astarte cf. *cantabrigiensis* Woods
Gervillia sp. juv.
Mesosacella woodsi Saveliev
Nucula (*Leionucula*) *meyeri* Gardner
Nucula (*Leionucula*) cf. *plananta* Deshayes
cf. *Panopea plicata* (J de C Sowerby)
Parmicorbula striatula (J de C Sowerby)
Pleuriocardia (*P.*) sp. indet.
Pterotrigonia mantelli Casey
Resatrix (*?Dosiniopsella*) sp.
cf. *Thetis minor* J de C Sowerby

Gastropoda
?Ovactaeonina sp.
Ringinella albense (d'Orbigny)

This macrofaunal assemblage bears a strong resemblance to Habin Bridge, but with some notable differences. Rarities, such as *Astarte* at Habin Bridge, are common here, and the presence of *Resatrix* (*?Dosiniopsella*) (normally a *jacobi* Zone fossil) Casey (1961) would suggest a late *P. cunningtoni* subzonal age, probably later than the principal ironstone faunas from Paham Park etc.

Conclusions

a) Habin Bridge macrofaunas are probably of *Parahoplites cunningtoni* Subzone age, the equivalent of 'Group' XIV Shanklin, Isle of Wight (following Casey, 1961).

b) The Pulborough Sandrock from Stodham Park, Steep Marsh and Steep House is probably of latest *P. cunningtoni* Subzone, i.e. possible top of 'Group' XIV. Thus follows the correlation of the overlying Marehill Clay with XV in the Isle of Wight (Kirkaldy, 1933; Casey, 1961) with the *Nolaniceras nolani* Subzone, basal subzone or the *Hypacanthoplites jacobi* Zone of the Late Aptian.

APPENDIX 2

Selected borehole from the Petersfield district

SU 72 NW 4. Wheatham Hill, Froxfield [7455 2771]
Surface level +144.78m OD. Date 1934.

	Thickness (m)	Depth (m)
Lower Chalk (basal 5m) and Upper Greensand		
Rock	33.53	33.53
Gault		
Clay, blue	22.53	56.08

5. Steep Mill, Steep [742 258]
Surface level +82.60m OD. Date c.1903.

	Thickness (m)	Depth (m)
Head and Topsoil		
Topsoil, chalk, flints etc	0.91	0.91
Clay, blue and flints	0.61	1.52
Gault		
Gault with scattered nodules	26.83	28.35
Gault, sandy	5.79	34.14
Gault (dark, 67.06 to 77.43m)	37.18	71.32
Clay, dark, green, sandy	0.92	72.24
Folkestone Beds		
Sandstone, grey	0.20	72.44
Clay, sandy with bands of green sandstones	1.17	73.61
Sand, greenish grey	1.37	74.98
Sand, green, clayey	0.31	75.29
Sand, greenish grey	0.91	76.20

6. Little Langleys, Steep [7441 2608]
Surface level +105.75m OD. Date 1913

	Thickness (m)	Depth (m)
Upper Greensand		
Sandstone	8.23	8.23
Gault		
Gault	85.65	93.88
Folkestone Beds		
Sand	16.15	110.03

7. Alexander Lane, Froxfield [700 280]
Surface level c. +198m OD. Date 1981

	Thickness (m)	Depth (m)
Clay-with-flints		
Clay, red, stiff with large flints	13.72	13.72
Upper Chalk		
Chalk, soft, white with few flints	16.76	30.48
Middle Chalk (?including Lower Chalk)		
Chalk, hard, white	94.49	124.97

	Lower Chalk		
	Marl, soft grey (Plenus Marls?)	2.44	127.41
	Chalk, hard grey	2.13	129.54

SU 72 NE 1. Station Bridge, Liss [7768 2769]
Surface level +57.91m OD. Date 1928.

	Thickness (m)	Depth (m)
Topsoil	0.15	0.15
Head		
Sand, red	1.22	1.37
Marehill Clay		
Hard Black 'gault'	1.83	3.20
Pulborough Sandrock		
Gravel	0.15	3.35
Sand, green	0.92	4.27
Sandstone	0.05	4.32
Sand, green	0.61	4.93
Sandstone	0.07	5.00
Sand, green	1.10	6.10

2. Flexcombe [7637 2702]
Surface level c+67m OD. Date 1977.

	Thickness (m)	Depth (m)
Head		
Clay, grey, sandy with flints	0.91	0.91
Gault		
Clay, grey	2.90	3.81
Clay, blue	14.63	18.44
Clay, sandy	2.90	21.34
Folkestone Beds		
Sand, coarse-grained	2.43	23.77
Sand, fine-grained	8.34	32.11
Sandgate Beds		
Marehill Clay		
Clay, sandy	3.55	35.66

3. Flexcombe Borehole 02 [7684 2692]
Surface level +60m OD. Date 1977.

	Thickness (m)	Depth (m)
Head		
Clay, sandy	0.22	0.22
Sand, fine- to medium-grained with stones	0.92	1.14
Clay, sandy, light to medium grey	0.31	1.45
Folkestone Beds		
Sand, fine- to medium-grained, light greenish grey; some clay fragments	5.71	7.16
Sandgate Beds		
Marehill Clay		
Clay, sandy, olive-black	1.53	8.69
Clay, olive-black	5.79	14.48

Clay, slightly sandy, olive-black	3.62	18.10
Clay, sandy (up to 40% sand), olive-black	6.29	24.39
Clay, olive-black	13.11	37.50
Clay, brown with some stones	6.40	43.90
Pulborough Sandrock		
Sand, fine- to medium-grained, some clay, olive-brown	4.27	48.17
Clay, sandy, olive-black with fine to medium-grained reddish brown sandstone	2.43	50.60
Sand, clayey (15 to 20%), fine- to medium-grained with about 10% coarse grains, olive-grey	2.14	52.74
Sand, olive-grey, fine- to medium-grained with 5 to 10% coarse grains; 1% polished limonite grains	2.14	54.88
Sand, olive-grey, fine- to medium-grained with 3 to 5% coarse grains; 1% polished limonite grains	2.13	57.01
Sand, olive-grey, fine- to medium-grained with some polished limonite grains	1.37	58.38
Sand, clayey, olive-grey, no limonite	0.39	58.77
Sand, clayey (c.10%), olive-grey, fine- to medium-grained, 10% coarse grains; less than 1% limonite grain	0.07	58.84
Sand, olive-grey, fine- to medium-grained (up to 0.4mm)	8.77	67.61
Rogate Beds		
Sand, pale to greyish olive, medium- to coarse-grained; 2% fine gravel, poorly sorted; limonite grains 1 to 2%	1.59	69.20
Sand, light olive-grey, medium- to coarse-grained, 15% fine gravel, poorly sorted; 10 to 15% limonite grains	2.14	71.34
As above, but limonite 20 to 25%	2.06	73.48
Sand, olive-grey, medium- to coarse-grained (25%), poorly sorted; limonite 20 to 25%	1.52	75.00
As above, but limonite less than 5%	6.40	81.40
Hythe Beds		
Sand, olive-grey, fine- to coarse-grained (15%); limonite grains less than 5%	5.80	87.20
Sand, olive-grey, fine- (0.15mm) to coarse-grained (1mm); limonite grains less than 1%	3.20	90.40

4. Hill Brow Waterworks [7922 2673]
Surface level +159.21m OD

	Thickness (m)	Depth (m)
Hythe Beds		
Sand and soft sandstone	94.49	94.49
Atherfield and Weald Clay		
Clay	67.05	161.54

11. Mid Southern Water Co., Pumping Station, Greatham [7785 2964]
Surface level +67.05m OD. Date 1963

	Thickness (m)	Depth (m)
Topsoil		
Topsoil, dark sandy	0.61	0.61
Sand, fine-grained, almost white	0.30	0.91
Soil, dark sandy soft	0.46	1.37
Folkestone Beds		
Sand, light brown, hard, fine-grained	0.31	1.68
Sand, rust-coloured, cemented, fine-grained	0.45	2.13
Sand, light brown, soft, coarse-grained	0.61	2.74
Sandgate Beds		
Marehill Clay		
Clay, light brown	0.61	3.35
Clay, dark blue/green sandy - becoming sandier in depth	2.14	5.49
Sand, brownish green with a little clay	0.91	6.40
Sand, rust-coloured, coarse-grained	0.61	7.01
Sand, grey, fine-grained, pyrites and small stones	4.27	11.28
Clay, dark blue, some pyrites	3.81	15.09
Sandstone, cemented pyrites, stones and rock	6.86	21.95
Clay, dark blue	0.30	22.25
Sandstone, cemented pyrites, rock/ stones	0.61	22.86
Clay, dark blue	0.30	23.16
Sandstone, cemented, pyrites, rock	4.58	27.74
Clay, dark blue with thin layers of hard sandstone	5.79	33.53
Clay, sandy green	2.44	35.97
Pulborough Sandrock		
Sandstone, coarse-grained, crumbly	0.61	36.58
Sand, whitish becoming darker in depth, soft, fine-grained	5.48	42.06
Sandstone, fairly hard with shells and fossils	0.61	42.67
Sand, light grey, fine-grained	1.53	44.20
Sand, a little coarser than previous, darker in depth	8.53	52.73

Rogate Beds		
Rock, very hard with small pebbles	2.13	54.86
Clay, greenish, sandy	3.66	58.52
Sandstone, soft crumbly	0.05	58.67
Clay, black with large shells	0.77	59.44
Sandstone, hard at first but quite soft/crumbly towards 61.57m	2.13	61.57
Clay, dark grey, sandy	0.91	62.48
Clay, grey and sandstone	1.83	64.31
Sand, grey, coarse-grained, soft to drill but quite compact	2.75	67.06
Sandstone, very hard, fine-grained, dipping	1.67	68.73
Sandstone layers, coarse-grained sand and pebbles	2.59	71.32
Sandstone, hard	1.02	72.34
Sand, dark, cemented, coarse-grained with pebbles in places	3.25	75.59
Sandstone, very hard, dipping	1.23	76.81
Sand, brownish, coarse-grained	0.30	77.11
Sandstone, very hard, dipping	1.22	78.33
Sandstone in alternate hard and soft layers, pebbles	3.97	82.30
Hythe Beds		
Sand, dark grey, fairly coarse-grained, soft	1.98	84.28
Sandstone, hard	0.45	84.73
Sand, dark grey, fairly coarse-grained, soft	2.14	86.87
Sandstone, grey, hard		
Sand, greyish, coarse-grained, bands of hard rock	3.66	91.44
Sand, grey, cemented with layers of soft fine sand	3.96	95.40
Sandstone, grey, cemented	3.96	99.36
Sandstone, grey, cemented crumbly, soft with soft fine-grained sand	3.36	102.72
Sand, grey, fine-grained, soft, running	1.52	104.24

12. Mid Southern Water Co Pumping Station, Greatham [7805 2961]
Surface level + 78.63m OD. Date 1964

	Thickness (m)	Depth (m)
Topsoil		
Black sand	0.25	0.25
Head		
Sand and gravel, brown	0.66	0.91
Folkestone Beds		
Sand, compact, fairly soft, light brown	5.95	6.86
Clay, brown sandy	0.30	7.16
Sand, grey-green, cemented, traces of ironstone	0.76	7.92

Sand, light brown, fairly coarse and compact	1.53	9.45
Sandgate Beds		
Marehill Clay		
Clay, light brown, with nodules of ironstone	3.95	12.80
Clay, blue-black, with pyrites	6.40	19.20
Clay, green sandy, with some sandstone	1.83	21.03
Sand and sandstone, cemented with some stones	0.92	21.95
Clay, dark blue	1.82	23.77
Sand and stones, fine-grained, cemented	0.92	24.69
Clay, dark blue with pyrites	5.78	30.48
Rock, fairly hard	0.30	30.78
Clay, dark blue with occasional stones	2.14	32.92
Rock, fairly hard	0.30	33.22
Clay, blue-black with some stones	7.62	40.84
Clay, green-blue, sandy with some stones	1.22	42.06
Pulborough Sandrock		
Sand, fairly soft, grey, fine-grained	1.83	43.89
Sand cemented and stones, fossils	1.53	45.42
Sandstone and whitish coloured sand in thin layers	4.87	50.29
Sandstones with fossilised wood and small pebbles	0.92	51.21
Sand, fine-grained with traces of black clay and some small pebbles	1.21	52.43
Sand, fine-grained, cemented	1.52	53.95
Sand, fairly fine with some very coarse sand	0.91	54.86
Rogate Beds		
Clay, blue-black	0.61	55.47
Sand and clay, cemented fossilised wood	0.61	56.08
Clay, grey-green with small pebbles	0.92	57.00
Sand, cemented and small pebbles	0.30	57.30
Clay, dark grey-green, sandy, some small pebbles	1.53	58.83
Clay, black sandy, hard to drill	3.65	62.48
Clay, softer, black, sandier than previous bed	0.31	62.79
Sandstone, hard embedded with small pebbles	0.91	63.70
Clay, green	0.61	64.31
Clay, green, sandy with small pebbles	1.53	65.84
Clay, green, sandy, much lighter in colour than previous bed	0.76	66.60
Sandstone, hard	1.07	67.67
Clay, dark green, sandy with large shells and small pebbles	2.43	70.10
Sandstone, very hard embedded with small pebbles	1.83	71.93
Sand, cemented and small pebbles	0.61	72.54

Sand, grey, fine-grained	0.61	73.15
Rock (Bargates)	0.61	73.76
Sand, coarse-grained, compact	1.39	75.13
Rock (Bargate)	0.77	75.90
Sand, very coarse, with small pebbles	1.52	77.42
Sand, coarse with small pebbles with thin layers of clay	1.07	78.49
Rock (Bargate)	0.45	78.94
Sand, coarse cemented in places	1.37	80.31
Rock (Bargate)	1.58	81.69
Sand, coarse, thin clay bands and pebbles	0.45	82.14
Sandstone, hard grey in colour	0.61	82.75
Sand, coarse-grained, cemented with thin clay bands	0.92	83.67
Sandstone, grey, hard	0.45	84.12
Sand, coarse, cemented with coarse pebbles	0.92	85.04
Sandstone, grey, hard	0.61	85.65
Sand, coarse with thin bands of clay, sandstone and pebbles	3.05	88.70
Sandstone, grey, hard	0.76	89.46
Alternate bands of coarse sand, clay, sandstone and pebbles	4.30	93.73
Sandstone, grey, hard	0.45	94.18
Alternate layers of sand, clay, cemented sand (sand predominent)	2.44	96.62
Sand, coarse, cemented, fairly hard	0.61	97.23
Sandstone, grey, hard	0.76	97.99
Sand and soft sandstone with thin bands of clay, pebbles, fossils	1.98	99.97
Sandstone, grey, hard	0.77	100.74
Alternate thin bands clay, grey sand and small pebbles	1.06	101.80
Hythe Beds		
Sandstone, light grey, medium hard, crumbly in places	0.46	102.26
Sand, soft with thin bands of clay	0.77	103.03
Sandstone, light grey, medium hard, crumbly in places	1.52	104.55
Sand, soft with thin bands of clay	1.22	105.77
Sandstone, light grey medium hard, crumbly in places	0.61	106.38
Sand, soft, cemented in places, thin band of clay	3.04	109.42
Sandstone, grey, crumbly	0.61	110.03
Sand, light grey, soft	0.46	110.49
Sandstone, grey, crumbly	0.76	111.25
Sand, light grey, soft with some clay	0.31	111.56
Sandstone, grey, crumbly, fairly hard	0.61	112.17
Sand, light grey	0.91	113.08
Sandstone, grey, crumbly with thin bands of light grey sand	9.14	122.22

Sand, grey, cemented and alternate layers of sandstone and sand	2.16	124.38
Sand, light grey, fairly fine-grained	1.81	126.19
Sandstone, grey, crumbly, varying in hardness	0.91	127.10
Sand, grey-green, cemented	1.53	128.63
Sand, light grey, soft to drill	1.52	130.15
Sand, coarse, cemented	0.46	130.61
Sand, light grey, with layers of coarse sandstone	1.67	132.28
Sand, light grey, thin sandstone beds, pyrites, lignite, and small pebbles	7.78	140.06
Alternate beds grey-green sandstone, grey sand, cemented sand	2.89	142.95
Clay, dark grey, sandy and grey sand	1.22	144.17
Sand, grey-green, cemented	1.52	145.69
Alternate layers dark sandy clay, pyrites, light grey sand	8.23	153.92
Sand, grey-green, cemented, thin clay and sand bands, pyrites	3.20	157.12
Alternate layers dark sandy clay, cemented sand, light grey sand	8.39	165.51
?Atherfield Clay		
Clay, very dark grey, stopped drilling whilst still in clay	1.52	167.03

14. Clayton Court, Hill Brow [7884 2611]
Surface level +144.78m OD. Date 1938.

	Thickness (m)	Depth (m)
Hythe Beds		
Sand	1.22	1.22
Sandstone	2.74	3.96
Sand and sandstone	14.33	18.29
Sandstone	6.09	24.38
Sand and clay	6.40	30.78
Sand and sandstone, yellow	14.94	45.72
Sand and clay, yellow	7.62	53.34
Sand, yellow	1.52	54.86
Sand and clay	10.67	65.53
Sand, grey	3.05	68.58
Sand, white and clay	1.22	69.80
Sand and clay	9.45	79.25
Atherfield Clay		
Clay, green, sandy	5.78	85.03
Clay, blue, sandy	3.36	88.39

SU 82 NW

6. Rogate Sawmills [8045 2190]
Surface level +53.95m OD. Date 1943

	Thickness (m)	Depth (m)
Gault		
Clay, brown and blue	22.25	22.25
Folkestone Beds		
Sand, blue hard	3.35	25.60
Sand, brown	4.27	29.87

7. Woodhouse Farm, East Harting [8085 2064]
Surface level +60.96m OD. Date 1943

	Thickness (m)	Depth (m)
Gault [and Upper Greensand]		
Clay, blue and then veins of rock	95.10	95.10
Folkestone Beds		
Sand, brown	2.44	97.54

8. Nyewood [8024 2170]
Surface level +56.08m OD. Date 1904

	Thickness (m)	Depth (m)
Gault		
Clay, blue and yellow	36.92	36.92
Folkestone Beds		
Greensand	touched	

9. Nyewood [8017 2168]
Surface level +56.08m OD. Date 1932

	Thickness (m)	Depth (m)
Gault	42.06	42.06
Folkestone Beds		
Sand	5.79	47.85

10. Champs, Nyewood [8005 2140]
Surface level +57.30m. Date 1921

	Thickness (m)	Depth (m)
Gault		
Clay, blue, sandy	69.34	69.34
Sand rock	0.61	69.95
Folkestone Beds		
Sand, hard	3.96	73.91
Sand, blowing	5.95	79.86
?Marehill Clay		
Clay	0.30	80.16

11. Marsh Farm, Elsted [8359]
Surface level +42.67m OD. Date 1893

	Thickness (m)	Depth (m)
Gault		
Clay, dark, hard	28.96	28.96
Folkestone Beds		
Sands, green, white and black	32.00	60.96
Sandrock	0.61	61.57
Sands, green, white and black	9.75	71.32
Clayey at the base like pipe clay	touched	

12. Marsh Farm, Elsted [8359 2069]
Surface level +42.67m OD. Date 1935

	Thickness (m)	Depth (m)
Gault		
Dug well	12.19	12.19
Clay, blue	16.77	28.96
Clay, green and sandy	1.21	30.17
Folkestone Beds		
Sand, yellow with layers of sandy shale	39.93	70.10

13. Elsted Station [8348 2057]
Surface level +45.72m OD. Date 1899

	Thickness (m)	Depth (m)
Gault		
Clay, blue with rock at 7.3m	41.45	41.45
Folkestone Beds		
Sand-rock	3.66	45.11
Sand and stones	17.07	62.18

15. Hazel House, Elsted [8305 2042]
Surface level +48.77m OD. Date 1923

	Thickness (m)	Depth (m)
Gault	52.7	52.7
Folkestone Beds	3.7	56.4

20. Western Rother Observation Borehole No.5, Elsted [8422 2093]
Surface level +46.63m OD. Date 1978

	Thickness (m)	Depth (m)
Gault		
Clay, yellowish grey passing down to olive grey	8.0	8.0
Folkestone Beds		
Sand, yellowish orange, medium- to coarse-grained; then seams of ironstone and pipeclay	54.0	62.0

Sandgate Beds			
Upper Marehill Clay			
Clay, olive-grey, sandy		6.0	68.0
Upper Pulborough Sandrock			
Sand, olive-green, fine-grained, clayey		8.0	76.0
Lower Marehill Clay			
Clay, olive-grey, sandy		8.0	84.0
No borehole record		14.0	98.0
Lower Pulborough Sandrock			
Sand, olive-grey, fine-grained, silty; traces of clay, greyish orange-pink		8.0	106.0
Rogate Beds			
Sand, dark yellowish brown, fine-grained; numerous limonite grains, coarse- to medium-grained, well rounded, polished		6.0	112.0
Sand, greyish orange, fine- to medium-grained; contains 5 to 10% coarse sand to fine gravel; no limonite grains		2.0	114.0
Hythe Beds			
Sand, greyish olive, fine-grained, silty		24.0	138.0
Sand, greyish olive, fine-grained, chips of sandstone, well cemented, fine-grained		6.0	144.0

SU 72 SW 1. The Jolly Sailors, Petersfield [7417 2245]
Surface level +74.68m OD. Date 1891

	Thickness (m)	Depth (m)
Gault		
Old well	17.83	17.83
Clay, black	11.43	29.26
Folkestone Beds		
Sand, dark green	6.40	35.66
Sand-rock, soft	2.14	37.80
Sand, light-coloured, running	23.77	61.57
Sand-rock, soft	1.83	63.40
Sand, light-coloured, running	4.87	68.27

2. Bolings Hill Farm, Weston, near Petersfield [7354 2126]
Surface level +92.96m OD. Date 1913

	Thickness (m)	Depth (m)
Upper Greensand	24.38	24.38
Gault		
Clay, blue	68.58	92.96
Clay, blue and brown	33.53	126.49
Clay, sandy	3.96	130.45
Folkestone Beds		
Sandstone	4.58	135.03
Sand	7.01	142.04

3. Weston Farm, near Petersfield [7291 2187]
Surface level c+107m OD

	Thickness (m)	Depth (m)
Upper Greensand		
Light topsoil	4.57	4.57
Light grey clay	3.05	7.62
Gault		
Chalk, dark grey, hard	22.86	30.48
Chalk, dark grey, very hard	12.19	42.67

4. Stroud Borehole 03 [7225 2360]
Surface level +85.34m OD. Date 1977

	Thickness (m)	Depth (m)
Gault		
Clay, mottled yellowish and grey	2.29	2.29
Clay, olive-grey	8.68	10.97
Clay, mottled greyish olive and dusky yellow	2.75	13.72
Clay, sandy and clayey sand, fine- to medium-grained, forming 50% of bed	6.40	20.12
Clay, olive-grey	5.49	25.61
Folkestone Beds		
Sand, fine to medium-grained, well sorted, olive	1.83	27.44
As above, but with 5 to 15% clay content (? contamination)	7.01	34.45
Sand, clayey, fine- to medium-grained, olive; clay content 40%	1.53	35.98
Sandgate Beds		
Marehill Clay		
Clay, silty, olive grey	6.40	42.38
Clay, silty, sandy, greyish olive-green	3.35	45.73
Clay, silty, olive grey	1.83	47.56
Clay, olive grey	1.83	49.39
Clay, silty, olive grey	7.62	57.01
Clay, silty, with 10% sand content (? contamination)	1.75	59.76
Pulborough Sandrock		
Sand, fine-grained, silty, olive	3.64	63.40
Sand, clayey, fine-grained, olive grey	3.50	66.90
Sand, clayey; less than 1% polished limonite grains	2.98	68.88
Sand, fine-grained, 5 to 10% clay content; 1 to 2% polished limonite grains pale olive to greyish olive	1.53	70.41
As above, limonite grains more numerous	2.15	72.56

Sand, fine to medium-grained, slight clay content, dark yellowish brown; 4 to 5% well rounded limonite grains	1.83	74.39
Rogate Beds		
Sand as above but with 30 to 35% limonite grains	4.27	78.66
Sand, clayey, fine to medium-grained, olive grey, 1 to 2% polished limonite grains	8.84	87.50
Sand, fine-grained, silty, 1 to 2% limonite grains, pale olive	1.83	89.33
Clay, sandy, scattered limonite grains	6.86	96.19
Hythe Beds		
Sand, clayey, olive grey	6.10	102.29
Sand, fine to medium-grained, greyish olive	1.98	104.27
Sand, clayey, greyish olive	2.44	106.71
Sand, fine- to medium-grained, greyish olive	2.44	109.15
Sand, clayey, greyish olive	3.65	112.80
Sand, fine- to medium-grained, greyish olive	12.81	125.61
Sand, fine-grained, olive grey	1.83	127.44
Sand, fine- to medium-grained, pale olive to olive grey	15.85	143.29
Sand, silty, fine-grained, olive-grey	9.15	152.44

5. Former Luker's Brewery, Petersfield [6491 2334]
Surface level +60.35m OD.

	Thickness (m)	Depth (m)
Made ground		
Rubble and a few flints	3.05	3.05
Head and ?Folkestone Beds		
Sand, coarse	0.91	3.96
Sand, fine (quicksand), black	0.91	4.87
Sandgate Beds		
Marehill Clay		
Clay, dark sandy	2.45	7.32
Clay, black, hard	1.21	8.53
Clay, hard with greensand	0.92	9.45
Pulborough Sandrock		
Sand, black	2.74	12.19
Sand, grey, fine	9.15	21.34

6. Collyers, near Petersfield [7341 2465]
Surface level +97.54m OD. Date 1899.

Folkestone Beds, *Marehill Clay* and *Pulborough Sandrock*

	Thickness (m)	Depth (m)
Sand, white and yellow	26.82	26.82
Rogate Beds		
Clay, green sandy	15.55	42.37
Sand, green	1.06	43.43
Clay	4.12	47.55
Sand, green dark mixed with clay	0.91	48.46
Clay with sand	6.71	55.17
Sand, green mixed with clay	2.89	58.06
Hythe Beds		
Sand, green and yellow with hard beds, mixed with clay	26.98	85.04

9a Former Borough Farm Brewery [7413 2330]
Surface level +65.83m

	Thickness (m)	Depth (m)
Existing well	6.10	6.10
Head		
Loam, rich	0.61	6.71
Mixed clay sand and gravel	2.13	8.84
Folkestone Beds		
Sand, clean	5.18	14.02
Sand, clean with some green grains	7.01	21.03
Sandgate Beds		
Marehill Clay		
Clay, blue	1.37	22.40
Sand and small gravel	2.14	24.54
Clay, hard blue	7.77	32.31

9b Date 1898

	Thickness (m)	Depth (m)
Existing well	7.92	7.92
Folkestone Beds		
Sand	4.27	12.19
Sand, live	2.44	14.63
Sandgate Beds		
Marehill Clay		
Clay, sandy	6.25	20.88
Clay, blue	4.57	25.45
Pulborough Sandrock and Rogate Beds		
Sand, green	1.37	26.82
Sandstone	5.18	32.00
Sand, live	5.19	37.19
Sand, dark	1.52	38.71
Sand, mixed hard	2.13	40.84

9c

	Thickness (m)	Depth (m)
Dug well	6.10	6.10
Folkestone Beds		
Sand, red	1.82	7.92
Sand, red and ballast	3.66	11.58
Sand, dark	4.86	16.46
Sandgate Beds		
Marehill Clay		
Clay, dark	9.14	25.60
Pulborough Sandrock		
Sandstone, dark	11.28	36.88
Rogate Beds		
Clay, dark, sandy	5.89	42.67
Sandstone, red	6.10	48.77
Sandstone, dark	0.61	49.38
Clay, dark sandy	5.79	55.17

10. Tilmore [c.747 244]
Surface level +88.39m OD. Date 1898.

	Thickness (m)	Depth (m)
Pulborough Sandrock		
Sand	9.14	9.14
Rogate Beds		
Clay	5.49	14.63
Sandstone	19.51	34.14

11. Railway Station, 30m south of [c.742 234]
Surface level c.+65m OD.

	Thickness (m)	Depth (m)
Soil	0.30	0.30
Head		
Gravel, loamy	2.14	2.44
Folkestone Beds		
Sand with hard bed, 150mm thick, at base	12.19	14.63
Sandgate Beds		
Marehill Clay		
Clay	1.22	15.85
Sand to clay	1.83	17.68

12. Itshide Rubber Co Ltd, Petersfield [7465 2374]
Surface level +68.88m OD. Date 1929

	Thickness (m)	Depth (m)
Sandgate Beds		
Marehill Clay		
Clay	1.52	1.52
Clay, sandy	3.05	4.57

Pulborough Sandrock		
Sand, brown	9.76	14.33
Rogate Beds		
Clay, sandy	5.79	20.12
Sand rock	11.27	31.39
Clay, blue, sandy	7.32	38.71
Rock	1.22	39.93
Clay, blue, sandy	4.88	44.81
Rock	0.30	45.11
Clay	0.76	45.87
Hythe Beds		
Rock, hard and soft	7.47	53.34
Rock, green, hard and soft in veins	11.28	64.62
Sand	2.44	67.06
Sandrock, soft	66.14	133.20
Sandrock, hard	0.91	134.11
Atherfield Clay		
Clay	2.44	136.55

13. Petersfield and District Laundry Co, Petersfield [7417 2344]
Surface level +65.53m OD. Date 1937.

	Thickness (m)	Depth (m)
Made ground	0.91	0.91
Head		
Clay, brown, sandy	0.61	1.52
Sand and stones, loamy	1.68	3.20
Folkestone Beds		
Sand with bands of clay and stone	5.03	8.23
Sandgate Beds		
Marehill Clay		
Mud and stones	4.27	12.50
Clay, dark blue, sandy	2.43	14.93
Pulborough Sandrock		
Sand, green, hard, loamy with small stones	2.14	17.07
Sand, grey, hard with layers of sandstone	7.31	24.38
Rogate Beds		
Sand, hard with pebbles	4.27	28.65
Sand, green loamy	2.74	31.39
Rock	0.31	31.70
Sand, green, hard, loamy	2.13	33.83
Clay, with sand and stones	9.15	42.98
Sandrock	4.57	47.55
Clay, sandy	4.88	52.43
Hythe Beds		
Rock and layers of hard green sand	3.65	56.08
Sand, green	5.79	61.87
Sand, green and sandrock	19.21	81.08
Sandrock	1.22	82.30
Sand, green and sandrock	36.57	118.87
Sand, green, clay and sandrock	5.64	124.51
Sand, green and sandrock	10.52	135.03

	Clay	0.61	135.64
	Sand, green and sandrock	7.46	143.10
	Atherfield Clay		
	Clay, light brown	2.29	145.39
	Clay, light grey, sandy	0.15	145.54
	Clay, light brown	2.73	148.29
	Clay, light blue, sandy	0.30	148.59
	Clay, blue	0.30	148.89
	Clay, blue, sandy	2.90	151.79

15. Bedales School near Petersfield [7428 2493]
Surface level +88.39m OD. Date 1902.

	Thickness (m)	Depth (m)
Folkestone Beds		
Sandy loam	1.83	1.83
Sand, yellow, some water	7.62	9.45
Sandgate Beds		
Marehill Clay		
Clay, black	1.83	11.28
Pulborough Sandrock		
Sand beds	29.87	41.15

16. Petersfield sewerage pipe Borehole 4 [7497 2272]
Surface level c.+57m OD. Date 1965.

	Thickness (m)	Depth (m)
Topsoil	0.30	0.30
River Terrace Deposits		
Sand, brown and white, medium- to coarse-grained	1.07	1.37
Gault		
Clay, yellowish grey, silty, soft to firm	1.07	2.44
Clay, grey stiff	0.05	2.59
Folkestone Beds		
Sand, yellowish brown, coarse- to medium-grained, with pockets of clay	1.06	3.66
Sand, light brown, medium- to coarse-grained	1.52	5.18

SU 72 SE 1. Rogate No.3 [7906 2396]
Surface level +c.57m OD. Date 1972

	Thickness (m)	Depth (m)
Head		
Topsoil	0.60	0.60
Sandy loam	0.60	1.21
Sandgate Beds		
Rogate Beds		
Sandstone, orange-brown, clayey	1.21	2.43
Ironstone, sandy	1.21	3.65

Sand, fine-grained, brownish yellow, loamy	2.43	6.09
Sand, fine-grained, reddish brown, loamy with quartz pebbles	1.52	7.62
Hythe Beds		
Sand, fine-grained, orange-yellow, ferruginous	4.57	12.19
Sand, fine-grained, yellow speckled	1.52	13.71
Sand, fine-grained, brownish yellow, ferruginous	0.91	14.63
Sandstone, hard grey, crystalline	0.60	15.24
Sandstone, hard, brownish buff, crystalline, speckled with glauconite	0.60	15.84
Sand, fine-grained, reddish brown, loamy	0.91	16.76
Sandstone-ironstone, hard, grey to brown, crystalline	1.52	18.28
Sand, soft, light brown, loamy with ironstone and shell fragments	1.52	19.81
Sand with sandstone fragments, fine-grained, brownish yellow, ferruginous	3.04	22.86
Ironstone	1.52	24.38
Sandstone, fine-grained, yellow-speckled	1.52	25.90
Sand, fine-grained, green, clayey	3.96	29.87
Sandstone, hard, fine-grained, orange-buff, iron-stained speckled with glauconite	3.65	33.52
Sand, fine-grained, buff, silty	1.52	35.05
Sandstone, hard, fine-grained, buff-speckled, cherty	3.04	38.10
Sand, fine-grained, buff, silty	1.52	39.62
Sandstone, hard, very fine-grained, white, cherty speckled with glauconite and occasional pyrite nodules	4.57	44.19
Sandstone, hard, fine-grained, orange-buff, speckled with glauconite	1.52	45.72
Ironstone	0.30	46.02
Sandstone, hard, fine-grained, white-buff	5.79	51.81
Ironstone	1.52	53.34
Sandstone, hard, fine-grained, white-buff speckled with glauconite	7.62	60.96
Sand, fine-grained, buff with glauconite grains	3.04	64.00
Sandstone, hard, fine-grained, buff speckled with glauconite	6.09	70.10
Sandstone, very fine-grained, grey	1.52	71.62
Mudstone with sandstone fragments, hard, grey, sandy	4.57	76.20
Sandstone, soft, very fine-grained, grey	3.04	79.24
Sandstone, soft, grey, silty with pyrites nodules and carbonised wood	1.52	80.77
Sand, very fine-grained, grey, silty, with glauconite grains and pyrites	1.52	82.29

Sand, fine-grained, silty with pyrites lignite and carbonised wood	1.52	83.82
Sand, very fine-grained, bluish grey, compact, silty	3.04	86.86
Sand, bluish grey clayey	4.57	91.44
Atherfield Clay		
Silt, bluish grey, sandy	3.04	94.48
Clay, sticky, grey, silty	1.52	96.01

2. Ryefield Farm, West Harting [7727 2235]
Surface level +60m OD. Date 1934.

	Thickness (m)	Depth (m)
Gault		
Clay, blue	10.97	10.97
Folkestone Beds		
Sand	9.15	20.12

5. Pay's Farm, South Harting [7887 2011]
Surface level +84.73m OD. Date 1941.

	Thickness (m)	Depth (m)
Upper Greensand		
Sandstone	6.10	6.10
Sandstone, hard	2.74	8.84
Sandstone in hard and soft layers	16.46	25.30
Gault		
Clay, dark, sandy	7.92	33.22
Clay	3.05	36.27

6. Cowhouse Farm, Buriton [7508 2029]
Surface level +91.44m OD. Date 1928.

	Thickness (m)	Depth (m)
Upper Greensand		
Sandstone rock	12.80	12.80
Clay, brown, sandy	8.54	21.34
Sandstone rock	3.61	24.99
Gault		
Clay, black	20.73	45.72

7. Ryefield No.4 [7761 2230]
Surface level +50m OD. Date 1978.

	Thickness (m)	Depth (m)
Gault		
Clay, yellow, weathered	2.0	2.0
Clay, olive-grey to bluish grey	8.0	10.0
Folkestone Beds		
Sand, yellowish grey, fine-grained	10.0	20.0
Sand, light brown, tinged pink, medium-grained	8.0	28.0

Sand, yellowish grey, medium-grained, some clayey silt bands, 10% course	12.0	40.0
Sandgate Beds		
Upper Marehill Clay		
Clay, silty, olive black	2.0	42.0
Clay, silty, with fine-grained sand, dusky green	2.0	44.0
Upper Pulborough Sandrock		
Silt/very fine-grained sand, olive-grey	6.0	50.0
As above, but with a higher sand content and some medium-grained sand; some olive-black clay between 52 and 54m	6.0	56.0
Lower Marehill Clay		
Silt, clayey, olive-grey	2.0	58.0
Clay, silty, olive-grey	4.0	62.0
Clay, olive-grey	2.0	64.0
Lower Pulborough Sandrock		
Sand, fine-grained, greyish olive, glauconitic with traces of olive-grey clay	8.0	72.0
Sand, medium-grained, yellowish grey	6.0	78.0
Sand, medium-grained, dusky yellow; fragments of olive-grey clay; less than 1% limonite grains	2.0	80.0
As above with 1% limonite grains up to 7mm long	2.0	82.0
As above, with 2% angular to well rounded limonitic grains	2.0	84.0
Rogate Beds		
Sand, medium-grained, dark yellowish brown with 30% well polished and well rounded limonite grains	6.0	90.0
Sand, clayey, fine-grained, light olive-grey; limonite grains less than 5%; some olive-grey clay	4.0	94.0
Sand, fine- to coarse-grained, poorly graded, olive-grey; 10% limonite grains; some olive-grey clay	2.0	96.0
Sand, fine- to medium-grained, poorly graded; limonite content less than 5%	2.0	98.0
Hythe Beds		
Sand, fine-grained, dusky yellowish green, 5% coarse-grained sand; less than 1% limonite grains	2.0	100.0
Sand, fine-grained, greyish olive-green	4.0	104.0
Sand, fine-grained, dusky yellowish green, glauconitic	16.0	120.0
Sand, fine-grained; several fragements up to 1cm of moderately cemented fine-grained glauconitic sandstone	16.0	136.0
Sand, medium-grained, some olive-black clay fragments	8.0	144.0

Sand, medium-grained, greyish olive, glauconitic, fragments of light bluish grey fine-grained sandstone	2.0	146.0
Sand, medium-grained, glauconitic greenish grey; fragments of olive-black clay	10.0	156.0
Sand, fine-grained, glauconitic clayey, olive-grey, almost 50% compact clay pellets	2.0	158.0
As above, but clay fragments c.25%: fragments of weakly cemented sandstone	4.0	162.0
As above, but clay fragments 10%, more sandstone fragments	2.0	164.0
As above, but clay fragments less than 10%	20.0	184.0
Sand, silty, fine-grained, glauconitic, greenish grey	8.0	192.0
Atherfield Clay		
Sand, silty very fine-grained with many fragments of yellowish grey clay	2.0	194.0

8. Rogate Pumping Station [7943 2409]
Surface level c.+72m OD Date 1945.

	Thickness (m)	Depth (m)
Topsoil		
Soil, brown	0.61	0.61
Soil and sand	1.98	2.59
Sandgate Beds		
Rogate Beds		
Sand, wet	0.76	3.35
Sandstone, loose	1.83	5.18
Clay, brown with sand and small 'flints'	0.15	5.33
Rock	2.59	7.92
Clay, stiff, brown	0.61	8.53
Conglomerate Rock	2.75	11.28
Sandstone, soft	0.61	11.89
Conglomerate Rock	2.89	14.78
Rock, hard	0.76	15.54
Sandstone	1.83	17.37
Conglomerate Rock	1.22	18.59
Hythe Beds		
Sandstone	3.66	22.25
Clay, blue	0.15	22.40
Stone, blue	0.16	22.56
Sandstone, hard	0.45	23.01
Clay, blue	0.15	23.16
Sandstone, soft	2.75	25.91
Sand (water came in)	1.83	27.74
Sandstone	0.45	28.19
Sandstone, hard and blue stone	0.77	28.96
Sand and clay, blue	0.30	29.26
Sandstone	3.43	32.69
Sandstone, hard and blue stone	0.84	33.53

Clay, blue	0.15	33.68
Sandstone, hard and blue stone	1.37	35.05
Sandstone	2.14	37.19
Clay, green and sand	0.07	37.26
Clay, red and brown and sand	0.23	37.49
Clay, blue	0.15	37.64
Sandstone, very fine-grained, hard	2.75	40.39
Sandstone, white, hard	0.76	41.15
Sandstone and small stones	0.61	41.76
Sandstone, fine-grained	3.96	45.72
Sand, coarse-grained, and stones	0.15	45.87
Sandstone, white, hard	6.56	52.43
Clay, green and sand	1.01	53.44

9. Rogate Pumping Station [7944 2411]
Surface level +75.59m OD. Date 1945.

	Thickness (m)	Depth (m)
Topsoil	1.83	1.83
Sandgate Beds		
Rogate Beds		
Clay, brown	0.91	2.74
Sandstone	4.88	7.62
Rock, brown, very hard	0.46	8.08
Sandstone	3.81	11.89
Sandstone, soft	0.30	12.19
Sandstone, hard	3.35	15.54
Sandstone, dark, very hard	1.22	16.76
Hythe Beds		
Sandstone, soft	1.07	17.83
Sandstone, very hard	1.07	18.90
Sandstone, soft	3.05	21.95
Sandstone, very hard	1.52	23.47
Clay, brown and sandstone	2.13	25.60
Sand, loose	1.83	27.43
Sandstone, very hard	1.83	29.26
Clay, blue and sandstone	0.61	29.87
Sandstone	3.05	32.92
Sandstone, very hard	2.44	35.36
Sandstone	1.67	37.03
Clay and sand	0.77	37.80
Sandstone, hard	3.04	40.84
Sandstone, white, very hard	4.28	45.11
Sandstone, very hard	0.91	46.02
Sandstone, white, hard	3.66	49.68
Sandstone, very hard	0.92	50.60
Sandstone, white, very hard	0.61	51.21
Sandstone and sand	0.91	52.12
Sand and clay	0.92	53.04
Black sand	0.30	53.34

11a. Petersfield Waterworks [7529 2480]
Surface level +70.40m OD. Date 1886.

	Thickness (m)	Depth (m)
Sandgate Beds		
Rogate Beds		
Loam	3.05	3.05
Gravel with dark grains	2.74	5.79
Gravel with streaks of ironstone	5.64	11.43
Hythe Beds		
Sandrock, hard	5.94	17.37
Sandrock, hard with blue boulders full of shells	4.73	22.10
Sand, light brown	3.88	25.98
Greensand	3.36	29.34

11b. Petersfield Waterworks [7529 2480]
Surface level +70.40m. Date 1933.

	Thickness (m)	Depth (m)
Made Ground	0.91	0.91
Sandgate Beds		
Rogate Beds		
Clay, brown, loamy	1.53	2.44
Clay, sandy	0.76	3.20
Gravel	0.46	3.66
Hythe Beds		
Sand, hard	10.36	14.02
Sandstone, mild	11.28	25.30
Sandstone, greenish	5.03	30.33
Clay, sandy, hard	13.56	43.89
Sand, hard	4.50	48.39
Sand, very hard	0.38	48.77
Sand, grey, hard	37.49	86.26
Sand, green, hard	0.61	86.87
Atherfield Clay		
Clay, sandy and sand towards base	22.71	109.58
Clay, blue, stiff	1.88	111.46