Natural Environment Research Council

BRITISH GEOLOGICAL SURVEY

Geological Survey of England and Wales

SP 81 NW
BIERTON

Part of 1:50 000 Sheets 219 (Buckingham)
202 (Leighton Buzzard), 237 (Thame)
and 238 (Aylesbury)

A J M Barron

TECHNICAL REPORT WA/88/42

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 KEYWORTH BRITISH GEOLOGICAL SURVEY

INTRODUCTION

This report covers the area of 1:10 000 Geological sheet SP 81 NW, immediately north of Aylesbury in Buckinghamshire. The ground was originally surveyed at the 1:10 560 scale by A C G Cameron and A J Jukes-Browne in 1896 and 1897. The area south of grid line 16 and east of 818 (County Series 1:10 560 sheets Bucks 28 SE/E and Bucks 29 SW) was revised by C Reid in 1910. The area was also surveyed at the 1:25 000 scale by C R Bristow as part of a PhD thesis (Bristow, 1963). The present survey was carried out by A J M Barron in 1988. Palaeontological determinations of material from the Jurassic were made by B M Cox.

The River Thame and a parallel un-named tributary, called here the Hardwick stream, run from north-east to south-west across the area and their valleys divide it into three parts: in the north-west the ground rises from the village of Hardwick and the Hardwick stream towards Whitchurch which is on the adjacent map to the north (SP 82 SW). In the central part the village of Weedon stands on the western end of a ridge rising to 120 m (the Weedon ridge of this report) and part of the village of Aston Abbotts is on high ground rising to 135 m in the extreme north-east. The hamlet of Rowsham is immediately north of the Thame in the extreme east of the area. The large village of Bierton stands on a plateau in the south-east part of the area astride the A418 Aylesbury to Leighton Buzzard road. In the extreme south are the northern outskirts of Aylesbury.

Parallel reports covering adjacent areas are:

SP 82 SW Whitchurch (R J Wyatt)
SP 71 NE Fleet Marston (M G Sumbler)
SP 81 NE Wingrave
SP 81 SW Aylesbury

GEOLOGICAL SEQUENCE

		Landslip
DRIFT	QUATERNARY	Colluvial deposits (Hillwash)
		Alluvium
		River terrace deposits
		Glaciofluvial Sand and Gravel
		Glacial Sand and Gravel
		Till
SOLID	CRETACEOUS	Gault
	JURASSIC	Whitchurch Sand Formation
		Purbeck Formation
		Portland Formation
		including: Portland Stone Member
		Portland Sand Member
		Kimmeridge Clay Formation
		Ampthill Clay Formation

SOLID FORMATIONS

JURASSIC

Ampthill Clay Formation

The Ampthill Clay Formation crops out in the bottom of a shallow valley in the extreme west. It consists of about 15m of mid to dark grey mudstone with thin marl and siltstone beds, fossiliferous throughout, but only the uppermost 4m of the Formation crop out in this area.

The Formation gives rise to a heavy grey-brown clay soil with scarce oysters, including *Deltoideum delta,* fragments of which were found 200m south of the pumping station [8006 1965].

A borehole near Datchet House (Appendix 1, SP 81 NW/4) proves 4.00m of greenish grey and brown mottled silty clay with shell fragments. The surface level of this borehole is not consistent with the site given by the grid reference; the site may be further west in which case the lower beds proved will include the Ampthill Clay.

The outcrop of the Ampthill Clay in the extreme north-west, indicating an apparent reduced total thickness of the Kimmeridge Clay is anomalous, and may result from valley bulging (see Superficial Structures).

Kimmeridge Clay Formation

The Kimmeridge Clay Formation crops of over the greater part (about 19km^2) of the present area. It consists of between 21 and 35m of mid to dark grey mudstone, silty in parts, with several thin impersistent limestone beds (cementstones) mainly in the lower part. These consist of mid grey, very hard, argillaceous, fine-grained limestone, with calcite veins in places, forming beds no more than 0.2m thick and some may be nodular indicating a diagenetic origin. To the south-west in the district around Thame, the Kimmeridge Clay includes fine-grained sand beds in its upper part (see for example Barron, 1988), but in this area the only sand beds seen (north of Groveway Farm [8244 1866] and north-west of Lower Burston Farm [8335 1957] consist of less than

1m of grey finely sandy clay and are of very limited extent. It is thought that the beds equivalent to the uppermost 7m of the Kimmeridge Clay in the BGS Hartwell Borehole (Gallois and Cox, in prep.) and the uppermost 9m of the Formation in the BGS Brill Borehole (Barron, 1988, Cox, in prep.) which comprise the upper part of the Hartwell Clay of Hudleston (1880) and the whole of the "Wheatley Sands" (in Brill) of Arkell (1947) are absent in this area being cut out by the unconformity at the base of the Portland Beds (B M Cox, pers. comm.).

The two cementstone beds shown on the map have been identified by their fauna and lithology from specimens (see Appendix 3). The lower one is Bed (KC) 30 of Gallois and Cox (1976), the upper one comprises the lower doggers of Oates (in prep.) which is in the process of being related to the standard sequence of Gallois and Cox (1979).

The Kimmeridge Clay gives rise to a heavy grey-brown silty clay soil. At shallow depth (0.5m) it is usually grey, mottled with orange which assists in distinguishing it from the Gault.

There are no permanent exposures within the Kimmeridge Clay but it is regularly exposed in temporary sections. Where a gas pipeline trench crossed a brook south-west of Aston Abbotts (Appendix 2, Locality A) bluish grey clay and mudstone were seen and in a recently dug channel intended to divert the River Thame at Watermead (Locality B), over 0.6m of grey clay and blue grey mudstone were observed.

The strata exposed in the excavation of the artificial lake at Watermead [822 157] were measured and collected by M J Oates in 1987 (see Figure 1, pers. comm.) and he records over 15m of Lower and Upper Kimmeridge Clay which are currently being correlated with the Hartwell Borehole. A largely intact Plesiosaur skeleton was collected and is being prepared for display in the Aylesbury Museum.

The Formation was proved in many of the boreholes in the area (Appendix 1) and is generally described as grey clay, sometimes silty or containing shells, limestone beds and selenite within 10m of the surface.

Portland Formation

The main outcrop of the Portland Formation is around Bierton, comprises a broad tabular outlier covering about 1 km^2, and is the only outcrop in which sub-division of the Formation has been possible. To the south-east at Burcott [842 151] there is an outcrop of the Formation sandwiched between the Kimmeridge Clay and Gault, and at the eastern end of Bierton is a long narrow outcrop preserved in a shallow syncline; the East Bierton Syncline of Bristow (1963). The Formation also crops out on the upper slopes of the Weedon ridge and around Hardwick Hill Farm [812 199] on the slopes of the hill rising to Whitchurch.

The sequence at the surface in the area around Bierton is as follows:

Pale grey and cream fine-grained limestone, shelly in places	up to 3m	)	Portland
Brown fine to medium-grained sand	0 to 0.5m	)	Stone
Pale grey shelly sandy oolitic limestone	4 to 5m	)	Member
Orange brown sandy glauconitic calcareous silt with small black rounded pebbles	0.3-2m	)	Portland Sand Member

The uppermost unit is equivalent to the Creamy Limestones of Blake (1880) or Upper Limestone of Bristow (1963) and crops out only around Great Lane [834 155]. The sand bed below is probably equivalent to the Crendon Sands of Buckman (1925-27). Its mapped outcrop is restricted to the ground north-west of Church Farm where sand was augered and it was traced 600m to the north-west along a concave geomorphological feature which is associated with a sandy soil.

The shelly sandy oolitic limestone unit underlying the sand has the broadest outcrop around Bierton and is probably equivalent to the Aylesbury Limestone of Woodward (1895) or Rubbly Limestone of Blake (1880). It contains numerous fossils including large ammonites and bivalves (see Appendix 3, specimens AMB 460-463).

In the Bierton area this unit is exposed in a disused quarry at Dunsham Farm (Appendix 2, Locality F) and was seen in temporary exposures at Church Farm (Locality G) and in Burcott (Locality H).

The lowest unit of the Portland Formation in the Bierton area is the Portland Sand Member and comprises orange brown calcareous silt, sandy over much of the area, glauconitic and incorporating the shiny black phosphate and chert "lydite" pebbles. It is thought to be weakly cemented in places and to be equivalent to Bristow's "Lower Portland Sand" (1963). Sherlock gives an account of Ward and Cannon's brick pit [839 157] (1922, p.7)

			m
	Soil	2'0"	0.61
3.	Bluish grey limestone with sporadic lydite pebbles, upper part weathering brownish white	4'6"	0.45
2.	Soft ochreous limestone with numerous large lydite pebbles. Near the base is a layer of bluish grey sandy limestone nodules with ammonites	1'0"	0.30
1.	Kimmeridge Clay (Hartwell Clay) seen to	3'0"	0.91

Bristow (1963, p.52) interprets this description as indicating contemporaneous erosion at the base of bed 2 and the loss of the "Lower Portland Sand". However, as bed 2 can be traced throughout the area this is not thought to be the case but that it is the weakly-cemented representative of the Portland Sand. The Portland Sand Member was also seen in temporary exposures at Church Farm (Locality G) and Burcott (Locality H).

The Portland Formation preserved in the East Bierton Syncline [843 163] includes light brown fine-grained sand, orange brown glauconitic silt and pale grey pelletal limestone. The Formation is not exposed

in this area but all these lithologies were encountered by augering and were seen in burrows. Jukes-Browne (in Sherlock, 1922, p.7) recorded "4 feet of hard oolitic limestone" in a pond at the cross-roads [8454 1589]. Limestone was reported at 0.75m in house foundations at Corner Farm [8458 1583]. Bristow (1963, p.56) described the following section "alongside the new road [846 160]":

"4.	Sandy glauconitic basal Gault	2'0"	(0.61m)
3.	Sandy Rubbly Limestone	2'0"	(0.61m)
2.	Basal sand with lydites at base	3'0"	(0.91m)
1.	Hartwell Clay	2'0" +	(0.61m)

The Rubbly Limestone containing: *Protocardia dissimile* (J de C Sowerby), *Pecten lamellosus* (J Sowerby), *Ostrea* sp. and *Serpula* sp."

A trace of limestone was seen in an auger hole on the base of the Gault outlier north of Bierton [8402 1700] but no Portland outcrop could be traced around this knoll.

Away from Bierton, undivided Portland Formation has been mapped on the Weedon ridge; overlain by Gault east of the Weedon Fault and cut out by the unconformity at the base of the Gault at the eastern end of the ridge [826 183] (see also Structure). The beds consist of khaki and orange-brown very fine-grained sandy silty glauconitic clay overlain by buff and pale grey fine-grained sandy shelly limestone. These lithologies were seen in the soil, in auger samples and were seen in spoil from trenches at Weedon Lodge [8200 1805] (Locality D) and Weedon Lodge Farm [8186 1795] (Locality E). At Groveway Farm, mustard-coloured loose fine to medium-grained sand contained soft sandy limestone debris and a large ammonite fragment was seen dug from a fox earth [8238 1825] and about 1.0m of limestone is exposed in a ditch 180m to the west [8219 1827] (Locality C and Appendix 3, specimen AMB 459). Khaki and orange brown very silty clay with sand grade glauconite and a little buff glauconitic limestone debris was seen in a burrow near Chestnuts Farm [8167 1805]. There are several pits in the Formation but it is exposed in none of them. Around Lilies [8112 1843] limestone was seen in the soil in several places.

Pale grey sandy glauconitic limestone and orange-brown glauconitic sand were seen in the soil on the outcrop of the Formation around Hardwick Hill Farm [812 199]. Pale yellow-brown glauconitic fine-grained sand was dug in rabbit burrows 100m east of the farm [8132 1995]. Both this outcrop and those around Weedon may have been affected by cambering lowering the ends of spurs (see Superficial Structures).

Purbeck Formation

The Purbeck Formation crops out only in the fault block north-west of Dunsham Farm [8260 1606 to 8299 1540] where it underlies the Whitchurch Sand Formation. It consists of about 2m of pale silty clay, cream marl and off-white, fine-grained shelly limestone containing minute freshwater gastropods.

Whitchurch Sand Formation

The Whitchurch Sand Formation crops out in the faulted block west of Bierton [827 159 to 833 150], overlying the Purbeck Formation, and also north-east of Hardwick Hill Farm [8133 1999], overlying the Portland, where it forms part of the outcrop around Whitchurch.

The name Whitchurch Sands was proposed by Casey and Bristow (1964) for deposits of ferruginous sand recorded between the Portland or Lower Purbeck and the Lower Greensand or Gault in the South Midlands. In this district they were previously called Shotover Sands (Blake, 1893) or Shotover Iron Sands (Davies, 1899, p.40). Now known as the Whitchurch Sand Formation, the problem of its age is not yet resolved (see Barron, 1988) and for present purposes it is attributed to the Portlandian Stage and the Jurassic.

In the present area the Formation is comprised of up to about 4m of interbedded pale grey smooth clay and pale grey and orange-brown medium-grained sand with subordinate orange-brown ironstone beds. The outcrop in Bierton was almost certainly down-faulted prior to the deposition of the Gault (see Structure). On Cameron's 1897 fieldslip he notes "sand pit" in two places near Dunsham Farm [8310 1522 and

8327 1506] and Reid recorded the following at the north-western pit: "ferruginous loamy moulding sand and thin bed ironstone with ool (?) grains" which he nevertheless included in the Portland outcrop.

CRETACEOUS

Gault

The Gault crops out on the high ground in the north-east of the area, on the top of the Weedon ridge, as an outlier [842 170] between Bierton and Rowsham and in the south-east where the tract comprises part of the main outcrop of Gault north of the Chiltern Hills.

The Gault consists of up to about 33m of dark grey silty mudstone in this area, with thin glauconitic sandy horizons and phosphatised nodules and fossils. It weathers to very pale grey, (Appendix 2, Locality L) and at the surface it gives rise to a very heavy grey brown silty clay soil with black and grey phosphatised fragments, which distinguish it from the Kimmeridge Clay.

There is a substantial unconformity beneath the Gault in this area. In the north-east it rests directly on the Kimmeridge Clay, the Portland, Purbeck and Whitchurch Sand being absent. The junction has been placed with the aid of fossil evidence. At the eastern end of the Weedon ridge the Portland Formation is absent beneath the unconformity and around Bierton the junction is notably angular; as much as 10m of beds being cut out over less than 1km (see Structure).

A large number of phosphatised fossils were collected from the Gault outcrop, mainly ammonite fragments, but at the time of writing these were yet to be identified.

DRIFT
QUATERNARY

Till (Boulder Clay)

Deposits of till or boulder clay cap the Gault outcrop in the north-east. The largest deposit around and to the west of Aston Abbotts [83 19 and 84 19] is up to 12m thick and is overlain by Glacial Sand and Gravel. Two smaller deposits cap hills near Fox Covert [848 195] and 1km north of Rowsham [849 190]. The deposits consist of grey and brown stony clay, sandy in parts, especially in the upper part, the stones consisting of flints, sandstone and quartz pebbles and a little chalk. The base stands at between 120 and 131m OD.

A deposit of orange brown flinty silty clay occurs 500m east of Hardwick Hill Farm [8172 1999] on the edge of the area. This is also thought to be Till.

A borehole 900m west of The Abbey (Appendix 1, SP 81 NW/18) penetrated 10.6m of till consisting of blue grey silty clay with stones at the base, beneath Glacial Sand and Gravel.

The deposits may have been affected slightly by cambering (see Superficial Structures).

Glacial Sand and Gravel

Deposits of Glacial Sand and Gravel cap the hill in the extreme north-east around Aston Abbotts. They consist of up to 10m of pale orange to light brown medium-grained silty sand with brown flint gravel and brown sandstone ("Bunter") pebbles in places. The base stands at between 127 and 133m OD. A borehole (Appendix 1, SP 81 NW/18) a kilometre west of Aston Abbotts proved 1.5m of brown clay (? made ground) on 3.1m of silty sand. The sand and gravel overlies till, the upper part of which is fairly sandy, but the junction is marked in many places by springs or seepages (see Water Supply). The base is slightly uneven, this could be due to minor cambering of the

outer ends of spurs (see Superficial Structures) but is more likely the result of channelling.

Glaciofluvial Sand and Gravel

Deposits of brown stony sandy clay capping hills and spurs in the western part of the area are described as Glaciofluvial Sand and Gravel. They are distinguished from the Glacial Sand and Gravel overlying Till around Aston Abbotts by their lower elevation (maximum 97m, minimum 82m), by their poorly-sorted nature and by their resemblance to a system of high-level river terrace deposits collectively inclined towards the south-west. Their coarseness and elevation distinguishes them from the recent river terrace deposits. The deposits consist of brown and grey brown sandy to very sandy clay with varying amounts of flints, quartz and sandstone pebbles, ironstone fragments and limestone gravel. They are at their thickest, stoniest and sandiest immediately west of the A413 near Uppings Farm [807 178] where they are thought to reach 2m in places. The deposits feather off at the edges, notably south of Uppings Farm [802 172] where the boundary is very approximate. Over much of the outcrop of the deposits grey clay can be seen in the soil. This is thought to have been brought to the surface at least partly by cryoturbation.

Around Uppings Farm [804 179] and south-west of Weedon Hill [809 158] the deposit stands at at least two levels. This indicates at least two periods of deposition separated by spells of downcutting. The material is thought to have been deposited by high-energy braided meltwater streams.

River Terrace Deposits

Spreads of brown silty clay, generally sandy and stony, flank the alluvial tracts of the River Thame and Hardwick stream. They comprise deposits with flat terrace-like tops generally sloping towards the river and downstream. The terraces stand at two distinct levels; a lower level (distinguished provisionally here as First Terrace) between just above and 3m above the floodplain and a higher level (provisionally Second Terrace) between 3 and 8m above the floodplain

in the Thame valley, and between 2 and 4m above in the Hardwick valley. There appears to be no clear lithological distinction between the deposits of the different terraces; the proportions of sand and gravel are quite variable throughout as is the grade of the clasts, and the lithologies and relative abundances of the stones are generally similar to that seen in a section at Watermead (Appendix 2, Locality B) with flints being most common, followed by sandstone and quartz pebbles, and rarer ironstone and limestone debris.

The river terrace deposits were penetrated in several boreholes in the area (Appendix 1), mainly around the north side of Aylesbury (SP 81 NW/7, 11, 12, 15, 36, 42, 44, 45, 49 and 51) in which they are described variously as silty clay, stony sandy clay, gravelly sand and gravel. In boreholes for the A413 improvement scheme (SP 81 NW/19 and 23) and the Lakeside village development (SP 81 NW/67 and 83) the First Terrace deposits were proved.

Alluvium

The River Thame, the Hardwick stream and most of their tributaries are flanked by alluvial tracts composed of grey-brown silty clay with sand and gravel lenses and lag deposits. The floodplain of the Thame is generally between 100 and 200m wide but at the western margin [800 159] broadens to 800m. That of the Hardwick stream is generally about 50m wide, broader in places.

There is a large spread of alluvium east of Grendon Hill Farm [830 167] consisting of about a metre of sandy clay on sand which is linked to the Thame floodplain but has probably been formed by winter flooding.

Alluvial deposits are exposed in only one place: about a metre of sandy clay and sand with gravel was seen in a new cut at Watermead (Appendix 2, Locality K).

A number of boreholes penetrate alluvial deposits (Appendix 1, SP 81 NW/2, 37, 38, 39, 52, 53, 55, 56, 58, 62, 63, 65, 73, 76, 79, 84, and

90-94) proving it to be around 2m thick in the Hardwick valley and up to 3.3m in the Thame valley.

Colluvial Deposits (Hillwash)

Deposits of brown sandy silty clay, stony in places, plaster the sides and lie in the bottoms of many of the valleys in the area. They are shown as colluvial deposits; possible evidence was seen of solifluction in one borehole (see below) but it is possible that many of the deposits may be in part periglacial and therefore *bona fide* head. The deposits consist of material derived from formations and drift deposits upslope from their present position. Thus in the valley near Lower Burston Farm [843 185] the colluvial material consists of sandy stony clay derived mainly from the Gault, Till and Glacial Sand and Gravel.

Around the Watermead site [82 16] the deposits are very sandy clay - derived from the Portland Formation and Kimmeridge Clay. In the bottoms of valleys the deposits may reach 2m in thickness but elsewhere are probably no more than 1m thick, although around the Watermead site several boreholes and trial pits (Appendix 1, SP 81 NW/72, 74, 78, 81, 86, 98, 101, 102, 104, 109 and 110) penetrate colluvial deposits showing them to be up to 1.7m thick here. One pit (SP 81 NW/102) apparently shows a gravel pocket within weathered Kimmeridge Clay which suggests that cryoturbation may have taken place, indicating a periglacial environment.

STRUCTURE

The regional dip in this area is less than half a degree to the SSE, and this is only slightly modified in places by faulting, folding and superficial structures (see below).

The only folding visible in the outcrop pattern is the shallow syncline north-east of Bierton (the East Bierton Syncline of Bristow, 1963) which has preserved Portland Formation in a NNW-SSE trending structure formed prior to the deposition of the Gault. The early Cretaceous earth movements also produced gentle anticlines on either

side with similar trends. Subsequent erosion truncated the anticlines, being responsible for the absence of the Portland Formation south-west of Corner Farm [844 156] and, if the anticline is projected NNW, to the east of Groveway Farm [826 183], its eastern equivalent being responsible for their absence north-east of Grove Farm [847 162] and beneath the Gault in the knoll [842 170] west of Cane End Farm. Dips on the limbs of these folds are thought to be less than one degree.

The main trend of the faulting is also NNW-SSE and has been detected mainly within the Portland Formation outcrops. Faulting is believed to both pre-date and post-date the deposition of the Gault; the system of faults around Dunsham Farm [830 153] has preserved a block of the Purbeck and Whitchurch Sand formations, not seen beneath the Gault anywhere else around Bierton, but the faults in east Bierton and Weedon affect the Gault outcrop and therefore must post-date it.

The main Weedon Fault, running from near Lilies Farm [8110 1863] to south of Chestnuts Farm [8163 1770] throws down to the east along its middle section but subsidiary faults, thought to belong to a later period of faulting, have caused the sense of throw to be reversed along the northern part near Lilies Farm and the southern part [8150 1792] east of Stockaway.

SUPERFICIAL STRUCTURES

Cambering is thought to have affected the outer ends of spurs capped by both the Portland Formation and the hilltop glacial drift. The process involves softer beds, such as clay, being squeezed out or washed out from beneath harder or permeable strata and the gradual lowering of the overlying strata (see Hollingworth, Taylor and Kellaway, 1944 and Horswill and Horton, 1976). This is thought to have profoundly affected the Kimmeridge Clay and Portland Formations around Manor Farm, Weedon [814 184] and Hardwick Hill Farm [812 199] and the Sand and Gravel and Till south of The Abbey, Aston Abbotts [845 196] to only a minor degree may have been much more profoundly affected.

Clay strata at the bottom of valleys may be affected by a process known as valley bulging in which they are squeezed upward above their original level. This may have taken place north-west of Hardwick [801 198] and in the Hardwick valley [825 199] affecting the Ampthill and Kimmeridge Clay formations.

LANDSLIP

Minor slips have occurred on the steep slopes of Gault in the valley by Fox Covert [845 195 and 846 194]. The drift deposits overlying the Gault in this area are sufficiently durable to allow the development of steep slopes in the clay formations and the included sandy beds conduct water to spring and seepage lines (see Water Supply) providing lubrication to shear planes within the underlying clay. The mapped landslips are not extensive but any part of the steeper slopes around Aston Abbotts may be susceptible to slippage. An analogous situation occurs around the Weedon ridge and north-east of Hardwick where the Portland beds are both durable and permeable. Landslips within the outcrop of the underlying Kimmeridge Clay were not detected but may have taken place and have been blended back into the slope by human activity. The steeper parts of these slopes may also be still susceptible.

MADE GROUND (AND LANDSCAPED GROUND)

There are several minor areas of made ground or fill in this area; some constructed as dams for ponds or sludge tanks for instance near Aston Abbotts [8396 1995, 8442 1944] near Lower Burston Farm [8425 1875] and near Dunsham Lane [8276 1509]; some are spoil from or within pits or quarries, for instance near Burston Hill Farm [8331 1844 and 8366 1879] and at Dunsham Farm [8311 1523].

There is a small area of made ground near Dunsham Lane [8240 1519] at the site of demolished farm buildings, and a length of abandoned railway embankment about 0.5m high in the extreme south-east [8490 1505]. Considerable earthworks exist at the abandoned village sites at Lower Burston Farm [841 188] and south-west of Weedon Hill [806 157] together with Civil War earthworks at the latter location.

The major deposits of made ground are much more recent; areas of landfill, presumably mainly domestic refuse deposited on the floodplain, fringe the northern outskirts of Aylesbury [800 153 to 822 152]. Some of these have been filled up level with the river terrace and are now built over and the southern boundary is difficult to place precisely, notably around Beresford Avenue [8139 1513].

At a site east of the A413 road, just north of the Aylesbury outskirts and now called Watermead [821 155] a combined residential and recreation development was under construction at the time of survey (1988). Considerable landscaping had already taken place including the excavation of an extensive artificial lake. Spoil from this operation (Kimmeridge Clay and drift deposits) had been utilised to raise ground level in several places but principally to construct a substantial 20m high conical mound. The River Thame has also been diverted around the north and west sides of the mound.

ECONOMIC GEOLOGY

Most of the formations and deposits in this area have been dug for materials at one time or another although there are no major extraction sites now in use.

There are a few minor pits in the Kimmeridge Clay outcrop, and the largest pit in the area is Ward and Cannon's brick pit in Bierton [839 158] (see Sherlock 1922, p.7) which was dug through the Portland Formation to extract Kimmeridge Clay for brickmaking. On a field slip, Reid noted in 1910 "lydite bed 2' (0.6m), dark blue very sandy clay 8' (2.4m) (dug to 25' (7.6m))" at this site.

The Portland Formation outcrops are pockmarked with pits particularly around Dunsham Farm [830 153], Barnett House [837 158] along Rowsham Road [843 162] and around Weedon [81 18]. The Portland Stone has been used as a rough building stone and the sand beds for various purposes. However, the softer fine-grained limestones were used in the past as a vernacular construction material known as "witchett", involving burning the stone and mixing it with water as a poor-quality mortar.

Material for witchett was probably also dug from the Purbeck in pits north-west of Dunsham Farm [8294 1550].

The Whitchurch Sand was dug around Dunsham Farm [8273 1586, 8310 1522 and 8327 1506] for sand. Reid notes its use as moulding sand on his 1910 field slip, Bristow (1963, p.53) reports its use as building sand for Aylesbury Prison - they both record it as being from the Portland.

There are several small pits on the Gault outcrop notably around Burston Hill [834 185] and north of Rowsham from which clay may have been taken for brickmaking or phosphatic material for "coprolite" fertilizer.

There are many disused pits in the Glacial Sand and Gravel and Till around Aston Abbotts from which sand and gravel were extracted for construction uses.

There are a couple of pits in the glaciofluvial sand and gravel deposits at Uppings Farm [8036 1811] and north-west of Rectory Farm [8019 1861] from which gravel would have been extracted.

No evidence has been found for exploitation of the river terrace deposits or the alluvium. In the neighbourhood of Aylesbury, no doubt any pits would have been backfilled with refuse and be indistinguishable.

WATER SUPPLY

The main water bearing strata in this area are the Portland Formation and the sandy drift deposits. However, a well at Grendon Hill Farm [8271 1676] was noted on an old map as containing water at 15 feet (4.6m) "large ironstones 1' - 1'6" at base in ... Kimmeridge Clay giving irony water". This is probably Bed KC 30 of Gallois and Cox (1976). Another well was seen in the Kimmeridge Clay outcrop 500m west of Rowsham [8442 1788].

Seepages were seen in several places around the Portland Formation outcrop, notably 450m east of Hardwick Hill Farm [8168 1999] and near

Groveway Farm [8251 1829]. Wells were seen in several places on the Portland outcrop and immediately below the base. A well at Barnett House [8370 1582] was found to be 5.3m deep with a water level 2.5m below ground level (May 1988). The water was 1.0m below ground level in a well in Burcott [8420 1512]. The Uptown Well and pond [8359 1521] by the church in Bierton are just below the base of the Portland Formation and are presumably supplied by spring or pipe. A well at Hardwick Hill Farm [8124 1992] is about 5m below the Portland base but the water stood at ground level and is thought to be piped in.

The edge of the glacial sand and gravel deposit around Aston Abbotts is marked by a very strong spring line, at the top, the Till is quite sandy so the issues may not be precisely at the base of the sand and gravel. A spring, reported to be perpetual, was seen west of The Lines [8402 1965] and a strong seepage line 250m to the east [8428 1962] fed a small brick reservoir [8423 1953].

The surface drainage on the clay formations feeds many ponds, some natural, others formed or enlarged by man-made banks (see Made Ground).

APPENDIX 1

BOREHOLES AND TRIAL PITS

Abbreviations:

AmC	Ampthill Clay Formation	c	circa (approximately)
G	Gault	KC	Kimmeridge Clay Formation
OD	Ordnance Datum	Pl	Portland Formation
PlS	Portland Sand Member	PlSt	Portland Stone Member
RTD	River Terrace Deposits	S.L.	Surface level

		Depth m
2. Gas pipeline borehole 25		
	[824 195] S.L. + c 86m OD	
	Topsoil	to 0.20
Alluvium	Clay, brown, silty, stiff, with rootlets	to 0.55
	Clay, brown and grey mottled, very sandy, silty, very stiff with fine to coarse flint gravel	to 1.50
	Sand, brown, fine to medium-grained, very clayey, silty, loose with some gravel	to 2.00
KC	Clay, dark grey, silty, laminated, firm to stiff, numerous shell fragments	to TD at 3.50
4. Gas pipeline borehole 27		
	[804 197] S.L. + 97.75m OD	
	Topsoil	to 0.35
KC/AmC	Clay, pale greenish grey and light brown mottled, silty, laminated, with streaky calcareous patches (decomposed fossils)	to 2.00
	Clay, greenish grey and brown mottled, silty, blocky structure, with bands of fossil fragments and clusters of gypsum	to TD at 4.00

Depth m

7. Quarrendon housing borehole C4

[8003 1518] S.L. + 72.38m OD

	Topsoil	to 0.4
RTD	Clay, brown and grey, silty with occasional fine gravel	to 1.75
KC	Clay, grey, silty, stone bed from 2.60 to 2.90, shell fragments from 3.00, laminated from 4.00	to TD at 10.00

11. Quarrendon housing borehole G3

[8006 1533] S.L. + 71.40m OD

RTD	Clay, brown, silty, sandy with fine to medium-grained gravel, grey-brown at base	to 2.20
KC	Clay, grey, silty with shell fragments, laminated from 8.5	to TD at 10.00

12. Quarrendon housing borehole G5

[8002 1530] S.L. + c72m OD

	Fill	to 2.9
RTD	Drift	to 3.6
	Kimmeridge Clay	to TD at 8

15. Quarrendon sports pavilion borehole 2

[8080 1519] S.L. + c76m OD

	Fill	to 2.1
	River Terrace Deposits	to 3.4
KC	Clay, black, silty with abundant shells	to TD at 7.0

		Depth m
18.	**[8362 1998] S.L. + 134.2m OD**	
	Topsoil	to 0.3
?Made Ground	Clay, brown, firm	to 1.5
Glacial Sand and Gravel	Sand, fine to medium-grained, silty, compact	to 4.6
Till	Clay, blue-grey, silty, stiff, laminated in places, very hard at 14.3, stony below	to 15.2
G	Clay, blue-grey, silty, very hard, laminated in places with occasional sand and shells	to TD at 30.4
19.	**A413 improvement borehole 1**	
	[8171 1565] S.L. + 74.05m OD	
	Topsoil	to 0.62
RTD	Sand, clayey, gravelly	to TD at 1.23
23.	**A413 improvement borehole 5**	
	[8160 1604] S.L. + 74.43m OD	
	Topsoil	to 0.23
RTD	Clay, dark brown, slightly sandy	to 0.77
	Clay, light brown, sandy, chalky	to TD at 1.54
26.	**A413 improvement borehole 8**	
	[8156 1623] S.L. +75.23m OD	
	Topsoil	to 0.16
Hillwash	Clay, grey, stiff, chalky with flints	to 0.84
KC	Clay, grey, firm	to TD at 1.23

Appendix 1 cont.

		Depth m
29.	**A413 improvement borehole 11**	
	[8148 1636] S.L. +84.5m OD	
	Made Ground	to 0.31
Drift	Clay, sandy	to 0.39
KC	Clay, grey mottled	to TD at 3.04
31.	**A413 improvement borehole 13**	
	[8143 1645] S.L. + c84.5m OD	
	Made Ground	to 0.31
KC	Clay, brown, mottled	to 0.99
	Clay, grey, mottled	to TD at 3.04
34.	**A413 improvement borehole 16**	
	[8130 1672] S.L. + c81.1m OD	
	Made Ground	to 1.13
KC	Clay, grey, stiff, chalky	to TD at 1.54
36.	**Haydon Hill Farm Estate borehole 3**	
	[8019 1524] S.L. + 73.06m OD	
	Topsoil	to 0.61
RTD	Clay, yellow-brown, silty	to 1.21
	Clay, yellow-blue, silty	to 1.98
	Clay, blue-grey, silty	to 2.43
KC	Clay, dark grey to black, with shells	to TD at 10.05

		Depth m
37.	**Haydon Hill Farm Estate borehole 4**	
	[8076 1531] S.L. + 75.13m OD	
	Made Ground and topsoil	to 3.35
Alluvium	Clay, grey-brown	to 4.57
KC	Clay, brown-grey, silty with shells	to 7.92
	Clay, grey to black, silty, laminated with shells	to TD at 10.05
38.	**Haydon Hill Farm Estate borehole 5**	
	[8110 1529] S.L. + 72.82m OD	
	Topsoil	to 0.45
Alluvium	Clay, mottled, sandy, stony	to 1.37
KC	Clay, blue-grey, silty	to 2.74
	Clay, dark grey, silty	to 3.65
	Clay; very dark grey, silty with shells	to 9.14
	Clay, dark grey, silty with shells	to TD at 10.05
39.	**Haydon Hill Farm Estate borehole 6**	
	[8156 1516] S.L. + 72.39m OD	
	Topsoil	to 0.76
Alluvium	Clay, brown and grey mottled, sandy	to 2.59
	Sand and gravel	to 3.04
KC	Clay, blue-grey, silty	to 4.26
	Clay, dark grey, silty with shells	to TD at 10.05

		Depth m
42.	**Haydon Hill Farm Estate trial pit 3**	
	[8018 1513] S.L. + 74.51m OD	
	Made Ground and topsoil	to 0.60
RTD	Clay, yellow and brown mottled, stony	to 1.50
	Sand and gravel, grey, clayey	to 1.80
KC	Clay, blue grey, silty	to TD at 2.20
44.	**Haydon Hill Farm Estate trial pit 12**	
	[8042 1521] S.L. + 73.00m OD	
	Topsoil, stony, stiff	to 0.60
RTD	Clay, brown, stiff	to 1.07
	Clay, brown and grey, stony, stiff	to 1.83
KC	Clay, light grey and blue, silty, soft to firm	to TD at 2.45
45.	**Haydon Hill Farm Estate trial pit 13**	
	[8059 1513] S.L. + 77.51m OD	
	Topsoil	to 0.15
Made Ground and RTD	Clay, brown and grey mottled, silty, stony, stiff to very stiff	to 1.00
	Clay, dark grey, silty with pockets of brown sand and gravel	to 1.80
KC	Clay, dark grey, silty	to TD at 2.20

Appendix 1 cont. Depth m

49. Haydon Hill Farm Estate trial pit 17

[8099 1524] S.L. + 74.32m OD

	Made Ground and topsoil	to 0.60
RTD	Clay, brown, very stony, stiff to very stiff	to 1.20
	Sand, light brown, medium to coarse-grained with medium-grained gravel	to 1.50
	Clay, blue to dark grey, silty, sandy, stony, stiff to very stiff	to TD at 1.70

51. Haydon Hill Farm Estate trial pit 19

[8154 1505] S.L. + 73.28m OD

	Topsoil and ?Made Ground, stony	to 1.50
RTD	Clay, brown, silty, sandy, stony, firm, soft below water entry at 2.10	to TD at 2.40

52. Lakeside Village borehole 1

[8192 1560] S.L. + 73.53m OD

	Topsoil	to 0.1
Alluvium	Clay, dark brown, very silty	to 1.0
	Gravel, brown, silty, clayey, flint clasts with pockets of grey clay	to 1.5
KC	Clay. pale brown to black, silty, poorly laminated, with shell fragments; blue grey and laminated from 3m; dark grey and shaly from 4m	to 4.4
	Mudstone, pale grey, calcareous, shelly	to 4.6
	Clay, dark grey, shaly, fissured	to 12.7
	Mudstone, dark grey, calcareous, shelly, thinly laminated	to 13.0
	Clay, dark grey, shaly, fissured, numerous shells	to TD at 15.0

Depth m

53. **Lakeside Village borehole 2**

[8191 1565] S.L. + 73.66m OD

	Topsoil	to 0.2
Alluvium	Clay, orange brown and grey mottled, silty, sandy, with some flint gravel; greyer and more gravelly with depth	to 1.4
KC	Clay, dark grey, laminated with a few shells	to 4.0
	Mudstone, calcareous, shelly, very thinly bedded	to 4.2
	Clay, dark grey, laminated and interbedded with mudstone; slightly shelly from 9.3	to TD at 16.00

55. **Lakeside Village borehole 4**

[8189 1570] S.L. + 73.63m OD

	Topsoil	to 0.2
Alluvium	Clay, orange brown and grey mottled, silty, sandy	to 1.0
	Gravel, yellow-brown, fine to medium-grained, silty, sandy, clayey	to 1.3
KC	Clay, blue-grey with yellow-brown patches, some shells	to 1.8
	Clay, dark grey, laminated, a few light brown silt pockets and thin mudstone laminations	to 3.2
	Limestone, dark grey, slightly shelly	to 3.6
	Clay, dark grey, fissured with laminations and shells; thin limestone beds from 9.0; mudstone beds from 12.0	to TD at 17.0

		Depth m
56.	**Lakeside Village borehole 5**	
	[8193 1545] S.L. + 73.31m OD	
	Topsoil	to 0.35
Alluvium	Clay, orange-brown, silty, very sandy with fine to medium-grained flint gravel; grey mottling increasing downwards, less sandy and gravelly downwards	to 1.2
KC	Clay, dark blue-grey, silty, laminated, with silt pockets, selenite and shells	to 2.5
	Clay, dark grey, fissured with laminations and shell fragments	to 10.0
	Mudstone, dark grey, shaly	to 10.2
	Clay, dark grey, fissured, with thin foliated laminations and some shells	to 11.9
	Limestone, dark grey, shelly, with calcite veining	to 12.7
	Clay, dark greenish-grey, thin foliated laminations and shell layers	to TD at 15.0
58.	**Lakeside Village borehole 7**	
	[8224 1549] S.L. + 72.98m OD	
	Topsoil	to 0.2
Alluvium	Clay, light grey, silty	to 1.3
	Silt, grey brown, very clayey, a few yellow-brown silt layers; a little gravel from 2.0	to 2.4
KC	Clay, blue-grey, fissured, laminated, with pockets of silt and some shells	to 3.0
	Clay, dark grey, fissured, with shells; laminations from 5.2	to TD at 8.0

Appendix 1 cont. Depth m

60. Lakeside Village borehole 9

[8236 1557] S.L. + 74.87m OD

	Topsoil	to 0.3
Colluvial Deposits	Clay, yellow-brown, sandy, silty with a little flint gravel	to 0.75
KC	Clay, blue-grey and brown, fissured with shell fragments and yellow brown laminations	to 1.7
	Clay, dark grey, fissured, with yellow-brown silt laminations, selenite and shells	to 4.0
	Clay, dark grey, silty, fissured, laminated with shells	to TD at 9.0

61. Lakeside Village borehole 10

[8229 1592] S.L. + 75.50m OD

	Topsoil	to 0.3
Colluvial Deposits	Clay, pale orange-brown mottled, silty, slightly sandy, with a trace of flint gravel	to 0.7
KC	Clay, brown and grey, laminated, fissured, with a few brown and blue-grey silt partings	to 2.0
	Clay, dark grey, laminated, fissured, with selenite and a few brown silt partings	to 3.0
	Clay, dark grey, fissured, with laminations and a little selenite; darker and shelly below 4.0	to TD at 7.0

Appendix 1 cont. Depth m

62. **Lakeside Village borehole 11**

[8269 1517] S.L. + 73.42m OD

	Topsoil	to 0.4
Alluvium	Clay, khaki, sandy, silty, with roots and flint gravel	to 1.0
KC	Clay, blue-grey and brown mottled, laminated, fissured, with selenite and roots	to 2.0
	Clay, blue-grey, silty, highly fissured, laminated, sand on partings, with selenite and mudstone laminae	to 3.5
	Clay, dark grey, thinly foliated, fissured, a trace of shells	to TD at 7.0

63. **Lakeside Village trial pit 1**

[8185 1580] S.L. + 73.75m OD

	Topsoil	to 0.2
Alluvium	Clay, orange-brown and grey mottled, silty, with a little gravel	to 0.8
	Gravel, orange-brown, very clayey, silty, fine to coarse grained with layers of clayey sandy silt to 1.2	to 1.4
KC	Clay, blue grey with brown mottles	to 1.8
	Clay, dark grey, with shell fragments; interbedded with mudstone from 2.1	to 2.9
	Limestone, dark grey	to TD at 2.9

Appendix 1 cont.

		Depth m
65.	**Lakeside Village trial pit 3**	
	[8194 1573] S.L. + 73.49m OD	
	Topsoil	to 0.2
Alluvium	Clay, pale grey and orange mottled, silty	to 0.75
	Gravel, pale yellow, silty, sandy with light grey calcareous patches	to 1.1
	Gravel, grey brown, sandy, fine to coarse-grained, flint clasts	to 1.45
KC	Clay, blue-grey and brown mottled	to 1.7
	Clay, dark grey with shells, laminated from 2.2	to 2.9
	Mudstone, grey, thinly bedded	to 3.1
	Limestone, dark grey with calcite veins	to 3.4
	Clay, laminated with mudstone layers	to TD at 3.8
67.	**Lakeside Village trial pit 5**	
	[8184 1565] S.L. + 73.89m OD	
	Topsoil	to 0.25
RTD	Clay, orange-brown and grey mottled, silty, sandy	to 0.8
	Clay, orange-brown and grey mottled, very silty with fine to coarse-grained flint gravel	to 1.2
	Gravel, yellow brown and white, flint clasts	to 1.5
KC	Clay, blue grey with brown mottles	to 1.9
	Clay, grey, laminated and interbedded with mudstone; darker and shelly from 3.1	to TD at 3.9

		Depth m
72.	**Lakeside Village trial pit 10**	
	[8208 1590] S.L. + 73.9m OD	
	Topsoil, grey-brown, loamy	to 0.2
Colluvial Deposits	Clay, pale yellow-brown mottled, silty	to 0.9
	Sand, pale yellow and grey, medium-grained; silty and gravelly to 1.1	to 1.3
KC	Clay, black, fissured	to 1.7
	Limestone, grey	to 1.8
	Clay, dark grey, shaly, laminated and interbedded with mudstone from 2.4	to TD at 3.7
73.	**Lakeside Village trial pit 11**	
	[8205 1578] S.L. + 73.42m OD	
	Topsoil	to 0.2
Alluvium	Clay, yellow-brown and grey mottled, fissured	to 0.6
	Clay, grey, streaked with brown, fissured	to 1.6
	Gravel, buff, yellow and grey-brown, medium to fine-grained, very silty, sandy	to 2.3
KC	Clay, dark grey, fissured with shell traces, pockets of claystone at 3.0	to TD at c4.0
74.	**Lakeside Village trial pit 12**	
	[8215 1580] S.L. + 73.71m OD	
	Topsoil	to 0.2
Colluvial Deposits	Clay, pale yellow-brown, very silty	to 0.9
	Gravel, yellow and white, very silty, sandy	to 1.2
KC	Clay, pale grey	to 1.6
	Clay, dark grey, fissured, with shell fragments; interbedded with mudstone	to 3.4
	Limestone, dark grey	to TD at 3.5

Appendix 1 cont. Depth m

76. Lakeside Village trial pit 14

[8207 1569] S.L. + 73.37m OD

	Topsoil	to 0.2
Alluvium	Clay, pale grey with rust mottles, fissured	to 1.1
	Clay, pale grey, silty, gravel trace	to 1.8
	Gravel, pale yellow, medium to fine-grained, silty	to 2.0
	Clay, pale blue-grey, fissured, slickensided	to 2.5
	Clay, dark grey, fractured, laminated, shelly	to TD at 3.5

78. Lakeside Village trial pit 16

[8230 1574] S.L. + 74.59m OD

	Topsoil	to 0.25
Colluvial Deposits	Clay, buff, khaki, orange and grey mottled, silty	to 0.7
	Clay, grey, fissured, with pockets of orange-brown clayey sand and of flint gravel	to 1.4
KC	Clay, grey, fissured, slickensided, with fine shell fragments; interbedded with dark thinly-bedded mudstone from 3.0	to TD at 3.1

Appendix 1 cont.

		Depth m
79.	**Lakeside Village trial pit 17**	
	[8213 1561] S.L. + 73.34m OD	
	Topsoil	to 0.2
Alluvium	Clay, pale brown and grey mottled, fissured	to 1.0
	Clay and gravel, brown and white, calcareous	to 1.3
	Gravel, ochreous, medium to fine-grained, clayey, silty, sandy	to 1.5
	Gravel, pale grey, sandy, angular flints	to 1.7
KC	Clay, pale grey, slickensided with shells; dark grey and fissured from 1.9; laminated and interbedded with mudstone from 2.2	to 3.3
	?Limestone	to TD at 3.3
81.	**Lakeside Village trial pit 19**	
	[8230 1565] S.L. + 73.0m OD	
	Topsoil	to 0.2
Colluvial Deposits	Clay, khaki, very silty	to 0.6
	Clay, khaki mottled greyish white, very sandy	to 1.1
KC	Clay, pale grey, fissured; dark blue-grey from 2.2, with shell laminations	to 2.8
	Limestone, dark grey, crystalline	to 3.0
	Clay, blue-grey, fissured, laminated with crushed shells	to TD at 3.7

		Depth m
83.	**Lakeside Village trial pit 21**	
	[8184 1542] S.L. + 73.30m OD	
	Topsoil	to 0.25
RTD	Clay, rust brown, silty, a little gravel	to 0.5
	Gravel, brown and white, fine to coarse-grained flint clasts, silty	to 1.1
KC	Clay, dark grey, fissured, some shell fragments	to 1.7
	Limestone, dark grey	to 1.9
	Clay, dark grey, a few shell fragments laminated and interbedded with mudstone from 2.2	to TD at 3.9
84.	**Lakeside Village trial pit 22**	
	[8210 1550] S.L. + 73.20m OD	
	Topsoil	to 0.2
Alluvium	Clay, brown, grey and orange mottled, silty	to 0.8
	Gravel, orange-brown, fine to coarse-grained flints, silty, sandy	to 1.0
KC	Clay, grey, slightly laminated, brown mottling, some selenite; lenticular limestone bed from 2.2 to 2.4	to 2.4
	Clay, dark grey, slightly laminated, some shell fragments; interbedded in places with thinly-bedded mudstone	to TD at 3.6

Appendix 1 cont. Depth m

86. Lakeside Village trial pit 24

[8198 1596] S.L. + c74m OD

	Topsoil	to 0.25
Colluvial Deposits	Silt, grey-brown and rust mottled, very sandy, clayey	to 0.7
	Clay and gravel, grey-brown and rust-brown mottled, sandy, silty, fine to medium-grained flint gravel	to 1.2
KC	Clay, dark grey and light brown mottled	to 1.95
	Clay, grey and black, fractured and fissured, interbedded in places with mudstone and shell fragments	to TD at 2.5

90. Lakeside Village trial pit 28

[8230 1543] S.L. + c73m OD

	Topsoil	to 0.3
Alluvium	Clay, brown, silty, sandy	to 1.1
KC	Clay, grey-brown, fractured, fissured, slightly silty, with orange-brown mottling and slickensides	to 1.7
	Clay, dark-grey and black, slightly silty, with selenite and interbedded with thinly-bedded mudstone	to TD at 2.5

91. Lakeside Village trial pit 29

[8227 1533] S.L. +c73m OD

	Topsoil	to 0.2
Alluvium	Silt, orange-brown, very sandy, clayey	to 1.0
KC	Clay, blue-grey and brown mottled, fissured and slickensided	to 1.9
	Clay, dark grey, silty, fissured with orange-brown staining	to 2.3
	Clay, dark grey and black, highly fissured, poorly laminated with selenite and interbedded with mudstone	to TD at 2.6

Appendix 1 cont. Depth m

92. Lakeside Village trial pit 30

[8213 1533] S.L. + c73m OD

	Topsoil	to 0.15
Alluvium	Clay, grey-brown and orange-brown mottled, very silty	to 1.6
KC	Clay, blue-grey and brown mottled, fissured with shell fragments	to TD at 2.0

93. Lakeside Village trial pit 31

[8221 1533] S.L. + c73m OD

	Topsoil	to 0.25
Alluvium	Clay, brown and orange-brown mottled, sandy, silty	to 1.1
	Gravel, brown, fine to medium-grained flint clasts, sandy	to 1.6
KC	Clay, grey-brown, silty, fissured	to 1.7
	Clay, dark grey, fractured, fissured with selenite	to TD at 2.7

94. Lakeside Village trial pit 32

[8225 1544] S.L. + c73m OD

	Topsoil	to 0.3
Alluvium	Clay, light grey-brown mottled, silty with a few shells; ironstaining from 1.95	to 2.6
	Clay, dark grey and black, organic, silty, very sandy with wood and shell fragments	to TD at 3.3

Appendix 1 cont. Depth m

98. Watermead trial pit 1

[8245 1580] S.L. + 76.84m OD

	Topsoil	to 0.2
Colluvial Deposits	Clay, yellow brown, silty, sandy	to 0.8
	Clay, blue-grey and brown mottled, fissured, a few yellow-brown silt layers and shell traces, selenite pockets to 1.7	to 1.7
KC	Clay, dark grey, silty, fissured, thinly laminated in parts, with selenite and shell fragments	to 2.6
	Clay, dark grey, silty, fissured, selenite pockets and interbedded with mudstone	to TD at 3.2

101. Watermead trial pit 4

[8243 1567] S.L. + 76.08m OD

	Topsoil	to 0.2
Colluvial Deposits	Clay, yellow-brown, very silty, sandy with traces of fine flint gravel	to 0.9
KC	Clay, light blue-grey with brown mottles, silty with white calcareous pockets, selenite and shells	to 1.7
	Clay, blue-grey, silty, with selenite, shells and laminations from 2.8	to TD at 3.0

Appendix 1 cont. Depth m

102. Watermead trial pit 5

[8230 1588] S.L. + 74.88m OD

	Topsoil, silty, clayey	to 0.27
Colluvial Deposits and ?KC	Clay, yellow-brown, very silty, sandy	to 0.6
	Clay, light blue-grey, brown flecked, silty, fissured, with numerous shell fragments; grey limestone gravel pocket from 1.0 to 1.3	to 1.7
KC	Clay, dark grey, silty, fissured, laminated and interbedded with shaly mudstone; pockets of selenite and shells	to 3.0
	Clay/mudstone, dark grey, very thinly-bedded	to TD at 3.3

104. Watermead trial pit 7

[8229 1579] S.L. + 74.54m OD

	Topsoil	to 0.2
Colluvial Deposits	Clay, yellow-brown and rust mottled, silty, slightly sandy. with bluish grey clay layers and a little fine flint gravel	to 0.8
KC	Clay, light blue-grey, brown flecked, silty, fissured with selenite and shell fragments; lenticular limestone from 1.7 to 1.9	to 1.8
	Clay, dark blue-grey, fissured, shelly, interbedded with mudstone layers	to 2.4
	Clay/mudstone, grey to black, highly fissured	to TD at 3.2

Appendix 1 cont. Depth m

109. Watermead trial pit 12

[8233 1559] S.L. + 74.49m OD

	Topsoil, brown, silty	to 0.3
Colluvial Deposits	Clay, orange-brown, silty, sandy with light grey calcareous layers	to 0.8
KC	Clay, light blue-grey, silty, brown stained, fissured, slickensided with white calcareous striations; darker and shell-detrital below 1.8; thinly laminated below 2.8 with organic traces	to TD at 4.5

110. Watermead trial pit 13

[8234 1552] S.L. + 74.49m OD

	Topsoil	to 0.3
Colluvial Deposits	Clay, yellow-brown, silty, sandy	to 1.1
KC	Clay, blue-grey, silty, fissured, poorly laminated	to 1.8
	Clay, dark blue-grey, silty, poorly laminated, fissured with thin laminations from 3.4	to TD at 4.4

APPENDIX 2

LOCALITIES

see Appendix 1 for abbreviations.

		Thickness m
A. Gas pipe trench stream crossing [8349 1953]		
KC	Clay and mudstone, mid to dark bluish grey, slightly silty	c 0.5
	Dark grey clay with *Nanogyra nana* in soil on surrounding fields	
		Depth m
B. River diversion, Watermead [8173 1573]		
	Topsoil, dark grey and orange-brown mottled sandy silty clay	to 0.2
RTD	Clay, khaki and orange-brown mottled, slightly stony, very sandy, sharp uneven base	to 0.5-0.6
	Gravel, orange-brown matrix, very sandy, clayey and silty with clasts of brown, grey, black and white angular flints, orange, brown and purple sandstone pebbles, orange quartz pebbles, very dark brown and black ironstone and black phosphate stones; lenses of pale grey very sandy stony clay with limestone gravel and flints; very uneven cryoturbated base	to 0.7-1.2
KC	Clay, dark grey mottled with khaki, friable with race; passing to dark blue grey mudstone, fissile with abundant shell debris on partings	seen to 1.8
		Thickness m
C. Ditch section, Groveway Farm [8219 1827]		
Pl	Limestone, very pale grey, fine to medium-grained, slightly sandy with a little shell debris and large ammonites, orange stained in parts; very roughly bedded	up to c1.0

Appendix 1 cont. Thickness m

D. Trench along front of Weedon Lodge [8200 1805]

Material dug from trench:

Limestone, pale grey, greenish grey and pale orange-grey, sandy, glauconitic, fine-grained with large bivalves (PlSt)

Silt and fine sand, ochreous, orange-brown to khaki (PlS)

Clay, grey, silty (KC)

Fill

E. Trench, Weedon Lodge Farm [8186 1795]

Material dug from trench:

Limestone, light grey, shelly, glauconitic (PlSt)

Clay, orange-brown and khaki, sandy, glauconitic with lydites (PlS)

Clay, light grey and khaki, very silty (KC); immediately below Portland, becoming dark blue grey downwards

F. Disused quarry, Dunsham Farm [8299 1535]

PlSt	Limestone, off-white to cream, shell detrital, pelletal, flat and roughly-bedded 0.02-0.1	seen 0.5

G. House foundations, Church Farm [8344 1519]

PlSt	Limestone, pale grey to buff, slightly shelly, silty, rubbly and marly with large bivalves	c1.0
PlS	Silt, yellow-brown, calcareous	seen c0.5

H. Foundations, Burcott [8429 1520]

	Made Ground, concrete	0.5
PlSt	Limestone, pale grey, fine grained, soft	0.7
PlS	Clay, orange-brown, silty, glauconitic with black pebbles	seen 0.3

Appendix 2 cont. Thickness m

J. Trench, Fox Covert [8484 1931]

Material dug:

Mudstone, pale grey and fawn, friable; common phosphatic nodules, ammonites and bivalves (G)

K. River bank section, Watermead [8191 1592]

	Topsoil, dark grey-brown and orange-brown mottled, sandy, very slightly stony silty clay, passing to:	0.3
Alluvium	Clay, mid grey-brown and orange-brown mottled, sandy, very slightly stony; paler with depth; very fine limestone and flint gravel at base	0.6
	Sand, pale grey and orange-brown mottled, gravelly, very gravelly with depth, with flints and sandstone and quartz pebbles	seen c0.4

APPENDIX 3

PALAEONTOLOGY

Specimen no. AMB 432
1200m on 106° from Hardwick Church, Hardwick, Bucks.
[8181 1864]
Silty cementstone (rather dense) with indeterminate shell fragments.
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Specimen no. AMB 433
1750m on 094° from Hardwick Church, Hardwick, Bucks.
[8240 1885]
Small, worn piece of silty cementstone with common shell fragments (bivalve and ammonite indeterminate).
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Specimen no. AMB 434
1700m on 097° from Hardwick Church, Hardwick, Bucks.
[8234 1876]
Worn piece of cementstone with perisphinctid ammonite fragments/impressions and other indeterminate shell fragments.
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Specimen no. AMB 435
900m on 228° from Hardwick Church, Hardwick, Bucks.
[8000 1838]
Worn piece of silty/silty-textured septarian cementstone with several *Protocardia*.
Horizon: Kimmeridge Clay (KC30 of standard sequence)

Specimen no. AMB 436
2100m on 133° from Hardwick Church, Hardwick, Bucks.
[8218 1753]
Small piece/chip of silty cementstone with indeterminate small shell fragments (?bivalve).
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Specimen no. AMB 437
450m on 250° from Hardwick Church, Hardwick, Bucks.
[8022 1883]
Loose specimen of *Laevaptychus*.
Horizon: Kimmeridge Clay (KC24 - KC33 of standard sequence)

Specimen no. AMB 438
1220m on 055° from Hardwick Church, Hardwick, Bucks.
[8166 1967]
Worn, silty, weakly septarian cementstone with scattered serpulid bits and indeterminate shell fragments.
Horizon: Kimmeridge Clay (lower doggers of M J Oates)
(*Nanogyra virgula* recorded nearby)

Appendix 3 cont.

Specimen no. AMB 439
2000m on 120° from Hardwick Church, Hardwick, Bucks.
[8238 1795]
Silty/silty-textured septarian cementstone with poorly preserved perisphinctid ammonite fragments and impression.
Horizon: Kimmeridge Clay (upper or lower doggers of M J Oates)

Specimen no. AMB 440
2250m on 331° from Bierton Church, Bierton, Bucks.
[8252 1725]
Septarian cementstone with shell fragments including *Aulacostephanus* ex gr. *eudoxus* (d'Orbigny) and indeterminate bivalves.
Horizon: Kimmeridge Clay (KC30 of standard sequence)

Specimen no. AMB 441
450m on 196° from Hardwick Church, Hardwick, Bucks.
[8054 1855]
Silty cementstone, weakly septarian, with bivalve fragments and ?serpulid bits.
Horizon: Kimmeridge Clay (?KC30 of standard sequence)

Specimen no. AMB 442
1550m on 223° from The Abbey, Aston Abbotts, Bucks.
[8341 1887]
Piece of worn, cube-shaped (?septarian) cementstone with scattered small, indeterminate shell fragments.
Horizon: Kimmeridge Clay (upper doggers of M J Oates)

Specimen no. AMB 443
1680m on 098° from Hardwick Church, Hardwick, Bucks.
[8232 1874]
Piece of silty-textured, septarian cementstone with ?poorly preserved, small shell fragments.
Horizon: Kimmeridge Clay (upper doggers of M J Oates)

Specimen no. AMB 444
1620m on 099° from Hardwick Church, Hardwick, Bucks.
[8226 1974]
Loose specimen of vertebra (?marine reptile)
Horizon: Kimmeridge Clay (clays between upper and lower doggers of M J Oates)

Specimen nos AMB 445-446
2790m on 308° from Bierton Church, Bierton, Bucks.
[8142 1699]
Pieces of worn, silty cementstone with perisphinctid fragments.
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Appendix 3 cont.

Specimen nos AMB 447-448
1570m on 253° from the Abbey, Aston Abbotts, Bucks.
[8296 1959]
Small, worn pieces of septarian cementstone with tiny shell fragments (?including *Protocardia).*
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Specimen nos AMB 449-450
1970m on 257° from The Abbey, Aston Abbotts, Bucks.
[8256 1961]
Piece of silty cementstone with shell fragments/impressions including perisphinctid ammonite, serpulid and indeterminate others, plus a smoother-textured pale cementstone nodule with clean moulds of fossil fragments including perisphinctid ammonite (and nucleus).
Horizon: Kimmeridge Clay (KC30 of standard sequence)

Specimen no. AMB 451
2010m on 351° from Bierton Church, Bierton, Bucks.
[8333 1726]
Piece of septarian, silty cementstone with poorly preserved perisphinctid ammonites.
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Specimen no. AMB 452
1890m on 351° from Bierton Church, Bierton, Bucks.
[8334 1713]
Piece of worn, silty, septarian cementstone with perisphinctid ammonite fragment.
Horizon: Kimmeridge Clay (lower doggers of M J Oates)

Specimen no. AMB 453
1600m on 201° from Hardwick Church, Hardwick, Bucks.
[8009 1748]
Piece of worn, silty cementstone with indeterminate bivalve fragments.
Horizon: Kimmeridge Clay (KC30 of standard sequence)
(associated *Nanogyra virgula* marked on field slip)

Specimen no. AMB 454
1350m on 231° from The Abbey, Aston Abbotts, Bucks.
[8342 1917]
Very worn piece of barren, smooth-textured cementstone.
Horizon: Kimmeridge Clay (upper doggers of M J Oates)

Specimen no. AMB 455
1080m on 242° from The Abbey, Aston Abbotts, Bucks.
[8349 1953]
Loose right valve of *Nanogyra*
Horizon: ?Upper Kimmeridge Clay

Appendix 3 cont.

Specimen no. AMB 456
1290m on 266° from The Abbey, Aston Abbotts, Bucks.
[8318 1991]
Loose right valve of *Nanogyra*.
Horizon: ?Upper Kimmeridge Clay

Specimen nos AMB 457-458
1930m on 318° from Bierton Church, Bierton, Bucks.
[8234 1673]
Loose specimens of *Nanogyra virgula* (Defrance).
Horizon: Kimmeridge Clay (almost certainly Eudoxus Zone (KC24-KC32)

Specimen no. AMB 459
1700m on 114° from Hardwick Church, Hardwick, Bucks.
[8219 1827]
Ammonite whorl fragment (very evolute with pavloviid ribbing) in shell-fragmental ?sandy limestone.
Horizon: Portland Formation
?Portland Stone Member (?Aylesbury (Rubbly) Limestone)

Specimen no. AMB 460
1090m on 358° from Bierton Church, Bierton, Bucks.
[8359 1636]
Broken ammonite *(Galbanites?)* with scattered lydites and green glauconitic grains in limestone matrix, also internal mould of trigoniid.
Horizon: Portland Formation

Specimen nos AMB 461-463
180m on 245° from Bierton Church, Bierton, Bucks.
[8345 1520]
Bivalves preserved in pale cream-coloured limestone with some sparry calcite (large mytiloid or pterioid, *Protocardia dissimilis* (J de C Sowerby), cyprinid?).
Horizon: Portland Formation
?Portland Stone Member

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Natural Environment Research Council

BRITISH GEOLOGICAL SURVEY

Geological Survey of England and Wales

SP 81 NW
BIERTON

Part of 1:50 000 Sheets 219 (Buckingham)
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KEYWORTH BRITISH GEOLOGICAL SURVEY

INTRODUCTION

This area, covering the 1:10 000 sheet SO 90 SE, immediately to the west of Cirencester, forms part of the mid Cotswold plateau. It was originally surveyed at the 1:63 360 scale by Edward Hull and included in the Old Series Sheet 34, published in 1857. The drift was surveyed by H.G.Dines in 1931. The area west of grid line 952 was surveyed as part of the Gloucester (234) and Malmesbury (251) sheets in 1962 by R. Cave, and the area south of grid line 01 was surveyed by P.Toghill in 1966 as part of the Swindon (252) sheet. These areas were resurveyed and the remainder completed by A.J.M.Barron in 1985.

This map is part of 300 sqkm of ground surveyed under the jointly-funded BGS-Thames Water Authority Cirencester project. The project also involved the interpretation, classification and correlation of over eighty boreholes between Tetbury in Gloucestershire and Burford in Oxfordshire, mostly in the surveyed area and in the area immediately to the south. All the bore-holes had been logged by geophysical methods, principally the gamma-ray response technique, and a few had been cored. Therefore it has been possible to make deductions about the lithostratigraphy of the area from both surface and subsurface data which, where relevant, have been included in this report.

The village of Coates lies in the southern part of the area, and part of the village of Daglingworth lies in the north eastern corner. The landscape is dominated by the extensive tracts of woodland comprising Oakley and Hailey Woods, and Cirencester Park, together covering some 9 sqkm. The rest of the upland area is under cereal crops with some grazing land. Part of the densely-wooded valley of the River Frome, flowing south west to the Severn, lies in the north west corner and a stream called the Dunt runs south east through Daglingworth to join the River Churn and thence the Thames. The main Cirencester-Stroud road runs east-west across the area; the Swindon-Stroud railway and the disused Thames and Severn Canal cut through Hailey Wood in the south west. Much of the canal in this area is in a tunnel under Hailey Wood.

Parallel reports covering adjacent areas are:

SO 90 NE	Duntisbourne Abbots	(A.J.M.Barron)
SP 00 SW	Cirencester	(A.Horton)

GEOLOGICAL SEQUENCE

		Landslip
DRIFT	Quaternary	Alluvium
		Alluvial Fan
		Head

GEOLOGICAL SEQUENCE cont.

SOLID	Jurassic	Great Oolite Group: Cornbrash (Lower) Forest Marble Formation including Limestone White Limestone Formation Hampen Marly Formation Taynton Limestone Formation Througham Tilestone Formation Lower Fuller's Earth Inferior Oolite Group: Upper Inferior Oolite Lower Inferior Oolite Lias Group: Cotteswold Sands Upper Lias Clays

SOLID FORMATIONS

Lias Group

Upper Lias Clays and Cotteswold Sands

The Cotteswold Sands crop out only in the floor of the Frome valley in the north west of the area. They consist of orange-brown to grey-brown micaceous strata ranging from clayey sand to silty clay, of which only the highest 8m are thought to be present at outcrop, which is shown discontinuous partly because of concealment by landslip and partly because the Cotteswold Sands strata are thought to have been forced upward by superficial movements at places along the valley floor in a process known as valley-bulging.

The Cotteswold Sands are not exposed but grey and brown micaceous siltstone debris and ochreous clay were seen at several localities close above the floodplain [9531 0496, 9537 0468 and 9509 0410].

The underlying grey mudstones of the Upper Lias Clays are known only from boreholes which generally prove only the uppermost beds. Some 10.5m were recorded by the driller in the Bathurst Sawmills Borehole (Appendix 1, SO 90 SE/7) and the point resistance log indicates clayey strata over the same interval. The Pump House Borehole (SO 90 SE/2) at Manor Farm, Tarlton, proved 2.4m of "blue clay" thought to be of the Upper Lias, and the log of the Ewe Pens Borehole (SO 90 SE/5) shows 8.0m of sand and sandstone (Cotteswold Sands) above 16.2m of limestone and clay (Upper Lias Clays).

Inferior Oolite Group

Lower Inferior Oolite

The Lower Inferior Oolite crops out along the lower slopes of the Frome valley in the north west of the area. It comprises between 10 and 39m of off-white, cream and orange-brown, variously oolitic, shell-detrital, pisolitic and ferruginous limestones. The rocks are poorly exposed, being concealed by landslipped material and dense vegetation. However, an almost complete section through the beds is exposed in the track [9544 0490 to 9533 0490] (Appendix 2, Locality B) running from Pinbury Park to the river, in which strata of the Scissum Beds, Lower Limestone, Lower Freestone and Oolite Marl (including Upper Freestone) appear. The Pea Grit, normally found between the Lower Limestone and Lower Freestone, is not exposed. The Oolite Marl is here non-sequentially overlain by the Upper Trigonia Grit of the Upper Inferior Oolite (see below). This area lies on the southward extension of the anticlinal axis running through Birdlip (Buckman, 1897). The field evidence confirms Buckman's prediction that the Middle Inferior Oolite and the beds of the Lower Inferior Oolite above the Oolite Marl are absent, having been eroded away prior to the deposition of the Upper Inferior Oolite.

Only 0.2m of orange-brown, ferruginous, shelly, marly limestone of the Scissum Beds are exposed in the Pinbury Park track (Locality B) but the debris of the underlying Cotteswold Sands was found in a fox earth 40m to the north and only about 1m vertically below, so no more than 1m of Scissum Beds are thought to be present. Debris of orange-brown ferruginous limestone of the Formation was found with Cotteswold Sands material in another fox-earth [9508 0410] about 175m south-west of Henwood Mill.

In the Pinbury Park track, 0.3m of buff and pale grey, poorly-sorted, shelly oolite, assigned to the Lower Limestone, is separated from the underlying Scissum Beds by a 0.3m gap. The total thickness of the Lower Limestone is thought to be 2 to 3m. The overlying Pea Grit is not exposed here but 0.2m of pale grey, shelly, oncolitic oolite was seen in the area to the north [9515 0680] (Barron, in prep.). About 10m of cream medium to coarse-grained oolite of the Lower Freestone is exposed in the Pinbury Park track, but the base was not seen.

Above the Lower Freestone lies the Oolite Marl, generally consisting of 3 to 6m of off-white to pale brownish grey micritic limestone, oolitic in places, with numerous well-preserved fossils. Brachiopods are especially common, notably *Plectothyris fimbria*. In the Pinbury Park track, between 3 and 4m of beds are present. Taunton (1872, p.268) recorded *P. fimbria* on the western edge of the area in the spoil heap of No. 4 Shaft [9500 0256] of the Sapperton Canal Tunnel

(see Figure 2).

In the Pump House Borehole (SO 90 SE/2), the Inferior Oolite Group was proved to be 46.3m thick. It could not be subdivided. Only 10.8m of Lower Inferior Oolite were proved in the Ewe Pens Borehole (SO 90 SE/5), consisting of 8.8m of "hard yellow rock (Bath Stone [sic])" on 2.0m of "hard grey rock". This may indicate a locally condensed sequence. The Bathurst Sawmills Borehole (SO 90 SE/7) proved 42.5m of undivided Inferior Oolite strata.

Upper Inferior Oolite

The Upper Inferior Oolite crops out along the sides of the Frome valley in the north west of the area. It was also penetrated in four boreholes (Appendix 1, SO 90 SE/1,2,5 and 7). It consists of Clypeus Grit on Upper Trigonia Grit, totalling between 5 and 11m. Much of its outcrop is concealed by landslipped material, mainly from the Lower Fuller's Earth. It is exposed in the Pinbury Park track (Appendix 2, Locality B), where 6m of pale brown and pale grey, very rubbly, coarsely oolitic or pisolitic shell-detrital limestone, bioturbated in parts, with *Trigonia* (Clypeus Grit), rests on 1m of pale brown very coarsely shell-detrital and shelly limestone with ferruginous ooliths (Upper Trigonia Grit). In this section there is about 1.0m unexposed below the Upper Trigonia Grit. Debris of very coarsely shelly limestone, thought to be from the Upper Trigonia Grit, was seen in two other places; in Hen Wood [9501 0415] and below Course Copse [9529 0465], both on a strong convex feature thought to mark the base of the unit. The junction of the Upper Inferior Oolite with the Lower Fuller's Earth is not exposed. The Upper Trigonia Grit forms the transgressive unit above Buckman's "Bajocian Denudation" (1897) and, as he predicted, appears to immediately overlie the Oolite Marl in this area.

The Manor Farm Borehole (SO 90 SE/1) proved 5.5m of Clypeus Grit, consisting of 1.2m of "limestone, bluish and raggy to coarsely-oolitic with a bored and oyster-encrusted top and marl pockets near the top with Ostrea acuminata (? from above)....; Anabacia, "Terebratula", Gervillia etc. (Rubbly Beds)" on "limestone, oolitic and partly pisolitic, grey to cream-grey, and massive in parts, up to 3ft or more with marl films between; top dark grey and marly with rolled nodules of pale oolite. Fossils... "Terebratulae", Clypeus... (White Oolite)" seen for 4.3m. The log of the Ewe Pens Borehole (SO 90 SE/5) distinguishes 5.8m of Upper Inferior Oolite as "[?Clypeus Grit and Upper Trigonia Grit] Hard rock". The gamma-ray log of the Bathurst Sawmills Borehole (SO 90 SE/7) does not extend to these strata but in gamma-ray logs of other boreholes in the vicinity, (see B.G.S. files and the B.G.S. Winstone Borehole in Barron, in prep.) the Upper Trigonia Grit produces a very marked peak thus enabling division of the Inferior Oolite and correlation over a wide area.

Great Oolite Group

Lower Fuller's Earth

The Lower Fuller's Earth crops out on the middle slopes of the Frome valley. Buckman's correlation (1901) with the Lower Fuller's Earth of the South Cotswolds was confirmed by Arkell and Donovan (1952). In local boreholes (Appendix 1) it ranges from 21.3 to 31.7m in thickness and consists of mid to very dark grey fossiliferous clay with thin beds of dark grey, shelly, fine-grained limestone.

At the surface, only grey and grey brown weathered clay was observed. The formation is extensively landslipped and its apparent thickness at outcrop is reduced in places by cambering (see Superficial Structures) to as little as 12m at Pinbury Park [9545 0495].

In the gamma-ray logs of boreholes to the south of this district it has been possible to correlate distinctive traces within the Lower Fuller's Earth (see B.G.S. files) demonstrating the persistence of individual beds over a large area.

Just over a kilometre of the Sapperton Canal Tunnel in this area (Figure 2 and Taunton, 1872) was driven through the Lower Fuller's Earth, debris from which can be seen in many spoil heaps at shafts along its line (see Made Ground).

Througham Tilestone Formation

The Througham Tilestone Formation succeeds the Lower Fuller's Earth and consists of 3 to 5m of brown and grey, thinly-bedded, sandy limestone, siltstone and clay. It is overlain by the Taynton Limestone and Hampen Marly Formations. Because of the lack of exposure, narrowness of outcrop and concealment by landslip and vegetation it has proved impractical to distinguish them on the map and these three formations have been grouped together at outcrop on the map as the Hampen Marly Formation. Debris of grey and brown, thinly-bedded, sandy limestone (tilestone) was seen in several places, mainly on landslipped ground; in Hen Wood [9510 0444], 290m SSW of Pinbury Park [9571 0471] and 500m WNW of Park Corner [9554 0449]. This material is assumed to be from the Througham Tilestone Formation, originally identified in the area 5km to the north west around Througham (Woodward, 1894, p.281; Richardson, 1904, p.161; Arkell and Donovan, 1952, p.245) where the strata were worked extensively for roofing tiles.

The relationship of this formation to the Stonesfield Slate beds of Oxfordshire is not clear. However, the evidence of boreholes (Appendix 1) shows it to underlie the Taynton Limestone Formation (see below). The specimens from the Manor Farm Borehole (SO 90 SE/1) have been re-examined and 5.2m of very fine-grained sandy limestone and laminated siltstone have been assigned to the Througham Tilestone. About 5m of "sand, clay (and) hard blue rock" in the Ewe Pens Borehole (SO 90

SE/5) are also assigned to the Througham Tilestone Formation.

The Througham Tilestone Formation has a characteristic gamma-ray log signature and it has been possible to correlate logs of boreholes in the area, indicating that 4.5m of the formation is present in the Bathurst Sawmills Borehole (SO 90 SE/7) and 3.4m in the Woodhouse Borehole (SO 90 SE/8), which is described in the chippings log as grey clay and grey and brown fine-grained limestone.

Taynton Limestone Formation

There is no evidence at outcrop in this area for the presence of the Taynton Limestone Formation. This may be due to the lack of exposure, the thick vegetation cover or the landslipping; or it may be that the formation has substantially thinned or died out from east to west hereabouts; there is no record of it on the geological 1:50 000 Sheet 234 (Gloucester) to the west and a recent reinterpretation (see B.G.S. files) of the Bisley Borehole (SO 90 SW/1), 5km to the west, has 13.8m of Athelstan Oolite directly on 6.5m of Througham Tilestone. It is also possible that a marginal facies of the formation is developed locally. To the south of the present district, between Kemble and Tetbury, correlation of the gamma-ray logs of boreholes (see Introduction and B.G.S. files) suggests that the Taynton Limestone Formation thins and dies out from north east to south west.

Several of the boreholes in this area, however, do appear to prove Taynton Limestone, which further to the east typically consists of grey to buff shell-detrital oolite. It has been deduced that the formation is present in both the Bathurst Sawmills and Woodhouse boreholes (SO 90 SE/7 and 8) from the correlation of gamma-ray logs in the area; there are 4.4m of it in the former and 7.2m of grey to cream oolitic limestone in the latter. In the Manor Farm Borehole (SO 90 SE/1) 5.8m of shelly, oolitic and sandy limestone has been assigned to the formation. The log of the Pump House Borehole (SO 90 SE/2) 400m ENE shows 7.9m of "light (and) dark brown stone" all or part of which may be from the formation. About 6.1m of "rock, blue marl, blue rock (and) hard grey rock" in the Ewe Pens Borehole (SO 90 SE/5) has been assigned to the Taynton Limestone.

Hampen Marly Formation

The Hampen Marly Formation (formerly the Hampen Marly Beds of Arkell, 1933) crops out on the upper slopes of the Frome valley immediately below the convex feature at the edge of the White Limestone plateau. On the map its outcrop includes all of the beds between the White Limestone and the Lower Fuller's Earth. The formation is thought to consist of between one and four metres of brown, marly, thin-bedded, fine-grained limestone with thin clay seams. Debris of brown or grey brown marly limestone was seen in several places including Course Copse [9508 0478], 450m WNW of Park Corner [9563 0455], in Hen Wood

[9501 0446] and in The Leasowes [9537 0403].

In the Manor Farm Borehole (Appendix 1, SO 90 SE/1) 3.9m of oolitic limestone with marl films, some cross-bedding, shell bands and a brown and green marly clay seam have been tentatively attributed to the formation. About 2.1m of "blue stone and clay" in the Pump House Borehole (SO 90 SE/2) and 3.0m of "sand, clay, rock (and) blue marl" in the Ewe Pens Borehole (SO 90 SE/5) may also represent the formation. From the gamma-ray logs of the Bathurst Sawmills and Woodhouse Boreholes (SO 90 SE/7 and 8) 2.2 and 1.7m respectively of the formation is thought to be present, described in the latter as "grey calcareous clay".

Arkell (1933) and Palmer (1979) suggested that the formation dies out or passes into White Limestone lithologies south westwards from its type section in the Hampen railway cutting [SP 062 205], for it is poorly represented in the railway cuttings at Chedworth [SP 06 11]. However, the surface evidence and the correlation of the borehole gamma-ray logs indicate that the formation can be traced from Burford in Oxfordshire to Kemble from where it dies out south westwards towards Tetbury. This indicates that the dying out or transition of the formation from distinct lithologies into limestones more typical of the White Limestone occurs further to the south west than Palmer suggests (1979, p.192 and text-fig.2).

White Limestone Formation

The White Limestone Formation crops out over about 13 sqkm of the central and north western parts of the area and along the valleys in the south and east. It has not been possible to distinguish the members of the formation described by Arkell (1931) and modified by Barker (1976), Palmer (1979) and Sumbler (1984), which are defined on the basis of gastropod species in hardground horizons.

In this area, the formation consists of between 19 and 27m of off-white, cream, grey and pale brown pelletal micritic limestone with scattered shell-detritus and evidence of bioturbation. The pellets commonly have a micritic coating. Palmer (1979, p.201) suggests that they are mostly of faecal origin. It is cross-bedded and thinly-bedded in places, massive in others, with thin grey or yellow marl and brown clay seams locally. It includes four conspicuous hardground horizons, known as Dagham Stones, which comprise hard, cream, grey and pale brown, sub-porcellanous, pelletal and micritic limestones with shells and shell debris and conspicuous ramifying burrows up to c2cm in diameter, filled or lined with ochreous material which weathers out to leave cavities. Woodward (1894, pp.286-287) was first to suggest that the cavities were burrows. This conclusion was supported by Fursich and Palmer (1975) who give a detailed description. The tops of the beds are particularly hard and may be bored or oyster encrusted. These are thought to have formed during pauses in sedimentation when

the sediments of the uppermost few centimetres of the sea bed were recrystallised. In only a few places, notably in the west, impersistent beds of cream sparry oolite (Athelstan Oolite facies) were observed in the formation. Consequently the term White Limestone is retained for this area.

To the south west, the sequence passes into the fully open shelf oolites of the Athelstan Oolite and the overlying porcellanous Coppice Limestone of the Nailsworth-Tetbury area (Cave, 1977, pp.137-142). It is thought that the Coppice Limestone may be equivalent to the topmost two or three closely spaced Dagham Stone horizons grouped together, which in this area can be separated within the body of the formation.

At the surface, the formation weathers to a light brown clay soil with limestone debris, sparse in places, abundant in others. The stones usually have rounded-off corners and weather to off-white. The Dagham Stone debris is characteristically irregularly shaped which has led to the local name of "Osses 'eds". Very few fossils were found on the outcrop of the formation and these consisted of worn specimens of brachiopods, bivalves, echinoids and gastropods. The Dagham Stone beds, by virtue of their hardness, form convex features at the surface enabling them to be traced with some confidence across the district despite the paucity of exposure.

The Manor Farm, Pump House, Jarvis's Quarry and Woodhouse boreholes (Appendix 1, SO 90 SE/1,2,3 and 8) begin in the formation and so do not prove its full thickness. In the Ewe Pens Borehole (SO 90 SE/5) it has not been possible to distinguish between the Forest Marble and the White Limestone, but in the well at Hailey Farm, about 27m of the formation is thought to be present. It is estimated that 23.2m is present in the Bathurst Sawmills Borehole (SO 90 SE/7). Strong peaks on the gamma-ray traces within the formation have been related to Dagham Stone or hardground horizons. It is not certain whether this is due to clay minerals in the beds or in clay beds immediately above, or to radio-isotopes in phosphate absorbed from the sea-water into the hardground beds at the time of formation, a process described by Bathurst (1971, p.395). The variation in the thickness of the formation is thought to be due mainly to the erosive nature of the contact with the overlying Forest Marble Formation, which is most conspicuous around Overley Farm [982 048], east of Four Mile Lodge [965 019] and near Glebe Farm, Coates [973 006] and is particularly well exposed in Localities N and Z. The Signet Member, present over much of the area to the east (see for example Barron, 1987, and Sumbler, 1985), is thought to be absent from this district due to the channelling at the base of the Forest Marble.

The formation is exposed in a large number of small pits throughout the district (Appendix 2, Localities C,D,E,F,G,H,K,T,X,Y,Z,A1 and D1). The Dagham Stone beds were commonly worked for road metal in the past because of their hardness, so are to be seen in many of these pits. Many of them were previously larger and there were others now obscured (see Richardson, 1933, pp.67-68 and 70 and Woodward, 1894, pp.281-

282). However, the formation is still well exposed in the railway cuttings near Hailey Farm [9504 0176] (Locality K) and in Hailey Wood [9620 0123] (Locality M). About 3.5m of the formation, including a Dagham Stone bed at the base, were seen in a quarry [9983 0076] (locality N) 400m ENE of Field Barn, Coates, which is thought to be the Lime-kiln Quarry of Woodward (1894, p.282). The exposure in the approach cutting to the Canal Tunnel [9664 0056] (Locality P) is smaller than that seen by Richardson (1933, p.71).

In the south west, beds of oolitic limestone were seen in the railway cuttings near Hailey Farm and in Hailey Wood (Localities K and M). Richardson's description of Botany Bay Quarry (1933, p.70) almost certainly refers to a pit near Daglingworth Cross Roads [9747 0453], his Beechcopse Quarry is Locality J [9892 0183] and his description of Dean's Quarry is of a pit [9740 0179] 1400m west of Two Mile Lodge, now completely filled.

Forest Marble Formation

The Forest Marble Formation crops out over about 10 sqkm of the area, forming plateaux in the south and east, and small ouliers in Oakley Wood. A large faulted-down outcrop lies in the north east.

The tripartite division of the formation into Kemble Beds, Bradford Clay and Wychwood Beds of Woodward (1894), Arkell (1933) and Richardson (1933) is not utilised here for the reasons given by Sumbler (1984, pp.61-62). Most of the sections recorded by Woodward (1894, pp.365) and Richardson (1933, pp.67,70 and 76) are still available.

In this area the formation is between 16 and 24m thick and consists in the lower part of pale to dark grey and pale brown, medium to coarse-grained, shelly and shell-detrital, bedded, oolitic and peloidal sparitic limestones with lenticular clay beds, and, in the upper part, of grey clays, silty in parts with thin lenticular limestone beds, the shells and shell debris consisting mainly of bivalves and coral. Locally, cross-bedding showing a variety of directions is present, indicating a variable current regime.

The basal limestone bed has an average thickness of about 6m and forms the greater part of the outcrop, notably around Ewe Pens [995 025] and Coates [978 007]. The main outcrops of the clay beds are in the north east near Daglingworth and in the south west [964 001] to the south of the Tunnel House. On the limestone outcrop the soils developed are of orange-brown very stony clay with rough angular slabs up to 1m across. On the clay outcrop there are much deeper and heavier grey-brown clay soils, which generally contain a proportion of small limestone clasts.

The Forest Marble limestone has been used in much of this area for dry stone walls and road metal, and consequently there are a large

number of small pits, mainly in copses and the corners of fields. Most are now obscured but a selection of sections are listed in Appendix 2 (Localities F,L,Q,R,S,U,W,Z,B1,C1,D1,E1 and F1). Forest Marble limestone is exposed in the quarry [9983 0076] 400m ENE of Field Barn (Locality N) and in the approach cutting [9664 0056] to the Canal Tunnel (Locality P). Clay and limestone are exposed to the north west of the fault in the Hailey Wood railway cutting [9614 0126] (Locality M). The clay beds were worked at one time for brick clay south of Brick Kiln Plantation, but only a shallow depression remains [992 015]. The quarry [9598 0206] observed by Richardson near Four Mile Lodge (1933, p.76) now exposes 2.5m of Forest Marble limestone with a thin marl seam (Locality V).

Only four of the boreholes in the area (Appendix 1, SO 90 SE/4,5,6 and 7) penetrated the formation and all commenced in the basal limestone. It is estimated that 6m of Forest Marble limestone was drilled in the well at Hailey Farm (SO 90 SE/6) and 2.7m in the Bathurst Sawmills Borehole (SO 90 SE/7).

Cornbrash

Two small faulted outliers of Cornbrash are present in the extreme south of the district [9663 0001 and 9695 0002] to the south of Tarlton Bridge. Debris of brown rubbly shelly bioturbated limestone was seen on the outcrops and up to 3m of beds are thought to be present.

STRUCTURE

The regional dip of the Jurassic strata in this part of the Cotswolds is generally about 1:80 or 0.7 degrees to the south south east. This relatively simple structure is considerably modified locally by faulting and gentle folding. In this district, structural contours plotted for the top of the Lower Fuller's Earth (see Figure 1) show the broad structure within the limestone formations of the Great Oolite Group.

The strata north of the King's House-Wellhill Fault dip gently eastwards at about one degree. Between that fault and the Four Mile Lodge and Hailey Farm Faults the strata dip evenly south eastward at about 0.9 degrees. Along the sides of the Frome valley, cambering has modified the structure, causing increased valleyward dips in the Great Oolite Group limestones (see Superficial Structures).

In the south and south west there are fault blocks containing more steeply dipping strata (up to three degrees). All of the bounding faults are thought to be normal, with throws up to about 25m. Two of these faults (the Four Mile Lodge and Hailey Farm Faults) were detected by Hull during the original survey of this area and Taunton (1870, pp.268-269 and Figure A) believed that these were the faults he observed in the Sapperton Canal Tunnel. In the tunnel, the fault between the Inferior Oolite and the "Fuller's Earth" at Cassey Well throws in the same direction as the Four Mile Lodge Fault (down to the south east). It is about 120m to the south of the outcrop of the fault which may be due to the fault plane dipping at about 20 degrees, or to it consisting of more than one plane of dislocation below the surface.

The fault seen by Taunton between the "Fuller's Earth" and "Great Oolite" cannot be that surveyed by Hull in Hailey Wood. It was shown by Taunton as a reverse fault throwing down to the south east. Hull's fault throws down to the north west. However, in the present survey a fault was detected at the surface, throwing to the south and running sub-parallel and about 50m north of the railway, which if normal is projected to intersect the tunnel where Taunton saw his fault (see Figure 2).

The projection of the Hailey Farm Fault intersects the tunnel at a point halfway between the first two shafts south east of the railway (2,900 feet, 884m from the south east portal). At this point, Taunton (1870, Figure A) showed a change in the dip of the strata which to the south east dip evenly to the south east, but which between this point and the faulted-up "Fuller's Earth" are shown as forming a small syncline. This is not unlikely as this block is in a small graben structure. Taunton may have failed to identify the Hailey Farm Fault because although it has a throw here of about 25m, in the tunnel it probably juxtaposes the upper part of the White Limestone and the superficially similar Taynton Limestone Formation.

Three minor faults on the edge of the plateau [9543 0410, 9550 0425

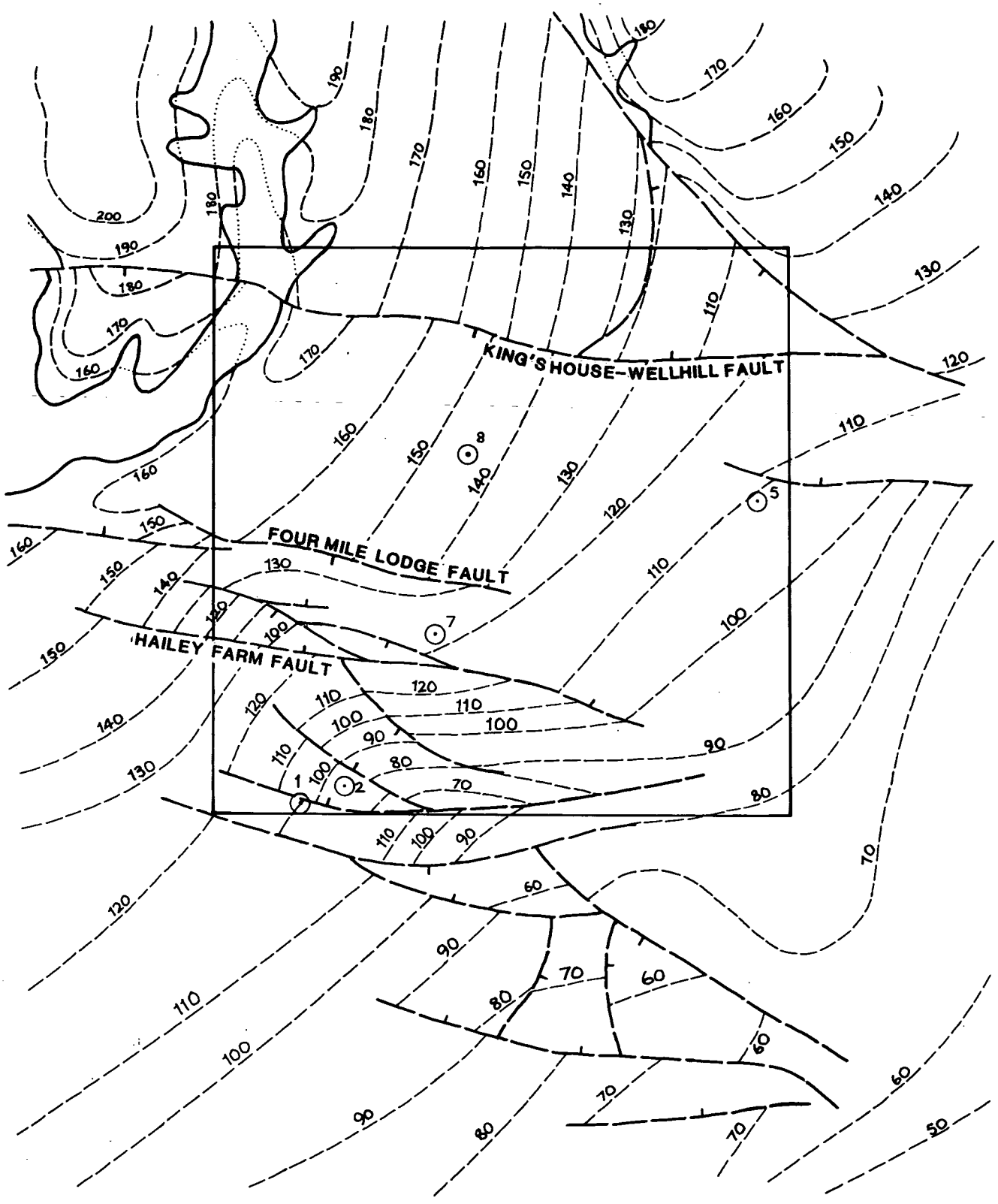


Figure 1.

Structure contours on the top of the Lower Fuller's Earth (m O.D.) in the area around sheet SO 90 SE.

Scale 1:50 000

Outcrop of the top of the Lower Fuller's Earth

Structure contour

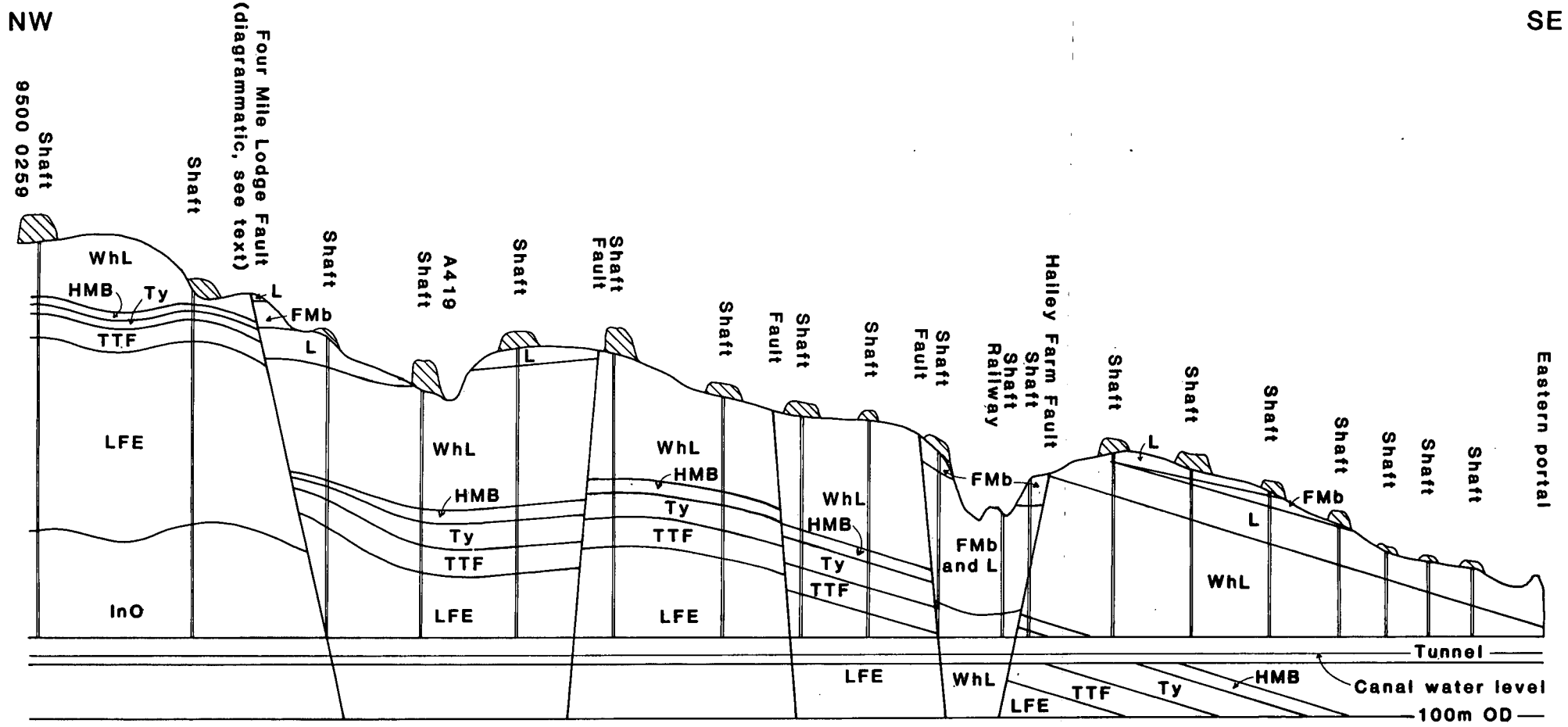
Structure contour, projected

Fault, tick on downthrown side

⊙1 Borehole in subject area

Figure 2.
Longitudinal section of the part of the Sapperton Canal Tunnel on sheet SO 90 SE.
(Re-interpretation of Figure A in Taunton, 1870)

Horizontal scale 1:10 000
Vertical scale 1:1000



and 9556 0434], south west of Park Corner, throw down small blocks of strata to the west. Some of the movement in the southern one is thought to be of tectonic origin but further movement related to cambering (see Superficial Structures) is thought to have taken place in all of them.

SUPERFICIAL STRUCTURES

Cambering has taken place in the beds above the Lower Fuller's Earth along the sides of the Frome valley. The process involves the squeezing out of clay strata and the lowering and disruption of overlying, more competent strata. In places, notably Course Copse [951 047], Pinbury Park [955 049] and The Leasowes [951 038], the apparent thickness of the Lower Fuller's Earth at outcrop has been reduced to as little as 10m and the overlying beds have been lowered by up to 20m. This can be seen in the deflection of the structure contours in Figure 1. The three minor faults [954 042] west of Park Corner were observed to run northwards into cambered strata and thence into landslip.

The outcrops of the Cotteswold Sands are thought to have been affected by valley bulging, a process in which clayey strata, such as the Upper Lias and Cotteswold Sands, which crop out in the floors of valleys, are squeezed upward (Horswill and Horton, 1976).

DRIFT

QUATERNARY

Head

Thin deposits of Head consisting of brown stony clay were mapped in the bottoms of many of the valleys in the district. The deposits may be as much as three metres thick in the larger tracts to the north of Wellhill Copse [996 042] and around the Thames and Severn Canal [970 001]. The clasts are of locally derived limestones.

Alluvium

Narrow tracts of alluvium flank the River Frome in the north west, the Dunt stream and one of its minor tributaries in the north east, and an un-named stream in the extreme south east. The deposits consist of brown silty clay, possibly as much as three metres thick in the case of the Frome.

Alluvial Fan

Two steep-sided cones of brown stony clay which flank the valley of the Frome are shown as alluvial fans [9543 0476 and 9537 0449]. A fan-shaped deposit of brown stony clay on the side of the stream valley in the south-east [9994 0035] is similarly classified.

LANDSLIP

Extensive landslipping of strata has taken place along the sides of the valley of the River Frome. The movements are thought to have been initiated by the lubrication of existing fissures and shear planes within the Lower Fuller's Earth by water seeping out at the base of the overlying limestone beds. Rotational movements have been recognised at the top of most of the slips and these have involved blocks of the overlying limestone beds. The resulting topography includes back-tilted benches or terraces, notably in The Leasowes [954 042]. In a few places, the slipped areas are restricted to the outcrop of the Lower Fuller's Earth but, generally, they include the Inferior Oolite outcrop and reach the floor of the valley.

MADE GROUND

There are two embankments for causeways [9573 0139 and 9611 0132] carrying tracks across the railway in Hailey Wood. Spoil from the Sapperton Canal Tunnel was drawn up shafts and dumped in nineteen tips along the line of the tunnel, mainly in Hailey Wood. To the north-west of where the tunnel intersects the Four Mile Lodge Fault [9531 0129], limestone from the Inferior Oolite was tipped. Between this point and where it intersects another fault in Hailey Wood [9597 0139] the tips consist mainly of grey mudstone from the Lower Fuller's Earth, and from there to the portal at the Tunnel House [9661 0060] they consist mainly of debris from the Great Oolite limestone formations.

Spoil derived from the excavation of the canal forms a bank up to 4m high [9665 0042] south-east of the Tunnel House and was used further to the east to embank the Canal.

WATER SUPPLY

The beds between the top of the Lower Fuller's Earth and the main clay beds of the Forest Marble comprise the 'Great Oolite aquifer' of which this area forms part of the recharge area. The water table in the aquifer above the Frome valley is perched and water escaping at the edges of the outcrop is diverted down shear planes or fissures to emerge at springs within the landslip. The aquifer is tapped by all the wells in the district (see Appendix 1) although only the Ewe Pens and Woodhouse water boreholes are believed to be still in use.

The Inferior Oolite is also a major aquifer and three of the wells (SO 90 SE/1,2 and 5) have tapped it.

All of the valleys in the district are dry apart from the River Frome, the Dunt stream and the un-named stream in the extreme south east.

APPENDIX 1

BOREHOLES

Abbreviations:

CG	Clypeus Grit	CtS	Cotteswold Sands Formation
D	Dagham Stone in WhL	FMb	Forest Marble Formation
HMB	Hampen Marly Formation	InO	Inferior Oolite Group
L	Limestone in FMb	LFE	Lower Fuller's Earth
LFr	Lower Freestone	LInO	Lower Inferior Oolite
LL	Lower Limestone	OoM	Oolite Marl
ScB	Scissum Beds	S.L.	Surface level of borehole
T.D.	Terminal depth	TTF	Througham Tilestone Formation
Ty	Taynton Limestone Formation	UInO	Upper Inferior Oolite
		ULi	Upper Lias
UTG	Upper Trigonia Grit	WhL	White Limestone Formation

		Depth m
1.	Manor Farm, Tarlton (1936) [9573 0007] S.L. c+149m OD (Re-examined in 1986)	
	Topsoil	c0.30
WhL	Limestone, oolitic, mostly thin bedded and cross-bedded	9.1
	Limestone, oolitic, fairly massive, Dagham Stone at c10.4m; corals, *Nerinaea* (Athelstan Oolite facies from c14.9m)	16.2
HMB	Clay, brown and green, marly	16.3
	Limestone, oolitic, very fine-grained, with marl films, cross-bedding and shelly bands inter-bedded with fine oolites from 18.9m	20.1
Ty	Limestone, oolitic, with many shell detritus layers, *Ostrea* and bivalves	22.9
	Limestone, oolitic, shell-detrital, sandy	24.7
	Limestone, grey, oolitic, shell-detrital	25.9
TTF	Limestone, sandy, very fine-grained, with thin sandy marl beds and wisps; fine shell detritus at 27.3m	27.4
	Limestone, clayey and finely sandy, with clayey sandy marl beds, oolitic near top, passing to silty mudstone with shell debris limestones	31.1

		Depth m
1. cont.		
LFE	Marl, sandy, fine-grained, with thin shelly limestones, rich in *Ostrea*	33.8
	Marl, dark grey, argillaceous, with much oyster debris and shell-rich limestone beds with *Ostrea acuminata*, silty in parts; limestones less common downwards; rolled and bored limestone pebbles at base	57.3
UInO	Limestone, blue-grey, rubbly, coarsely oolitic, with bored encrusted top, massive and paler below 58.5m, *Terebratula* and *Clypeus*	to T.D. at 62.8

2.	Pump House, Manor Farm, Tarlton (1946) [9612 0026] S.L. c+122m OD		
	WhL		17.7
	HMB, Ty and TTF		29.3
	LFE		61.0
	InO		107.3
	ULi	to T.D. at	109.7
3.	Jarvis's Quarry [9979 0001] S.L. c+116m OD		
	"Great Oolite"	to T.D. at	9.8
4.	Coatesfield Bridge [9786 0007] S.L. c+118m OD		
	"Forest Marble" and "Great Oolite"	to T.D. at	24.4
5.	Ewe Pens [9973 0279] S.L. c+153m OD		
L and WhL	Light coloured rock		30.5
HMB	Sand, clay, rock and blue marl		33.5

			Depth m
5. cont.			
Ty	Rock, hard grey and blue, and marl		39.6
TTF	Hard blue rock, sand and clay		44.6
LFE	Hard blue rock, and blue clay		65.9
UInO	Hard rock		71.7
LInO	Hard yellow and grey rock		82.5
CtS	Sand and sandstone		90.5
ULi	Blue clay and grey and yellow stone	to T.D. at	106.7

6. Hailey Farm
[9508 0145] S.L. c+153m OD

	L		c6
	WhL, HMB, Ty and TTF		c37
	LFE	to T.D. at	c40

7. Bathurst Sawmills TWA Observation
[9697 0161] S.L. +157.3m OD

	L		2.7
	WhL		25.9
	HMB		28.1
	Ty		32.5
	TTF		37.0
	LFE		65
	InO		107.5
	ULi	to T.D. at	118

		Depth m
8.	The Woodhouse TWA [9723 0320] S.L. +171.0m OD	
WhL	Limestone, light cream, fine-grained, hard, oolitic from 3m	19.3
HMB	Clay,grey,calcareous	21.0
Ty	Limestone, grey to buff, fine-grained, cream and slightly oolitic from 22 to 24m	28.2
TTF	Limestone, grey, slightly argillaceous, hard	29
	Limestone, very argillaceous, and calcareous clay	30
	Limestone, grey and brown, fine-grained	31.6
LFE	Clay, dark grey, and grey fine-grained limestone	39
	Clay, dark grey to T.D. at	43.0

APPENDIX 2

LOCALITIES

Abbreviations as Appendix 1.

		Thickness m
A. Section by River Frome. [9530 0492]		
LL	Oolite, buff and pale grey, poorly sorted and shelly	0.3
	GAP	0.3
ScB	Limestone, orange brown, ferruginous, shelly, marly, with a few sparry pellets	0.2
B. Pinbury Park. [9544 0490-9533 0490] Section in side of track		
CG	Limestone, pale brown, rubbly, bioturbated	c2
	Limestone, pale grey and pale brown, coarsely oolitic and pisolitic, shelly	c4
UTG	Limestone, pale brown, very coarsely shelly and shell-detrital with ferruginous ooliths	c1
	GAP	c1
OoM	Limestone, pale dove grey, micritic, with *Plectothyris fimbria*; passes down to off-white limestone	c3
LFr	Limestone, cream, oolitic, medium to coarse-grained	c8
C. Quarry near Cathedral Firs. [9829 0389]		
WhL	Limestone, very pale grey to cream, micritic, pelletal, bioturbated, roughly bedded	0.5
	Marl, pale yellow, gritty	0.05
	Limestone, as above	0.07-0.15
	Marl, as above	0.1
	Limestone, pale brown, micritic, slightly pelletal, slightly shelly	0.3-0.4

		Thickness m
C. cont.		
D	Limestone, pale brown, micritic, pelletal, very hard, with many vertical and oblique ochreous-lined burrows up to 5mm in diameter, passes down into	c0.4
WhL	Limestone, cream, pelletal, micritic, with a few shell fragments and burrows, softer than above; sharp base	0.5
	Limestone, cream, oolitic, sparry, massive, with common burrows	0.25
D. Quarry near Horseguards. [9765 0303]		
WhL	Limestone rubble, cream, pelletal, micritic	0.2
D	Limestone, cream, pelletal, micritic, intensely burrowed; passes to	0.3
WhL	Limestone, cream, pelletal, micritic, rubbly	0.2
E. Pit north of Square Tower. [9929 0297]		
	Topsoil	0.2
WhL	Limestone rubble, pale brown, shelly, micritic	0.3
	Limestone, pale brown, pelletal, sparitic, thinly and steeply cross-bedded (24 degrees to 050)	0.65-0.70
	Marl, pale yellow, oolitic	0.03-0.08
	Limestone, pale yellow, pelletal, shelly, sparitic, thinly cross-bedded to north	0.8
F. Quarry in Walnut Clump. [9903 0287]		
L	Limestone, pale brown, oolitic or pelletal, shell-detrital, medium to very-coarse grained, sparitic, thinly and unevenly bedded	0.4
	Marl, fawn, oolitic or pelletal	c0.05
	Limestone, as above, with white pellets and greenish micrite pockets	0.3-0.35
	Limestone, orange brown, pelletal, medium-grained, very shelly	0.45

		Thickness m
F. cont.		
	Marl, pale brown, gritty, soft	0.10
?WhL	Limestone, cream, pelletal, sparitic, shelly, thinly bedded at top, thicker and unevenly bedded downwards	0.5
G. Roadside section. [9520 0195]		
WhL	Limestone, pale grey, pelletal, micritic, semi-porcellanous and massive	0.6
	GAP	c1.8
	Limestone, grey, pelletal, micritic, slightly shelly, with brown pellets, very roughly bedded; sharp base	0.6
	Limestone, cream, pelletal, pellets crushed together, with a little interstitial spar	1.1
H. Roadside quarry. [9843 0189]		
WhL	Limestone, cream, pelletal, micritic, rubbly, passing down into very pale grey, massive, pelletal, micritic limestone	2.5
J. Quarry at Two Mile Lodge. [9892 0183]		
WhL	Limestone, off-white to cream, pelletal, with well-sorted grainstone texture and a few burrows, flat beds up to 0.15m	2.1
	Limestone, buff to fawn, pelletal, sparitic, beds up to 0.7m thick	2.0
K. Hailey Farm railway cutting. [9504 0176]		
WhL	Limestone rubble	0.5
	Limestone, buff, pelletal, micritic, medium to coarse-grained, roughly bedded and cross-bedded in parts	2.0
?D	GAP, some Dagham Stone rubble	c1
WhL	Limestone, pale brown, coarsely pelletal, micritic, massive	0.4
	Limestone, pale grey brown, pelletal, micritic, hard in	

		Thickness m
K. cont.		
	parts, rubbly in others, generally thick bedded (0.4-1.0)	c1.6
	Limestone, off-white to cream, pelletal, micritic, with a little shell detritus and thin uneven bedding	0.6
	Marl, grey, oolitic	0-0.2
	Limestone, off-white to pale yellow, pelletal, micritic, a little shell debris, thickly and well bedded 0.1-0.7	3.1
	GAP	c1
	Limestone, pale grey, finely oolitic, thinly bedded	0.6
L. Pit near Hailey Wood railway cutting. [9606 0125]		
L	Limestone, pale brown, oolitic, coarsely shelly, sparitic	c0.2
WhL	Limestone, pale brown, micritic, marly, finely shelly, bioturbated	c0.4
M. Hailey Wood railway cutting. [9620 0123] A fault crosses cutting near north-west end [9616 0125]		
Section north-west of fault:		
FMb	Mudstone debris, grey and brown	
L	Limestone, pale brown, oolitic, sparitic, very coarsely shell-detrital, cross-bedded	c2
Section south-east of fault:		
WhL	Limestone rubble	c1
?D	Limestone, buff, pelletal, micritic, with a little shell debris, intensely burrowed at top	1.40
WhL	Marl, ochreous	0-0.04
D	Limestone, cream to buff, fairly pelletal, micritic, with many ochre-filled burrows	0.36
WhL	Limestone, very pale grey, oolitic, medium to coarse-grained, with a little coarse shell debris, thickly bedded	3.30
	Limestone, very pale brown to fawn, oolitic, fine to medium-grained, poorly sorted grainstone, with a little coarse shell and lignite debris	1.00

		Thickness m
M. cont.		
	Limestone, very pale brown to fawn, oolitic, coarse-grained grainstone, with a little coarse shell debris, roughly bedded at top	0.95
	GAP	0.8
D	Limestone, pale grey to buff, oolitic, pelletal, semi-porcellanous, with scattered shell debris and ochre-lined irregular burrows up to 1cm in diameter; very hard upper surface, bored and encrusted with oysters	0.55
N. Quarry near Field Barn. [9983 0076]		
L	Limestone, pale grey and brown, pelletal, shell-detrital, medium to coarse-grained, sparitic, thinly and unevenly bedded, more massive near base; base uneven	c1.2
WhL	Limestone, very pale brown, pelletal, with a little shell debris, thickly bedded, but more massive and paler downwards; thin yellow marl seams up to 0.1m thick at 1.5, 1.8, 2.3, 2.6 and 2.8m, separated by massive limestone beds, sharp base	c3.0
D	Limestone, dove grey, pelletal, micritic, with ochre-lined irregular burrows up to 1cm in diameter persisting to c0.3m, passing into cream, pelletal, micritic limestone	0.5
P. Approach cutting to Sapperton Canal Tunnel. [9664 0056]		
L	Limestone, pale brown, pelletal, shell-detrital, medium to coarse-grained, sparitic, thinly and unevenly bedded, more massive near base (up to 0.3m)	c4.8
WhL	Limestone, very pale brown, marly, shelly, fairly soft	0.2
	Limestone, dove grey, pelletal, micritic, massive	0.40
Q. Quarry by Foss Way. [9988 0015]		
L	Limestone, pale to mid grey, oolitic, sparitic, coarsely shell-detrital, cross-bedded and massive, with seams of grey clay 0.2 and 0.4m thick near top	c5.0
	Clay, grey	0.1

Thickness m

R. Jarvis's Quarry. [9984 0004]

L Limestone, pale grey to orange brown, oolitic, sparitic, with medium to coarse-grained shell-detritus and micrite pockets, cross-bedded to south 1.5

S. Pit north-east of Square Tower. [9943 0288]

L Limestone, pale orange brown, oolitic, sparitic, with fine to coarse-grained shell-detritus, cross-bedded to south 1.7

T. Quarry near Horseguards. [9791 0259]

WhL Limestone, cream to pale brown, pelletal, micritic, a little shell debris, roughly bedded, a little interstitial spar c1.0

U. Quarry near Ivy Lodge. [9897 0257]

L Limestone, cream to brown, pelletal, sparitic, roughly cross-bedded, with yellow limonitic pockets 1.8

V. Quarry west of Four Mile Lodge. [9598 0206]

L Limestone, pale orange brown and brown, pelletal, sparitic, with medium to coarse-grained shell-detritus, cross-bedded to south and north near top, roughly and thinly bedded below; thin yellowish marl seam at 1.5 2.5

W. Ditch in Sweethills Plantation. [9924 0201]

L Limestone, pale brown, pelletal, sparitic, shell-detrital, thinly cross-bedded to south 0.6

Limestone, off-white, pelletal, sparitic, shell-detrital 0.1

X. Pit near Four Mile Lodge. [9642 0193]

WhL Limestone rubble, pale brown, pelletal, micritic 0.2

D Limestone, dove grey, pelletal, micritic, porcellanous, with ochre-lined irregular burrows; passes down into c0.2

WhL Limestone, cream to buff, pelletal, micritic, slightly shelly, roughly and thinly bedded 1.0

		Thickness m
Y. Pit south of A419. [9532 0190]		
WhL	Limestone, grey, pelletal, micritic, massive	0.8
Z. Pit north-east of Hailey Lodge. [9671 0189]		
L	Limestone, pale brown, pelletal, sparitic, very shelly, thinly cross-bedded	c0.3
D	Limestone, pale brown, porcellanous, pelletal, micritic, intensely burrowed, very hard	0.15
WhL	Limestone, cream, pelletal, micritic, slightly shelly	1.2
A1. Pit south-east of Sawmill. [9672 0136]		
D	Limestone, pale brown, porcellanous, pelletal, micritic, intensely burrowed, very hard; passes down into	0.3
WhL	Limestone, cream to buff, pelletal, micritic	0.6
B1. Pit near railway cutting. [9617 0130]		
L	Limestone, brown and grey, oolitic, sparitic, with medium to coarse-grained shell-detritus, dip 3 degrees to 140	0.5
C1. Pit south of Kembleview Plantation. [9959 0112]		
L	Limestone, very pale grey, pelletal, sparitic, slightly shell detrital, roughly bedded with low dip to south, trough cross-bedded to west	0.5
D1. Pit 500m SSE of Sawmill. [9665 0111]		
L	Limestone, pale grey, oolitic, sparitic, coarsely shell detrital, flaggy	0.2
WhL	Limestone, grey, micritic, extremely hard	c0.1
	Limestone, pale brown, pelletal, hard and rubbly	0.3
E1. Pit near The Star. [9531 0089]		
L	Limestone, very pale brown to cream, oolitic, sparitic, with medium to coarse-grained shell detritus, flaggy	c1.0

Thickness m

F1. Section by Tarlton Bridge. [9677 0021]

L	Limestone, pale brown, pelletal, sparitic, with medium to coarse-grained shell detritus, flaggy, roughly bedded and cross-bedded to east	1.2

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