Wansunt Pit, Dartford Heath

[TQ 515 738]

D.R. Bridgland

Highlights

Controversial Thames gravels, variously correlated with the Black Park or Boyn Hill Formations, are overlain at this site by palaeolith-bearing fine-grained sediments.

Introduction

Wansunt Pit is one of many old workings that once exploited the Pleistocene gravels and the underlying Thanet Sand of Dartford Heath. Although most have been infilled, the floor of Wansunt Pit has become a factory site and steep faces on its south-eastern side are still available for study. There is a long history of interest in the Dartford Heath deposits, which have been correlated by some workers with the famous Palaeolithic fossiliferous sediments at Swanscombe, a few kilometres to the east (Chandler and Leach, 1911, 1912; Leach, 1913; Smith and Dewey, 1914; Dewey *et al.,* 1924). A considerable controversy has existed since the turn of the century over the relations between the gravel at Dartford Heath and the various deposits at Swanscombe (Hinton and Kennard, 1905; Chandler and Leach, 1907; Zeuner, 1945), a problem that is by no means resolved (Bridgland, 1988a). The former was named the Dartford Heath Gravel by Gibbard (1979, 1985), who considered it to be earlier than the Swanscombe deposits and to be a downstream continuation of the late Anglian Black Park Gravel of the Middle Thames (see Chapter 3). It is difficult, however, to reconcile this interpretation with evidence from other sites in the region and with the projected downstream gradients of the Black Park and Boyn Hill Gravels of the Middle Thames.

Description

Wansunt Pit lies on the western side of Dartford Heath, excavated into the edge of the largely gravel-covered 'plateau'. The thickest depth of gravel recorded from any Thames valley site was once exposed here, almost 20 m in all (Smith and Dewey, 1914). Few detailed descriptions of exposures in the gravel exist. There has been speculation, however, that two separate aggradations were represented, one banked against the other (Cornwall, 1950; (Figure 4.8)A). No observations of two gravel bodies with such a relation have ever been made, however; published descriptions of pits on Dartford Heath all suggest that a single aggradation was represented (Chandler and Leach, 1911, 1912; Smith and Dewey, 1914; Dewey *et al.,* 1924; Dewey, 1959).

Chandler and Leach (1912) reported that up to 13 in of gravel was exposed in Wansunt Pit, the upper 4 m loamy and the remainder cross-bedded and sandy ((Figure 4.8)B). They believed that most of the non-local gravel clasts occurred in the lower sandy gravel, which suggests that the upper 4 m may have represented locally-derived, possibly colluvial material. The lower sandy gravel also yielded mammalian remains, the most exhaustive list being provided by Leach (1913). He recorded *Palaeoloxodon antiquus, Cervus elaphus, Cervus* sp., *Bos* or *Bison* sp., *Equus caballus* and indeterminate rhinoceros.

Over part of *the* site the gravel was cut out by overlying fine-grained deposits ('Wansunt loam') from which Palaeolithic artefacts were obtained (Chandler and Leach, 1911, 1912; Smith and Dewey, 1914). The sequence therefore comprised (see also (Figure 4.8)B):

		Thickness
5. Unstratified, loamy gravel	(?colluvium)	uncertain
4. Stratified silts and clays 3. Dark clay	'Wansunt loam'	0–3 m

2. Loamy gravel, planar-bedded	Dartford Heath Gravel	4 m
1. Sandy gravel, cross-bedded		up to 11 m

Smith and Dewey (1914) recorded a greater thickness for bed 2 (over 6 m) and reported that another 3 m of clayey gravel occurred beneath the floor of the pit, bringing the total thickness of Pleistocene deposits to nearly 20 m.

The stratified silts and clays (bed 4) yielded most of the flakes and implements, as well as fragments of mammal teeth (*Equus caballus* and *Bos* sp.), although the dark clay (3) contained a few flakes. Beds 3 and 4 were interpreted by Chandler and Leach as the fill of a small stream channel (Wansunt loam' — see below). The uppermost unstratified gravel (5) was interpreted as slope wash from the higher part of the heath to the south (see (Figure 4.8)B; Chandler and Leach, 1912).

A number of reviews and catalogues of the archaeology of Wansunt Pit have appeared since the initial discoveries, notably those of Clinch (1908), Smith (1926), Anon. (1931) and Wymer (1968).

Interpretation

Wansunt Pit provides valuable exposures in what many have regarded as the oldest gravel deposited by the Thames in its post-diversion valley. It is the type locality of the Dartford Heath Gravel (Gibbard, 1979), the name given to this high-level deposit in the Lower Thames. Part of the scientific importance of this site arises from the long-standing controversy over the age of the gravel and its relation to other deposits in the Middle and Lower Thames. For this reason, a detailed examination of past references to this and other Dartford Heath localities will be included here, to illustrate the development of the controversy.

Probably the earliest description of the Dartford Heath Gravel was by Trimmer (1853), who noted its continuation on the eastern side of the Darent valley as far as Greenhithe. Trimmer also traced his 'Dartford Gravel' southwards up the Darent valley to Sutton-at-Hone, but later mapping by the Geological Survey has shown the latter to be a more recent deposit (New Series, Sheet 271). Trimmer recorded 15 ft (4.5 m) of gravel exposed in a pit at Wilmington, on the south-eastern side of the heath. He described at length the composition of the gravel in the Dartford area, recording the presence of flints, southern lithologies from the Weald and quartzite pebbles from the Midlands. He noted that the spreads of gravel at Dartford Heath and Dartford Brent (on the opposite side of the Darent) coincide with the former confluence of the rivers Darent and Thames.

Evans (1872) figured a hand-axe found by F.C.J. Spurrell some 8 ft (2.5 m) beneath the surface of the Dartford Heath Gravel. He considered this gravel to be 'that of the upper level of Dartford Heath' (Evans, 1872, p. 532) and attributed it to the Thames rather than the Darent or the Cray. The above quotation from Evans is of interest, since it suggests that he may have observed more than one gravel unit at Dartford Heath, many years before the controversy over the terrace sequence in the Dartford area was initiated. The comment may simply mean, however, that Evans attributed the Dartford Heath deposits to a higher rather than a lower terrace. A second implement was found nearby in 1879 (Spurrell, 1880; Evans, 1897). Spurrell (1880) remarked that the 'Dartford Gravel' extended for many miles on either side of the present River Thames and that it contained Palaeolithic implements. He later illustrated a section at Dartford Heath, showing brickearth channelled into the edge of the gravel (Spurrell, 1886, plate 1). As no details of location or orientation were given, it is impossible to judge whether this might be an early reference to the 'Wansunt loam', although Spurrell (1886, p. 102) attributed it to the 'uppermost layers at Crayford' (for summary of Crayford deposits see below, Lion Pit).

Prestwich (1891) correlated the Dartford Heath aggradation with his 'Upper Valley Gravels' of the Darent, which he traced from the modern Darent–Eden watershed at Limpsfield, where palaeoliths were recovered. No artefacts or fossils were recorded at Dartford by Prestwich in this paper; a reference to this author, without date or source, by Chandler and Leach (1912), attributing rhinoceros, mammoth and *Corbicula fluminalis* to the Dartford Heath Gravel, remains a mystery. According to Newton (1895), however, Spurrell had found bones of mammoth, rhinoceros, ox, horse and deer in pits at Northfleet and Dartford Brent and, at the latter (probable location [TQ 555 743]), had also found the shells of *C. fluminalis, Bithynia tentaculata* (L.), *Valvata piscinalis* and *Pisidium fontinale.* This fauna indicates that temperate-climate sediments are (or were) included within the deposits covering Dartford Heath and Dartford Brent. Spurrell himself

recorded finds of mammoth and rhinoceros from the Dartford Heath gravels, in a brief report of a Geologists' Association excursion that visited Wansunt Pit (Spurrell, 1893). In another excursion report, Salter (1903) noted that sections 54 ft (16.5 m) deep were observed.

Spurrell (1886) and Salter (1903) both associated the Dartford Heath deposits with the high-level gravels of Kingston Hill and Wimbledon Common, which later appeared as 'Glacial Gravel' rather than terrace gravel on the New Series Geological Survey map (1921, Sheet 270). Spurrell's and Salter's views thus pre-empted the controversy that followed. This began, however, with the first real dissension from the view that the Dartford Heath and Swanscombe gravels were part of the same 'High Terrace' sheet, by Hinton and Kennard (1905). They believed that the Dartford Heath Gravel represented the earliest Lower Thames terrace (their 1st Terrace), aggraded to 136 ft (41.5 m) O.D., whereas the Swanscombe deposits, which reach only 100 ft (30.5 m) O.D., were assigned to their 2nd Terrace.

Chandler and Leach (1907, 1911, 1912) described more than 12 m of cross-bedded sands and gravels at Wansunt Pit, resting on Thanet Sand at 90 ft (27.5 m) O.D., and took these to be 'fluviatile drifts lying at the same level as the Swanscombe and Galley Hill gravel spreads; contemporaneous and, arguably, continuous with them, but now separated from them by the subsequent erosion of the Darent valley' (1907, p. 122). In this series of papers they consistently refuted the idea that the gravel at Dartford Heath was the result of an earlier, higher-level aggradation. They noted, with the collaboration of E.T. Newton, the admixture in the gravels of the characteristic suite of 'exotic' lithologies, which occurs throughout the Thames Basin, and southern rocks from the Darent catchment. Their observation of *Rhaxella* chert was the earliest record in the Thames valley of this important rock-type, attributed at that time to the Arngrove Stone of Oxfordshire and Buckinghamshire (Newton, 1907). Recent studies have shown that most, if not all, of the *Rhaxella* chert in the Pleistocene of the London Basin was derived from North Yorkshire during the Anglian glaciation (Bridgland, 1980, 1986b). Its presence in Pleistocene deposits in southeast England is therefore important evidence for an age contemporary with, or later than, this glacial event.

The interpretation of the Dartford Heath deposits promoted by Chandler and Leach was supported by Burchell (1933), King and Oakley (1936) and Marston (1937). The fluctuation of opinion concerning these deposits is reflected in the various Geological Survey memoirs describing the area. In the earliest of these volumes, Whitaker (1884, 1889) listed exposures at Dartford Heath and Dartford Brent and grouped the deposits there with gravels extending further eastwards to Swanscombe, considering them all to represent a dissected 'high terrace'. In the first edition of *The Geology of the London District,* Woodward (1909) reproduced Hinton and Kennard's classification of the Thames terraces, distinguishing the gravels of Dartford and Swanscombe as 1st and 2nd Terraces respectively. In the second edition of this memoir (Woodward *et al.,* 1922), the distinction was dropped and both Dartford Heath and Swanscombe were again included in the 'High Terrace'. Following a resurvey of the London district, undertaken before the First World War, the geomorphological feature and associated deposits formerly referred to as the 'High' or '100 ft' terrace were reclassified as 'Boyn Hill Terrace' (Bromehead, 1912; Dewey and Bromehead, 1915; Sherlock and Noble, 1922). On the New Series geological map of Dartford (Sheet 271), the Dartford Heath deposits, in common with patches of gravel east of the Darent from Dartford to Northfleet, duly appeared as Boyn Hill Gravel. In the accompanying memoir, Dewey *et* al. (1924) remarked that a number of exposures between Dartford and Northfleet indicated that the Boyn Hill Gravel occupies and overlies a channel running west to east; the base of the deposits thus rises to the south and to the north, where their lower levels are separated from the modern river by a buried ridge of bedrock. Rapid rises in the bedrock surface towards the edges of a large trough-feature of this kind may explain the variations in bedrock surface level beneath different parts of the Dartford Heath deposits that are apparent from published descriptions over the years.

The controversy initiated by Hinton and Kennard (1905) was rekindled by Zeuner (1945), who returned to a model in which the Dartford Heath Gravel was classified with the high-level deposits of Kingston and Wimbledon. Zeuner believed that all these deposits were related to the recently described Winter Hill Terrace of the Middle Thames (see Chapter 3). He considered that the 'bench' of the Winter Hill Terrace (the base of the terrace deposits) divided near the Thames–Colne confluence and that the higher of the two 'benches' so produced passed through the Finchley Depression, following Wooldridge's (1938) intermediate course to Essex (Chapter 3 and (Figure 3.4)), whereas the lower 'bench' followed the modern course of the river. Zeuner named the deposits overlying these two erosional features the 'Finchley Leaf and 'Kingston Leaf' respectively. The Kingston and Wimbledon gravels had previously been assigned to the Winter Hill Terrace by Saner and Wooldridge (1929). Zeuner (1945) traced his Kingston Leaf 'bench' from Burnham

Beeches (67 m O.D.) downstream to Hillingdon (55 m O.D.), Kingston and Richmond Hills (46 m O.D.) and Dartford Heath (27.5–30.5 m O.D.), therefore correlating the Dartford Heath Gravel with the lower division of the Winter Hill Terrace. He believed the Dartford Heath deposits to be older than those at Swanscombe, which overlie his 'Boyn Hill bench' at 75 ft (23 m) O.D., and that the formation of the two 'benches' was separated by the glaciation of the London area (see above, Hornchurch). In reintroducing the idea that the Dartford Heath deposits were distinct from the Boyn Hill Formation, as represented elsewhere in the Lower Thames, Zeuner perpetuated a controversy that has considerable significance for the classification and dating of the Lower Thames succession and its correlation with sequences else where. Later contributions to this debate will be considered below, in the section on correlation.

Other important Dartford Heath sites

Following the early descriptions of Wansunt Pit, most work on the Dartford Heath deposits has taken place at other sites. Newton (1930) described gravels penetrated by curious cones of sandy clay (loam) in Pearson's Pit [TQ 533 737], on the eastern side of the Heath. These features may have been similar to the 'pipes' that disrupt the Lynch Hill Gravel at Furze Platt, which are thought to result from Chalk solution (see Chapter 3, Cannoncourt Farm Pit). Pearson's Pit also produced implements from the body of the Dartford Heath Gravel (Marston, 1937; Dewey, 1959; Wymer, 1968). Marston concluded from these discoveries that the gravel represented 'a later stage of the Barnfield later Middle Gravels and Sands' (Marston, 1937, p. 351) and was of later age than the Swanscombe Lower and Lower Middle Gravels. This was in general agreement with King and Oakley (1936), who placed the Dartford Heath Gravel in their 'Middle Barnfield', or 'Late Boyn Hill Stage'. Wymer (1968) suggested that the implements may have come from the overlying 'loam', but Dewey (1959) clearly reported that some of Mr Pearson's personal collection of hand-axes had been derived from the lowest part of the gravel, the base of which was about 33.5 m above O.D.

A third important quarry that exploited the Dartford Heath Gravel was Bowman's Lodge Pit [TQ 518 738], a short distance to the east of the Wansunt Pit. Opened after the Second World War, the excavation of this pit was closely monitored by the archaeologist, P.J. Tester, who described Palaeolithic artefacts obtained from the surface of the gravel, beneath an overlying brickearth that he interpreted as a continuation of the Wansunt loam' (Tester, 1951, 1975). Cornwall (1950) described Bowman's Lodge Pit, noting that the base of the gravel rose eastwards from 26 m O.D. to 29 m O.D. in only a few hundred metres along the northern side of the pit, the gravel correspondingly thinning from 7.5 to 6 m. This appears to represent the eastern edge of gravel deposition on Dartford Heath.

Excavations in 1952 on the eastern fringe of Dartford Heath yielded Acheulian implements from fluviatile sands and loams overlying Chalk at 26.5 m O.D. (Tester, 1953). Tester concluded that these were typologically similar to the Middle Barnfield industry of Swanscombe; strong evidence, he considered, for the Boyn Hill age of at least the eastern portion of the Dartford Heath Gravel.

The 'Wansunt loam' and its Palaeolithic industry

Chandler and Leach (1911) were the first to observe the clays and silts ('Wansunt loam'), cut into the Dartford Heath Gravel, that yielded Palaeolithic artefacts and mammal teeth (see above, Description). They later described in detail how the gravel was truncated by a steep slope, in the north-eastern corner of Wansunt Pit, against which the silts and clays were banked (Chandler and Leach, 1912; (Figure 4.8)B). They interpreted this feature as the edge of a channel cut into the Dartford Heath Gravel, probably formed by a tributary stream and of significantly younger age (Chandler and Leach, 1911, 1912). Leach (1913) described a further, lower channel in Wansunt Pit, filled with hillwash and loam and containing charcoal and occasional palaeoliths. Chandler and Leach (1912) also recorded occasional finds of artefacts in the Dartford Heath Gravel itself, from Wansunt Pit and other sites, mainly in the upper loamy gravel, but including a rolled example from the cross-bedded gravel.

In 1913 Smith and Dewey (1914) conducted excavations for the British Museum at Wansunt Pit. Various cuttings were made in and to the north-east of the pit, in order to test the interpretation by Chandler and Leach of the clayey and silty deposits as the channel-fill of a minor tributary, a hypothesis put forward without the northern side of the inferred channel having been observed. The results of this work revealed that no northern side is preserved and that the clays and silts extend to the front edge of the terrace remnant at Dartford Heath, where they are truncated by the slope to the modern

Thames floodplain. It was concluded, therefore, that the fine-grained sediments were emplaced above and against the gravel by the Thames itself, possibly near the end of 100 ft (Boyn Hill) Terrace times (Smith and Dewey, 1914; Dewey *et al.,* 1924; Smith, 1926). These authors recorded many Acheulian implements from the clays and loamy and a few from the Dartford Heath Gravel itself. Following Smith's and Dewey's work, the deposits formerly attributed to the 'Wansunt Channel' have been generally referred to as the 'Wansunt loam'.

The artefacts collected from the Wansunt loam' were in an excellent state of preservation and included several sets of conjoinable flakes, suggesting the close proximity of a working floor. Indeed, Chandler and Leach (1912, p. 108) reported that 'At least one 'nest' of flakes was found such as would result from flaking on the spot'. Finished tools were also found, dominantly cordate and ovate hand-axes, although side- and end-scrapers were also identified (Wymer, 1968). Occasional flakes have been interpreted as showing evidence of Levallois technique (Chandler and Leach, 1912; Wymer, 1968), although Roe (1968b) listed no Levallois material from the site.

The Bowmans Lodge industry, from a supposed continuation of the Wansunt loam', is similar to that from the original site, mainly comprising typical Acheulian material, but with the important addition of a collection of small 'chopper-cores' (Tester, 1951, 1975; Wymer, 1968). The occurrence together of 'chopper-cores' and hand-axes in similar states of preservation, as they are in the Bowmans Lodge collection, is extremely rare in the Thames valley (Wymer, 1968). As at Wansunt Pit, occasional evidence of Levallois technique has been claimed (Tester, 1951, 1975; Wymer, 1968; Roe, 1981, p. 228). The Bowmans Lodge assemblage was used by Roe (1964, 1968a, 1981) in his statistical analysis of the typology of British Lower and Middle Palaeolithic hand-axe assemblages. Roe was impressed by the undisturbed nature of this material, which fell within his Group VI (ovate tradition, more pointed types), as did the assemblage from the Swanscombe Upper Loam, whereas the industry in the Middle Gravels at Swanscombe fell within his Group II (pointed tradition with some ovates). Roe's analyses, based on measurements of breadth and thickness, add support to the suggestion that the 'Wansunt loam' post-dates much of the Swanscombe sequence, although this is based largely on the superposition of Roe's Group VI over Group II at Swanscombe itself. It is clear, however, that the Swanscombe situation, with 'pointed' industries preceding 'ovate' ones, does not hold good for Britain as a whole (Roe, 1981, pp. 302–3). What remains uncertain is whether this model is stratigraphically valid for the immediate Swanscombe–Dartford area.

A hand-annotated 1:10,560 map of the Wansunt Pit site formerly belonging to A.L. Leach, a copy of which was supplied to the Nature Conservancy Council by J.N. Carreck, clarifies a number of questions about site locations in the vicinity of Wansunt Pit. Wymer (1968) suggested that the 'Wansunt loam' was first discovered in Martin's Pit; the above-mentioned map, however, shows Martin's Pit to have been to the south of Wansunt Pit, quite remote from the edge of the loam. The annotated map suggests that the southern edge of the Wansunt loam' passes through the northern part of the present GCR site.

Correlation with the Lower Thames sequence

The continuing controversy over the correlation between the Dartford Heath deposits and the Swanscombe sediments has hampered the integration of these terrace remnants in north Kent with the established Thames sequence.

Cornwall (1950) noted that there was no evidence for a protracted period of subaerial weathering of the Dartford Heath Gravel surface prior to the deposition of the Wansunt loam', a fact that suggested to him that the two deposits were not separated by any lengthy interval of time. He claimed, however, that the industry from the surface of the gravel appears, on typological grounds, to be slightly later than the 'Middle Barnfield Stage' at Swanscombe. These conclusions argue against the Hinton and Kennard model of the Dartford Heath Gravel as a separate, pre-Boyn Hill aggradation, especially if Smith and Dewey (1914) were correct in attributing the Wansunt loam' to the Thames. It is difficult to envisage the Thames depositing the latter sediments above the Dartford Heath Gravel after rejuvenation had taken the river on to a lower terrace level, yet Cornwall considered the Wansunt loam' to be of 'late Boyn Hill' age (therefore post-dating a supposed rejuvenation from the Dartford Heath to the Boyn Hill level). This would appear to favour the interpretation promoted by Chandler and Leach, in which the Dartford Heath deposits are seen as the culmination of the Boyn Hill Gravel aggradation. In an attempt to find a compromise between the two theories, Cornwall suggested that the highest parts of the heath might represent an earlier terrace, against which the Boyn Hill Gravel has been banked ((Figure 4.8)A), although he presented no field evidence in support of this idea; a similar suggestion had been made by Zeuner (1945, p.

120), in a footnote. If this was the case, the higher of the two units would be the Dartford Heath Gravel and the lower would be attributable to the Orsett Heath Gravel (Bridgland,, 1988a; see Introduction to this chapter).

Dewey (1959) reviewed this continuing controversy, as well as making a number of important observations and describing sites about which little or nothing has been published. He noted that at Pearson's Pit [TQ 530 733] the Dartford Heath Gravel overlay a buried channel, some 2.5 m deep and 30 m wide, cut into the Thanet Sand. He attributed this feature to a tributary flowing across the area to join the main valley and correlated it with the Lower Gravel and Lower Loam channel at Barnfield Pit, with which it is altitudinally comparable, concluding that the excavation of the latter pre-dated the deposition of the Dartford Heath Gravel. This interpretation implies that the Dartford Heath Gravel is part of the same terrace aggradation as the upper part of the sequence at Swanscombe, reaffirming the views of Chandler and Leach (1907, 1911, 1912).

The controversy was further intensified by Evans (1971). According to Evans, the first three terraces to be formed in the modern Thames valley had progressively shallower downstream gradients, indicating that base level rose between each, rather than falling (as would be expected in a terrace sequence — see Chapter 1). These three terraces were the Kingston Leaf, Black Park and Boyn Hill aggradations, for which Evans estimated contemporary sea levels of 27 m, 29 m and 32 m respectively. Wooldridge and Linton (1955) had attributed Zeuner's 'Kingston Leaf at Wimbledon and Kingston to the Black Park Terrace (as defined by Hare, 1947), but Evans did not accept this correlation, regarding the Kingston deposits as the result of a separate, higher-level aggradation, somewhat earlier than the Black Park Terrace. Evans's hypothesis implied that the Kingston Leaf and Black Park gravels, because of their steeper downstream gradients, should fall below the Boyn Hill Terrace surface somewhere in the London area, so that the products of the three aggradations are superimposed in the Lower Thames. Therefore (according to Evans), the deposits at Dartford, which are aggraded to the highest level of any Lower Thames gravels, would represent the latest of these three aggradations, that of the Boyn Hill Terrace. The Black Park Gravel, if represented at all at Dartford, would fall within the lower part of the sedimentary sequence there, beneath the Boyn Hill deposits.

However, P.L. Gibbard (pers. comm.) has refuted Evans's idea of a separate Kingston Leaf; he has pointed out that the Kingston Hill deposits are higher than the main Black Park Gravel because they represent the equivalent terrace of the tributary River Wey. Gibbard (1979) reaffirmed the conclusions of Hinton and Kennard (1905) and Zeuner (1945) by correlating the Dartford Heath Gravel with the Black Park Gravel of the Middle Thames, citing the similarity in gravel composition between Dartford Heath and Richmond in support of this argument. He later reiterated this view and suggested that a downstream continuation of the Dartford Heath Gravel could be recognized in Essex, at Orsett (TQ 655 811; Gibbard *et al.,* 1988). However, Bridgland (1980) followed Evans (1971) in concluding that the Black Park Gravel falls below the Boyn Hill aggradation in the London area. He suggested that the Swanscombe Lower Gravel and Loam might represent part of the Black Park aggradation, but that the Swanscombe Lower Middle and Upper Middle Gravels and the Dartford Heath deposits represent the Boyn Hill Gravel. Projection of the Black Park and Boyn Hill Gravels downstream from the Middle Thames, using data presented by Gibbard (1985) in the latter area, indicates that they should intersect between London and Dartford (Figure 4.7). The Black Park surface would therefore be expected to be lower, not higher, than the Boyn Hill surface in the Dartford area, as Evans predicted. However, the elevation of the upper surface of the Dartford Heath Gravel, 41.5 m O.D., is *c.* 7 m higher than the general level of the Boyn Hill Terrace surface in this area.

Other explanations of the anomalously high level of part of the Dartford Heath spread must be considered, therefore. It is difficult to envisage a mechanism that could result in the localized accumulation of fluviatile deposits so high above the normal floodplain level. The location of the Dartford Heath deposits at the back edge of the terrace, at the apex of a major bend in the floodplain at that time and in the region of the multiple Darent/Cray/Thames confluence. (Figure 4.1), may be of relevance. Dewey *et al.* (1924, p. 90) opened their account of the Boyn Hill (100 ft) Terrace of the Dartford area by noting that: 'the gravel spreads are, in part, of the nature of deltas at the confluence of the tributaries with the main river'. The Orsett remnant, claimed by Gibbard *et al.* (1988) as a downstream correlative of the Dartford Heath Gravel, is only 2–3 m higher than the Boyn Hill/Orsett Heath Gravel at the Orsett Heath type locality, nearby. Its extra elevation may well reflect its position at the back-edge of an Orsett Heath Gravel terrace remnant.

Records of buried channels beneath the terrace sediments of the Dartford area (Dewey *et al.,* 1924; Dewey, 1959) may be of some significance to this discussion. Bridgland (1980, 1983a, 1983b, 1988a) described a major buried channel system underlying the downstream continuation of the Boyn Hill/Orsett Heath Gravel across eastern Essex, which he correlated with the Lower Gravel Channel at Swanscombe and the Clacton Channel (see Chapter 5). The terrace gravels overlying this channel system, the highest post-diversion Thames deposits recognized in eastern Essex by Bridgland, were correlated with the Boyn Hill/Orsett Heath Gravel, no continuation of the Black Park Gravel apparently being represented. This supports the view, first suggested by Evans (1971), that the Black Park Terrace passes beneath the later Boyn Hill aggradation east of London; the former aggradation is probably represented within the channel deposits that underlie the latter in this area (Bridgland, 1980, 1988a; (Figure 1.3)). This interpretation gains further support from the low height of the till at Hornchurch (see above, Hornchurch) and the gradient of the earliest River Lea deposit, the Westmill Upper Gravel (Cheshire, 1983c, 1986a; Chapter 3, Part 2; (Figure 4.7)), both of which imply that the Lower Thames valley was excavated to below 30 m O.D. by the late Anglian, the recognized age of the Black Park Gravel.

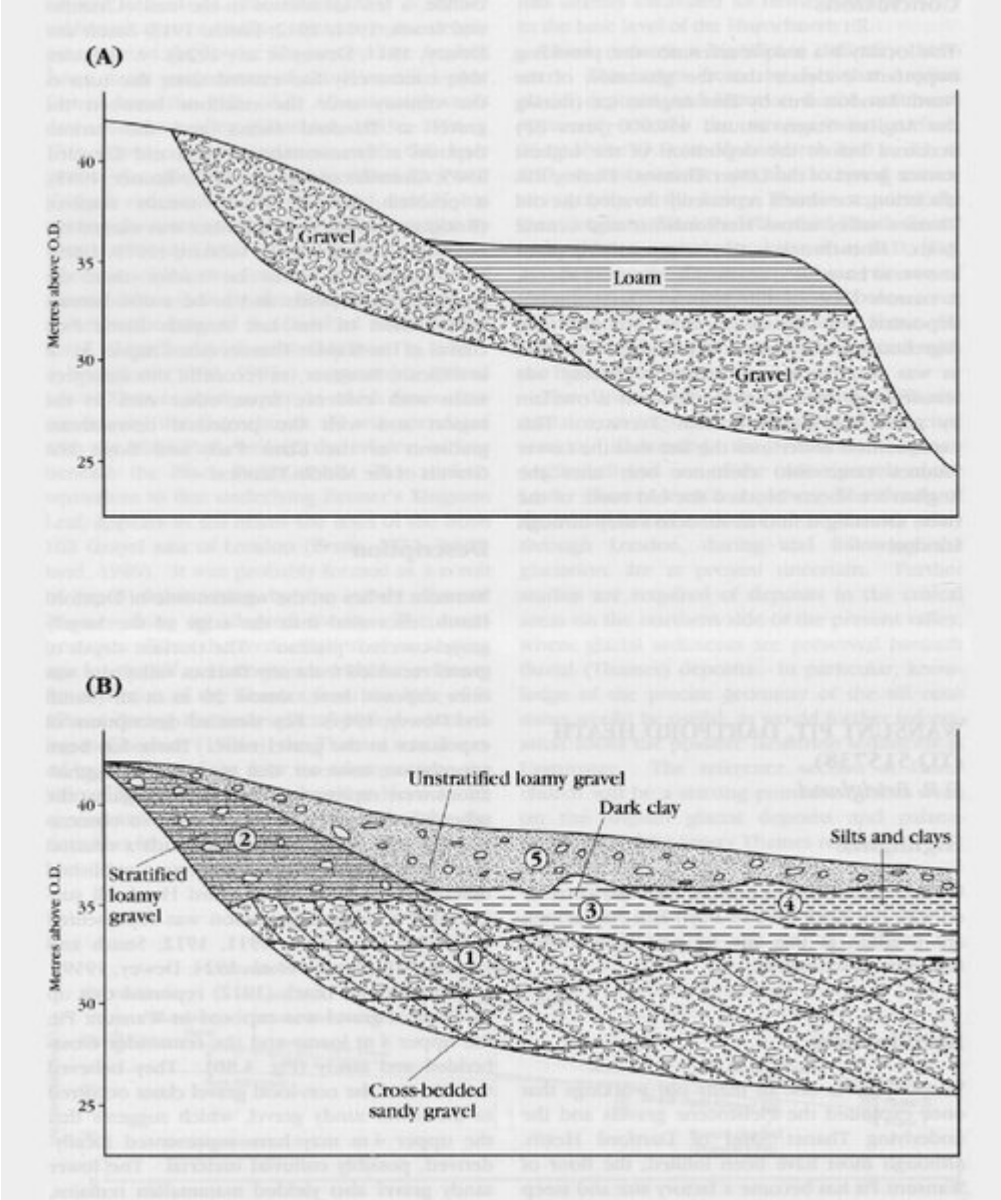
The balance of evidence, therefore, appears to favour the interpretation of the Dartford Heath Gravel as part of the Boyn Hill/Orsett Heath Formation. The most significant points are: (1) the recorded thickness of the gravel at Dartford Heath, which implies a single aggradation up to 20 m thick; (2) the record, by Dewey *et al.* (1924), of a major channel beneath the mapped spreads of gravel east of Dartford Heath, apparently equivalent to that beneath the Boyn Hill/Orsett Heath Gravel of the Swanscombe area; (3) Dewey's (1959) observation of a tributary channel, cut to the base level of the Swanscombe Lower Gravel, beneath the Dartford Heath Gravel at Pearson's Pit (which reinforces 2); (4) the fact that the Black Park Formation, with its steep long-profile, appears likely to fall below the Boyn Hill level upstream of Dartford, therefore precluding correlation with the Dartford Heath Gravel (Figure 4.7); and (5) evidence from the glacial history of the area to the north-west, which indicates that the Lower Thames valley system was excavated to below the level of the Dartford Heath Gravel by late Anglian times. These points combine to provide a strong case for assigning the entire Dartford Heath sequence to the Boyn Hill/Orsett Heath Formation.

The interpretation of the Dartford Heath Gravel and associated deposits by Gibbard (1979; Gibbard *et al.,* 1988), and that favoured in this report, are clearly incompatible. These different views represent the latest episode in a long-standing controversy regarding the interpretation and wider correlation of the Lower Thames sequence. The resolution of this controversy is a task requiring urgent attention. The last remaining exposures of this deposit, at Wansunt Pit, will be of prime importance for future work on the gravel. The possibility that part of the Wansunt loam' remains *in situ* at the site heightens its scientific importance. Future work may determine whether a surviving remnant of the loam is indeed present and provide new information about the origin and age of both the loam and the underlying gravel.

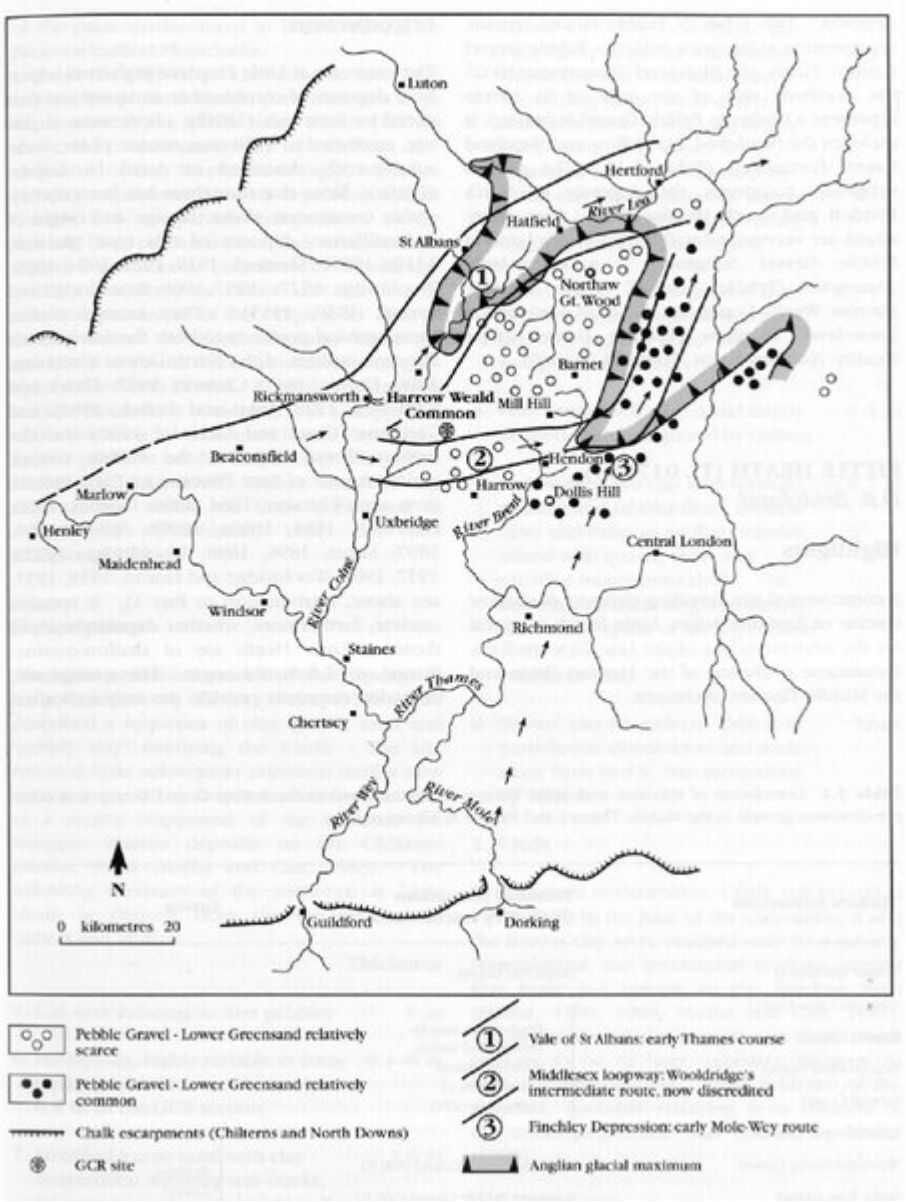
Conclusions

Wansunt Pit provides exposures in the Dartford Heath Gravel, the highest-level terrace deposit in the Lower Thames. Controversy has continued throughout this century over the relation of this deposit to others in the terrace 'staircase' in this part of the valley, particularly the famous Swanscombe skull site. Some workers have regarded the gravel at Wansunt Pit as a remnant of a very early terrace, one that is not preserved downstream. Others have regarded it as merely an unusually high 'feather-edge' remnant of a high-level terrace that is widely recognized elsewhere in the valley, including Swanscombe the view favoured in this volume. The resolution of this dispute is of considerable urgency, as it has implications for the dating of the Pleistocene terrace sequence in the Lower Thames and for relating it to the original formation of this part of the valley, following the river's diversion by ice around 450,000 years ago. An important aspect of the geological interest at Wansunt Pit is the occurrence there, in a loam deposit overlying the gravel, of a rich assemblage of well-preserved Palaeolithic artefacts.

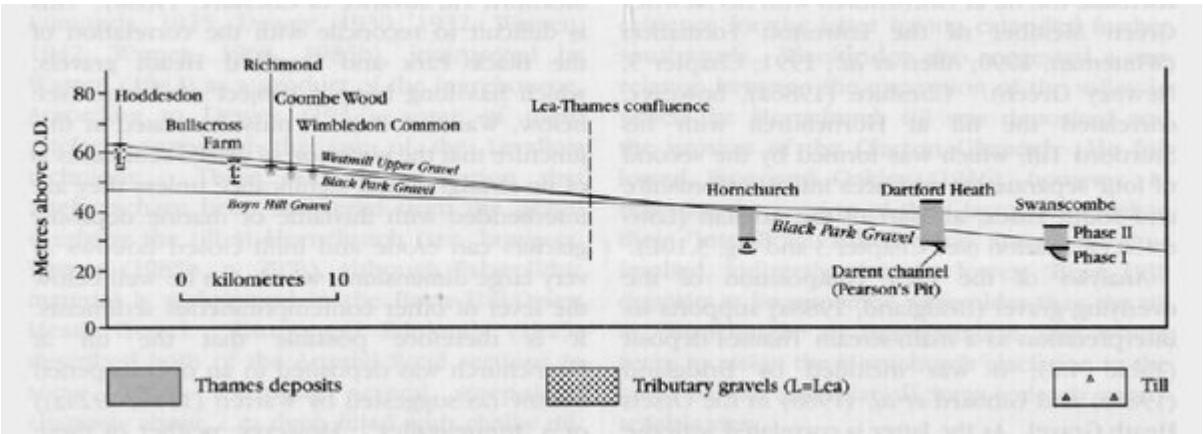
References



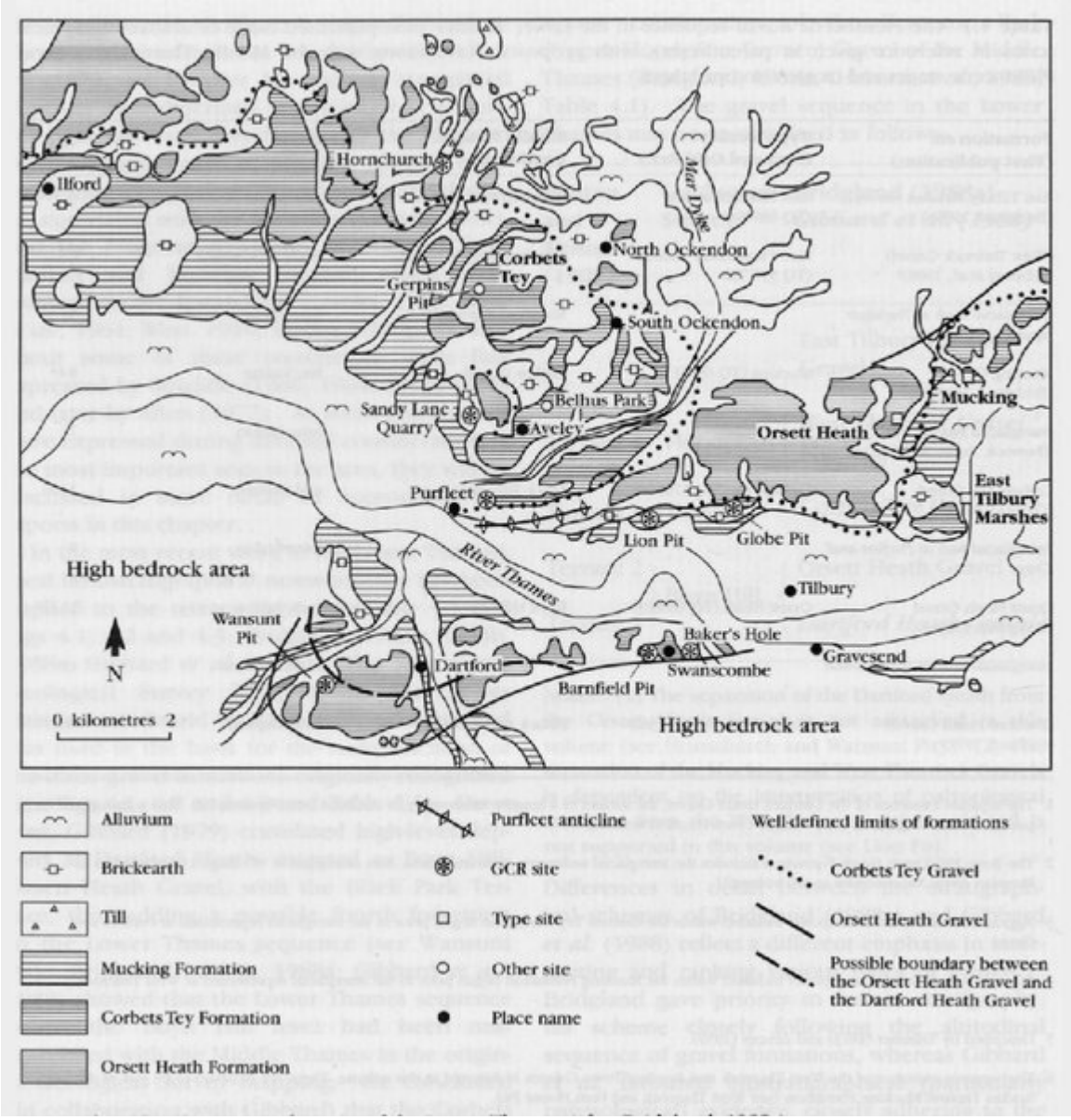
(Figure 4.8) Contrasting interpretations of the sediments at Dartford Heath: (A) hypothetical and idealized section, after Cornwall (1950); (B) a composite section based on observations of exposures in Wansunt Pit (after Chandler and Leach, 1912). Bed numbers used in the description section are indicated.



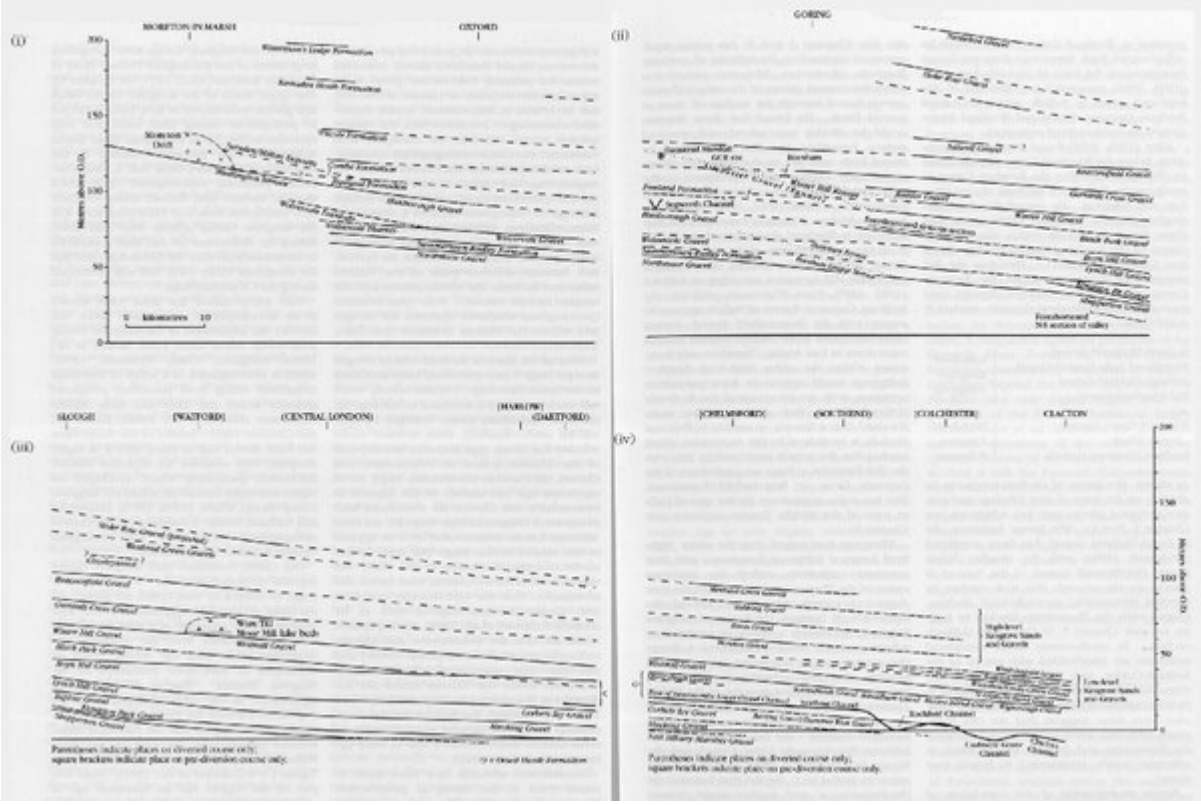
(Figure 3.4) Map showing Wooldridge's reconstructed courses of the Thames and its tributary, the Mole–Wey. The distribution of Pebble Gravel remnants is also shown; those remnants in which Greensancl chert is scarce are distinguished from those in which it is relatively common.



(Figure 4.7) Long profile projections of the Black Park and Boyn Hill Formations between the Middle and Lower Thames. The correlation with the Westmill Upper Gravel of the Lea basin is also shown.



(Figure 4.1) The Pleistocene deposits of the Lower Thames (after Bridgland, 1988a).



(Figure 1.3) Longitudinal profiles of Thames terrace surfaces throughout the area covered by the present volume. The main sources of information used in the compilation of this diagram are as follows: Arkell (1947a, 1947b), Briggs and Gilbertson (1973), Briggs et al. (1985), Evans (1971) and Sandford (1924, 1926) for the Upper Thames; Gibbard (1985) and Sealy and Sealy (1956) for the Middle Thames; Bridgland (1983a, 1988a) and Bridgland et al. (1993) for the Lower Thames and eastern Essex; Whiteman (1990) for central Essex.