Priest's Hill, Nettlebed

[SU 700 872]

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Highlights

A site high on the Chiltern escarpment, Priest's Hill is the location of what may be the oldest interglacial deposits to be preserved in the Thames catchment. Critical to the interpretation of the interglacial sediments and their implications for the evolution of the River Thames is the relation between the Priest's Hill deposits and the Nettlebed Gravel, which covers higher ground in the vicinity. The Nettlebed Gravel is widely believed to be the earliest true Thames gravel, derived through an early Goring Gap.

Introduction

This site lies on the western side of Windmill Hill, Nettlebed, which at 211 m O.D. is one of the highest points on the Chiltern escarpment in the area of the Goring Gap. The modern river passes through the gap in the escarpment *c.* 10 km to the south-west and 150 m below the level of the deposits at Nettlebed. These unbedded, clayey, sandy gravels, containing a high proportion of rounded flint pebbles, were classified as Westleton Beds' by Prestwich (1890b), a term also used by Monckton and Herries (1891) and White (1892, 1895). The deposits were subgrouped with the Pebble Gravel (Blake, 1891; Salter, 1896; Shrubsole, 1898; White, 1908b) and appear as such on the Geological Survey map (New Series, Sheet 254). On the basis of its elevation, Wooldridge (1927a) grouped this outlier with his high-level Pliocene (Diestian) marine deposits, which he later (Wooldridge, 1957, 1960) redefined as Early Pleistocene. The gravel remnants at Nettlebed have recently been reinterpreted as fluvial deposits (Horton, 1977, 1983; Gibbard, in Turner, 1983; Gibbard, 1985). Gibbard regarded them as early Thames deposits, classifying them as Nettlebed Gravel, the highest lithostratigraphical division within his system of Middle Thames terrace gravels and, therefore, probably the earliest Thames formation to have been preserved (if the interpretation of the Little Heath and Lane End gravels as marine is correct — see Little Heath).

Priest's Hill is of exceptional significance, since an Early Pleistocene interglacial organic deposit has been discovered there, in association with the Nettlebed Gravel (Horton, 1977, 1983; Turner, 1983; Gibbard, 1985). Although the precise relation between the organic sediments and the gravel is unclear at present, the former offers a potential means of determining the age of the earliest elements of the Middle Thames sequence.

Description

Several gravel remnants are preserved at Nettlebed, occurring slightly below the summit of Windmill Hill and on the subsidiary summit of Priest's Hill (203 m O.D.), in both cases overlying thin basal London Clay above Reading Beds. The summit of Windmill Hill, 211 m above O.D., is gravel-free (Blake, 1891; White, 1892; Horton 1977). White (1892) regarded the surviving drift remnants on Windmill Hill as the infills of 'pipes' and hollows in the Reading Beds and considered it likely that the hill-top was once covered with a similar deposit, since removed by denudation. The gravel consists primarily of flint (both reworked from Palaeogene beds and derived directly from the Chalk) and quartz, with subordinate Palaeozoic chert and quartzite (Table 3.2). The size and origin of the quartzite component is a subject of some doubt (see below).

Prestwich (1854), in the earliest record of the site, illustrated a section showing 1.5 m of crudely stratified gravel above *c.* 4 m of bedded white and yellow sand with flint and quartz pebbles, the latter having an erosive base cutting into Reading Beds sands and clays. The base of the gravel was also irregular and it is not clear whether Prestwich regarded the sand as part of the drift or of the solid geology. Monckton and Herries (1891), who described a comparable section at Priest's

Hill, considered the sand to be associated with the gravel. It is possible that this sand is equivalent to that seen underlying the organic sediments in recent temporary sections (Horton, 1977, 1983; below).

The Nettlebed interglacial site has only been investigated from boreholes and temporary exposures. In July 1975 the following sequence was revealed, apparently filling a depression in the Reading Beds (Horton, 1977, 1983; (Figure 3.7)):

		Thickness
6.	Soil	0.2 m
5.	Grey, poorly sorted clayey gravel (= Nettlebed Gravel?)	1.35 m
4.	Grey-white sand	0.04 m
3.	Humic, pebble-free clay	0.025 m
2.	Dark brown humic silt with scattered pebbles and plant remains	0.66 m
1.	White silty, pebbly sand	0.93 m

Turner (1983) published a preliminary pollen diagram from the Nettlebed organic deposits (beds 2 and 3), showing rather more than the first half of a typical Pleistocene interglacial cycle (see (Figure 3.8)).

Interpretation

Prestwich (1890b) and White (1892, 1895) regarded the 'Westleton Beds' at Nettlebed as marine deposits of Pliocene or Early Pleistocene age. Salter (1896), who classified the deposits with his 'High Barnet Type' of pebbly gravel, was unusual amongst early workers in dissenting from this view, regarding all the high-level gravels as fluviatile. Wooldridge (1927a) closely associated the gravel at Nettlebed with that capping the Palaeocene outlier at Lane End (see above, Little Heath), *c.* 12 km to the north-east and 10 m lower in altitude. He correlated these and other high-level deposits on the Chilterns with the Lenham Beds of Kent, on the basis both of altitude and heavy-mineral content, attributing them to a Late Pliocene/Early Pleistocene marine incursion into the London Basin (Wooldridge, 1927a, 1957, 1960; Wooldridge and Linton, 1939, 1955). Recent work by Moffat (1980; Moffat and Catt, 1986a) has confirmed the possibility that the Lane End gravel is a Pliocene/Early Pleistocene marine deposit, but they and most other recent workers have favoured Salter's fluviatile interpretation of the Nettlebed sediments.

Horton (1977) recorded channelling within the sequence at Nettlebed, including the channel filled with humic silts and clays (beds 2 and 3) containing terrestrial pollen. He therefore thought the deposits to be of fluvial origin. Further support for this interpretation came from a resistivity survey, which revealed a channel trending NNW–SSE, approximately parallel with the orientation of the Goring Gap (Turner, 1983). Turner (1983) and Gibbard (1985) also cited evidence from a study by scanning electron microscopy (SEM) of sand grains from the Nettlebed Gravel, the surfaces of which showed various stages in the eradication (presumably during fluvial transport) of characteristic features formed by attrition in a marine environment, presumed to have been inherited from Palaeogene deposits (see above, Harrow Weald Common). Both Turner (1983) and Gibbard (1985) attributed the Nettlebed Gravel to the Thames, but were uncertain of its relation to the organic channel deposits.

The palynological sequence from the Nettlebed interglacial sediments (beds 2 and 3) (Turner, 1983; (Figure 3.8)) begins with a pre-temperate phase (biozone I), passes through an early temperate phase (biozone II) and includes the early part of a late-temperate phase (biozone III). Birch (dominant), pine and subordinate spruce pollen characterize biozone I. Oak (abundant) and elm appear in biozone II, whereas biozone III is heralded by the appearance in the pollen record of hornbeam and the marked expansion of hazel. Despite the absence of exotic taxa from this record, spruce being the only non-native tree represented, Turner considered it quite different from interglacial pollen diagrams from the Middle and Upper Pleistocene. He pointed to the absence of temperate indicators such as ivy, holly and lime, to the late rise of hazel and to the early appearance of spruce as significant features, concluding that the deposit represents an interglacial episode prior to the Cromerian Stage, probably one hitherto unrecognized in Britain. Gibbard (1985) was in broad agreement with Turner's conclusions and proposed the provisional term 'Nettlebedian' for the stage represented. He suggested that the non-polleniferous sands (bed 1) underlying the organic sediments might have formed during a previous cold episode. Gibbard assessed the palaeobotanical evidence for correlation of the Nettlebed interglacial with the more complete continental Pleistocene record and concluded that it probably belonged somewhere within the late Early Pleistocene/ early Middle Pleistocene 'Cromerian Complex' of The Netherlands. The stratigraphical position of the deposit, at a very high level within the Thames terrace system, implies a considerable age (Turner, 1983). Its relation to the Thames terrace system, as described in Chapter 1 (Figure 1.3) and (Figure 3.3), suggests that the Nettlebed deposit is very much older than that at Sugworth or any of the temperate-climate sediments in Essex that are ascribed to the 'Cromerian Complex' (see Chapter 5). It is considerably higher within the terrace sequence than the Gerrards Cross Gravel, for which an Early Pleistocene age now appears likely (see Chapter 1; below, Westwood Quarry). Further investigation of the Priest's Hill sediments is urgently required in order to address this question. In particular, evidence from palaeomagnetism, to establish whether the site pre-dates the Matuyama–Brunhes reversal (see Chapter 1), would be of considerable value.

The Nettlebed interglacial sediments have great potential as a means of dating the earliest Pleistocene deposits of the Thames system. Unfortunately, there is some doubt as to their precise relation to the Nettlebed Gravel. Gibbard (1985) observed that the clayey gravel (bed 5) overlying the organic channel-sediments closely resembles the Nettlebed Gravel of the Windmill Hill outlier in its clast-composition (Table 3.2), suggesting a direct correlation. However, the former has a very clayey matrix, in places reminiscent of the local Reading Beds, raising the possibility that the pollen-bearing sediments are capped by a soliflucted mixture of Nettlebed Gravel and Palaeogene clay and, therefore, that the channel deposits may post-date the deposition of the early Thames gravel at this altitude. The fact that Priest's Hill lies a few metres lower than the Windmill Hill outlier increases the feasibility of the latter interpretation.

It is therefore uncertain whether the Nettlebed Gravel was deposited before or after the interglacial sediments. However, the fact that both appear to be fluvial deposits belonging to the Thames terrace system suggests, given the small amount of vertical separation between them, that they are closely related in time. Even if the channel deposits are the product of a tributary, their position near the crest of the escarpment implies considerable antiquity. In terms of terrace stratigraphy, both the Nettlebed Gravel and the Priest's Hill channel deposits appear to pre-date the Stoke Row and Westland Green Gravels (Figure 3.2), the earliest formations to provide unequivocal evidence for a Thames catchment that extended beyond the Cotswolds.

Further possible outliers of Nettlebed Gravel have been recognized at Russell's Water [SU 714 889] and Kimble Farm [SU 749 888], both downstream from the type locality (Turner, 1983; Gibbard, 1985; (Figure 3.6)). This suggests a downstream gradient of *c.* 0.9 m per kilometre for this formation. Although it falls directly in line between Nettlebed and Kimble Farm, analysis of the Russell's Water deposit by Moffat (1980; Moffat and Can, 1986a) shows it to be composed dominantly of angular flint, which suggests that it is not part of the Nettlebed Gravel.

Gibbard (1985) suggested a correlation of the Nettlebed Gravel with the 400 ft (Northaw) Pebble Gravel, but the Nettlebed deposit contains fewer rounded flints, reworked from Palaeogene deposits, than the latter ((Table 3.2); see above, Harrow Weald Common). However, Nettlebed lies near the edge of the Tertiary sedimentary basin, beyond which Chalk would presumably have outcropped when the Nettlebed Gravel was deposited, as it does now, providing a supply of fresh flint. Rounded flint would have been progressively picked up from Palaeogene sources between Nettlebed and Hertfordshire. The compositional differences between the Nettlebed Gravel and the Northaw Pebble Gravel do not, therefore, preclude their correlation. However, Moffat and Catt (1986a) have identified gravels equivalent to Gibbard's Stoke Row Gravel, which post-dates the Nettlebed Gravel (see (Figure 3.2) and (Table 1.1)), on the Chiltern dip slope in Hertfordshire, at altitudes comparable to the Northaw Gravel (Figure 3.6). Plotting of the altitudinal distribution of the Pebble Gravel remnants on the dip slope (Chiltern Pebble Gravel Subgroup) and in North London and south Hertfordshire (North London Pebble Gravel Subgroup) along a projection of the early Thames course across the area (Figure 3.6), indicates that correlation of the Nettlebed Gravel with the Northaw Gravel is untenable. Instead, the latter is likely to represent a south-bank tributary stream and to correlate with the Westland Green Formation of the main river ((Figure 3.6); see above, Harrow Weald Common). Even the higher Stanmore Gravel, which is also interpreted as a tributary deposit, is too low to correlate with the Nettlebed Gravel; it probably equates with the Stoke Row Gravel (Figure 3.6).

An outlier of gravel at Mardley Heath [TL 247 185] is worthy, on the basis of its altitude and position on the Chiltern dip slope (Figure 3.6), of consideration as a possible downstream correlative of the Nettlebed Gravel. Described by Moffat (1980; Moffat and Catt, 1986a), this deposit contains significant quartz and quartzite components and has been interpreted (Moffat and Can, 1986a) as Westland Green/Stoke Row Gravel. However, interpretation of the Mardley Heath site is problematic. The deposit contains heavy minerals characteristic of Anglian glacial sediments and its gravel fraction is dominated by non-rounded flint (Moffat, 1980), both of which suggest that it is Anglian outwash and, therefore, of no relevance to the early evolution of the Thames.

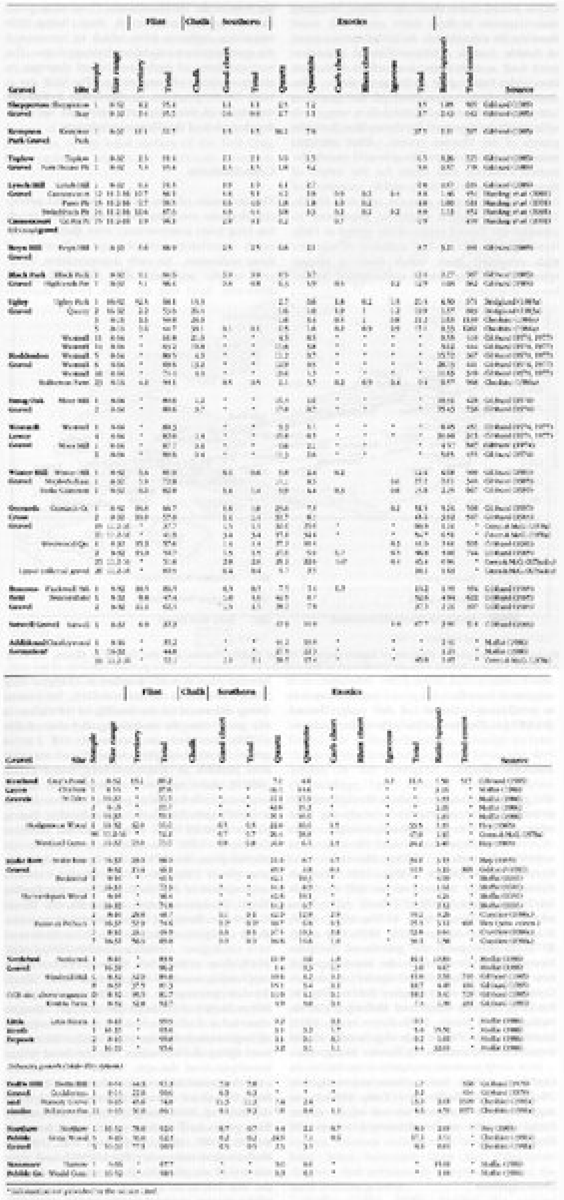
Turner (1983) cited the presence of quartz and quartzites in the Nettlebed Gravel as an indication that a link between the Kennet-Thames and the Midlands already existed at the time of its deposition, rejecting White's (1906) theory that such material was reworked from the quartz-rich facies of the Reading Beds. However, the increased amounts of Midlands material that are present in later Thames formations indicate that the main input of 'exotic' material through the Goring Gap occurred after the deposition of the Nettlebed Gravel. Different estimates of the composition of the Nettlebed Gravel have been given by Moffat (1980, 1986; Moffat and Can, 1986a) and Gibbard (in Turner, 1983, 1985). The most important discrepancy is that Moffat found less than 1% quartzite above the 8 mm sieve size, whereas Gibbard recorded *c.* 4% and concluded that the quartzose component of the gravel indicated a Midlands provenance (Table 3.2). Moffat (1986) interpreted the 'quartz signature' (see above, Harrow Weald Common) from the Nettlebed deposit as evidence for derivation from the Reading Beds and the Lower Greensand, but not from Triassic deposits. This would seem to imply that the Oxfordshire extension of the Thames was already in operation, but that no Triassic material had, up to that time, entered the catchment. Horton (1977) listed 18.5% quartzite from Nettlebed, but this figure clearly includes vein quartz and so must be disregarded. However, he did state that 'Northern Drift' pebbles were absent, suggesting support for Moffat's findings. Amongst the early workers, the views of Prestwich (1890b) are of some relevance to this problem, as he gave clear details of the composition of the gravel at Nettlebed. Prestwich (1890b, p. 140) considered that 'Pebbles of hornstone (?), veinstone, and Sarsen stone' accounted for 8% of the deposit. The record of sarsen suggests that he regarded the quartzitic material present as being of Palaeogene derivation. Hornstone (= schorl-rock?) is a highly durable lithology that is usually attributed to a Midlands Triassic source, but such material is also present in Mesozoic pebble beds within the present Thames catchment (Bridgland, 1986b). Thus it remains uncertain, at present, whether the Nettlebed deposits contain material from outside the present Thames basin. This question is of considerable importance, since it has major implications for Pleistocene palaeogeography and the evolution of Thames drainage.

The high-level gravel at Nettlebed is of major importance, therefore, as it probably represents the earliest evidence for Thames drainage that has survived. The GCR site at Priest's Hill is of even greater importance, however, on account of the very early interglacial sediments that have been preserved there in association with the Nettlebed Gravel. These are thought to represent an Early Pleistocene temperate episode hitherto unrecognized in Britain. The occur rence of fluvial sediments at this considerable altitude indicates that the present crest of the Chilterns was at valley-floor level at that time. This last fact demonstrates the enormous amount of erosion that has occurred during the Pleistocene.

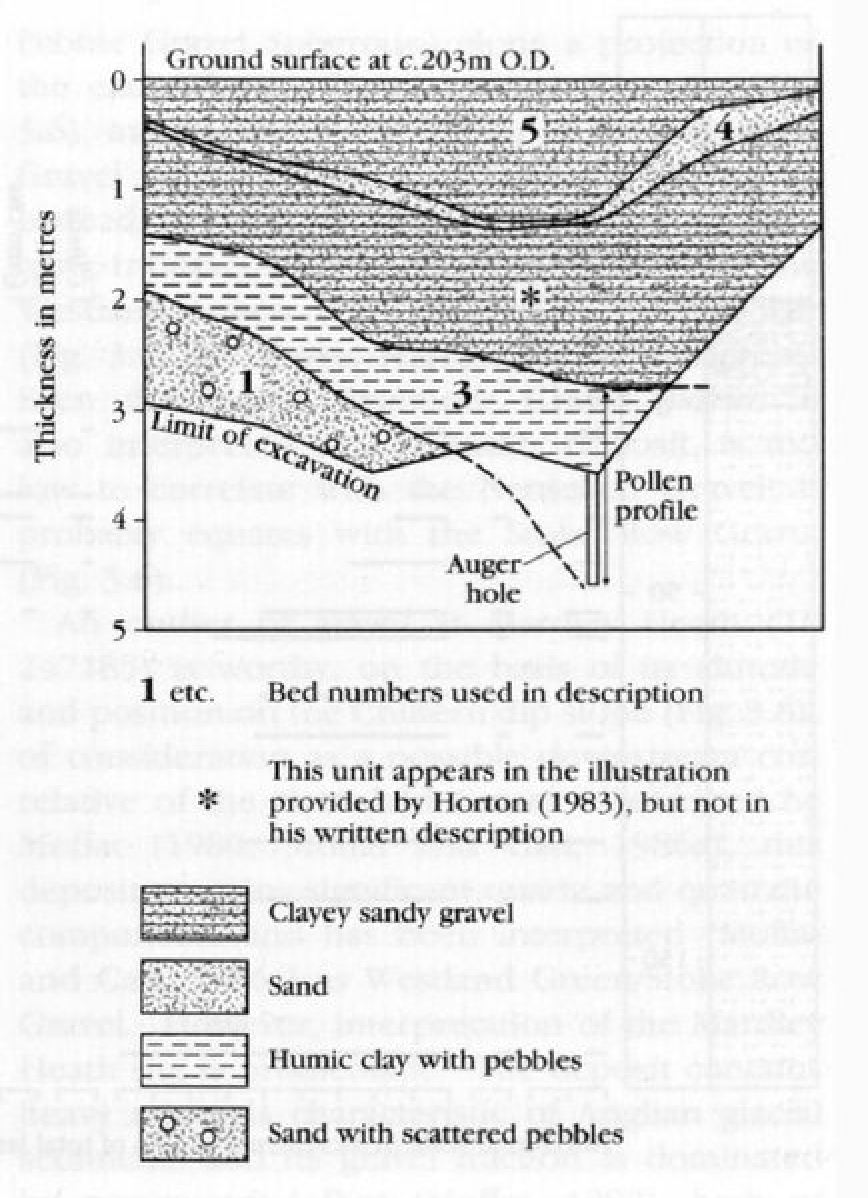
Conclusions

At Priest's Hill, underlying a clayey gravel, are beds of silt and clay, containing pollen, that seem to fill an old river channel. Analysis of the pollen reveals a dominance of temperate-climate plant species and indicates that the silt and clay accumulated during a warm (Interglacial') phase of the Quaternary Ice Age. The high altitude of this site (around 200 m above sea level) suggests a very early age. It is similar to the level of the Nettlebed Gravel, the highest and oldest Thames gravel to be recognized. The Nettlebed Gravel is preserved in the vicinity of the Priest's Hill site and may be represented by the clayey gravel overlying the pollen-bearing sediments. This would suggest that the interglacial deposits were part of the Nettlebed Gravel Formation and would indicate that they are of very great antiquity. An alternative interpretation is possible, however. The clayey gravel may be a later mixture of material, largely derived from the Nettlebed Gravel, that has accumulated above the channel-fill sediments. In this case the interglacial beds could be considerably younger than the Nettlebed Gravel. However, their high altitude inevitably indicates that they are very early and of great significance; no major river can have flowed at this level for a very long time. The evidence from Nettlebed provides a clear indication of the vast amount of erosion that has taken place during the Pleistocene.

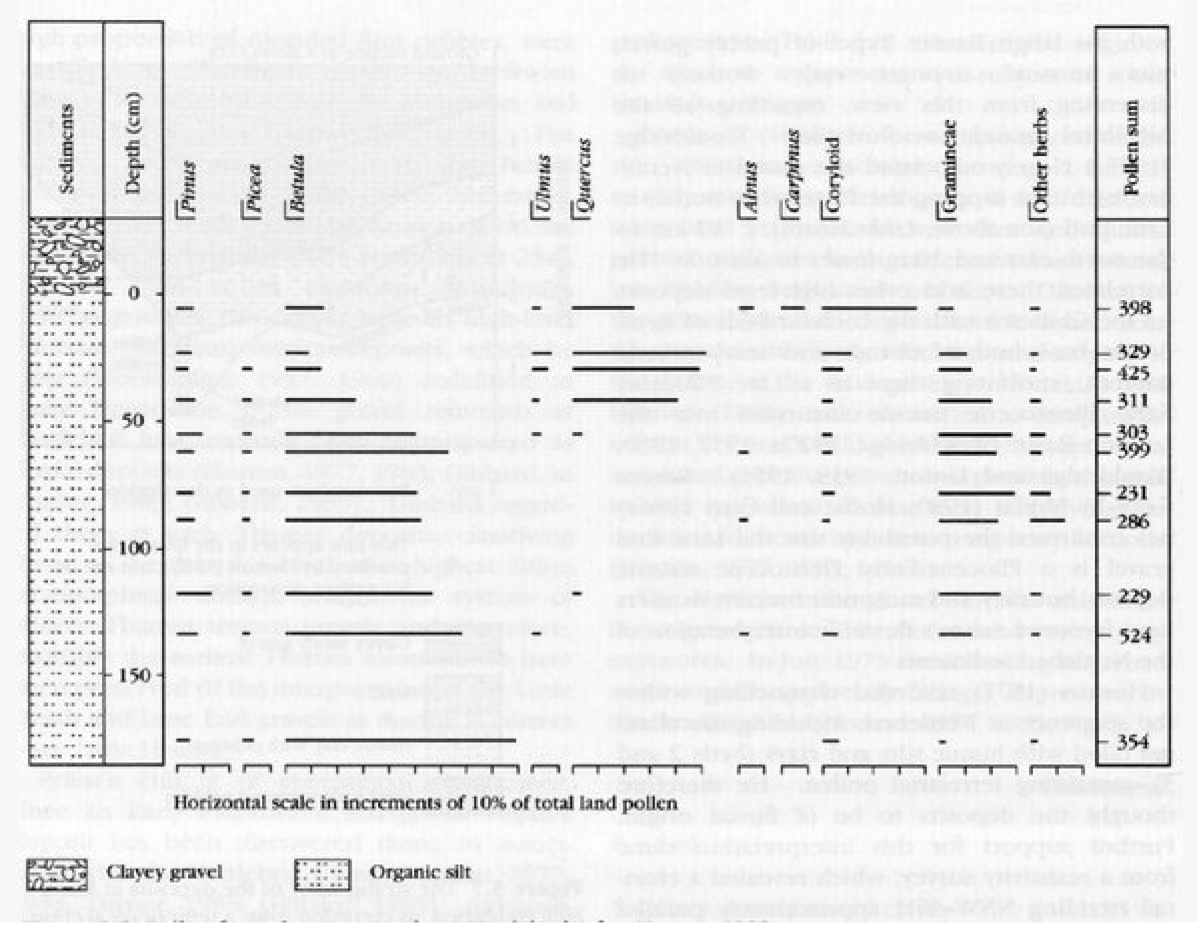
[References](#)



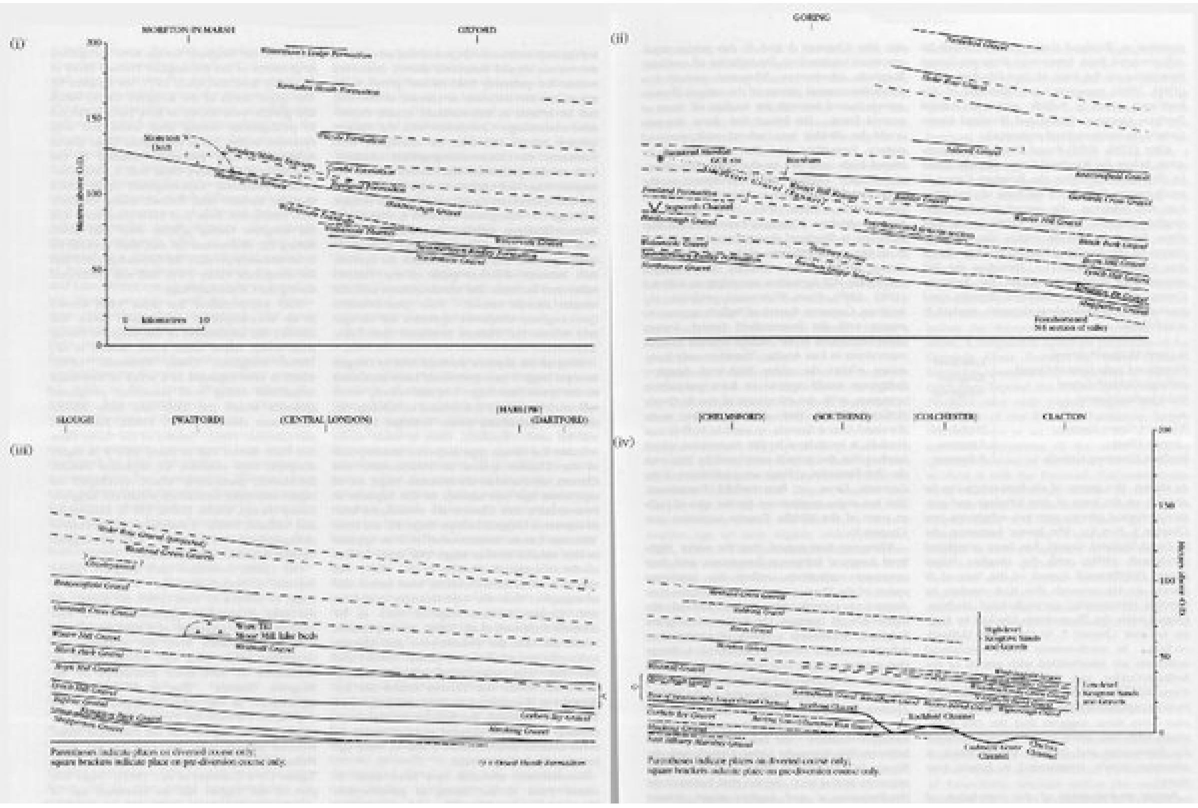
(Table 3.2) Clast-lithological data (in percentage of total count) from the Middle Thames and Vale of St Albans (compiled from various sources). The data concentrates on key sites, GCR sites and localities mentioned in the text. Note that many different size ranges are included and that these yield strikingly different data (this can be observed where results from different fractions from the same deposits have been analysed). As in (Table 4.2), (Table 5.1) and (Table 5.3), the igneous category includes metamorphic rocks (very rarely encountered) and the quartzite category includes durable sandstones. The Tertiary flint category comprises rounded pebbles (sometimes subsequently broken) reworked from the Palaeogene (see glossary with (Table 4.2)).



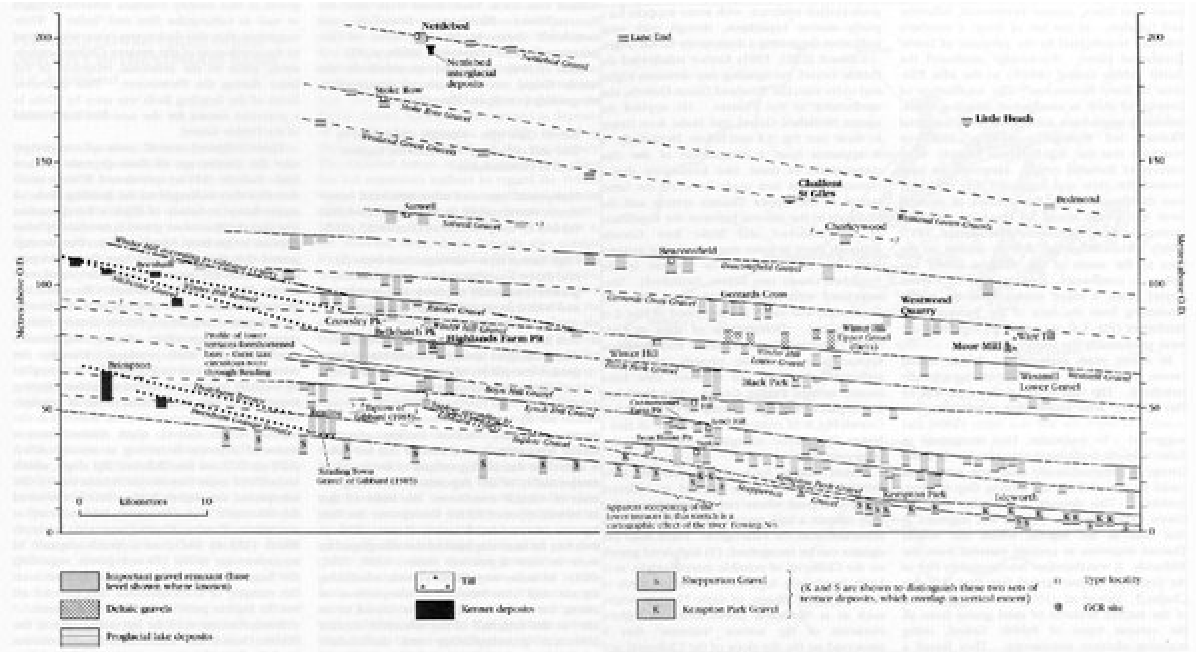
(Figure 3.7) The stratigraphy of the deposits at Priest's Hill, Nettlebed, as recorded from a temporary section. The position of the pollen profile is shown (after Horton, 1983).



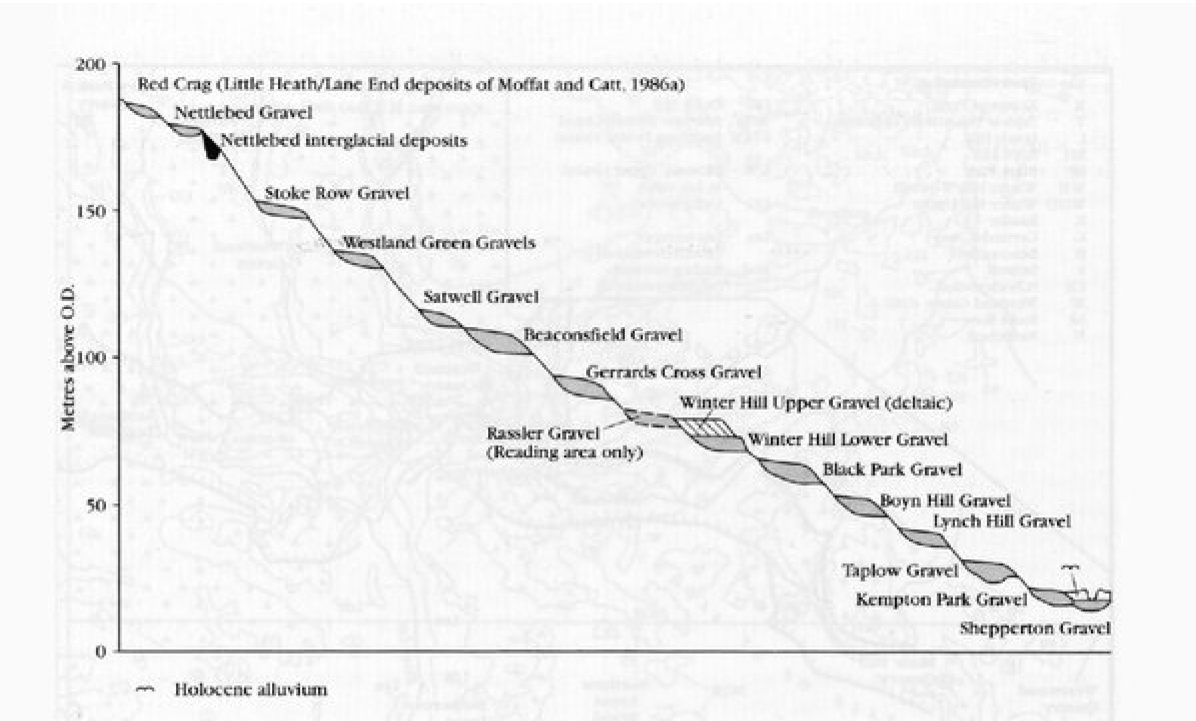
(Figure 3.8) Pollen from the organic silts at Nettlebed (after Turner, 1983).



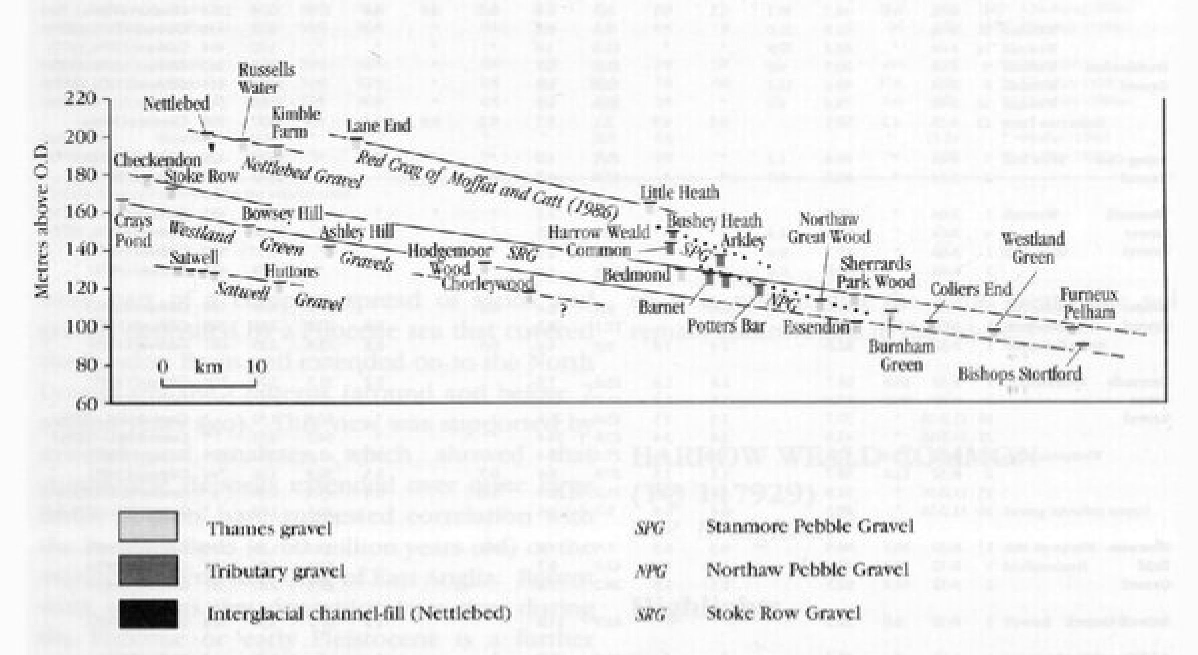
(Figure 1.3) Longitudinal profiles of Thames terrace surfaces throughout the area covered by the present volume. The main sources of information used in the compilation of this diagram are as follows: Arkell (1947a, 1947b), Briggs and Gilbertson (1973), Briggs et al. (1985), Evans (1971) and Sandford (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.



(Figure 3.3) Long-profiles of terrace formations in the Middle Thames. Compiled predominantly from data provided by Gibbard (1985), with subordinate information from Sealy and Sealy (1956) and Thomas (1961). Modifications to the source information are described in the text.



(Figure 3.2) Idealized transverse section through the classic Middle Thames sequence of the Slough-Beaconsfield area. The stratigraphical position of the Rassler Gravel, not preserved in this area, is shown.



(Figure 3.6) Long-profile diagram of higher deposits in the Middle Thames and the Vale of St Albans, showing the North London Pebble Gravels, attributed in this volume to deposition by a south-bank tributary of the early Thames.

Age (in thousands of years)	Upper Thames	Middle Thames	Lower Thames	Essex	Stage	δ¹⁸O
10	Recent floodplain and channel deposits: Holocene alluvium of floodplain and coast				Holocene	1
	Northmoor Gravel	Shepperton Gravel	Submerged	Submerged	late Devensian	2-4
71		Rejuvenation event				
		Temperate climate deposits of South Kensington (Ismaili centre), Isleworth and Kempton Park	Submerged	Submerged	early/mid Devensian? interstadial(s)	5a &/or 5c?
?	Cold climate gravels above Fyndham Gravel	Reading area: U. levels of Taplow Gravel Slough area: Kempton Park Gravel	East Tilbury Marshes Gravel	Submerged	early-mid Devensian	5d-2
122	Eynsham Gravel	Reading area: Within Taplow Formation Slough area: Trafalgar Square and Brentford deposits	Below floodplain	Submerged	Ipswichian (sensu Trafalgar Square)	5e
128	Stanton Harcourt Gravel	Reading area: Taplow Gravel Slough area: Basal Kempton Pk Gravel - incl. Spring Gardens Gravel of Gibbard (1985)	Basal East Tilbury Marshes Gravel	Submerged	late Saalian	6
		Rejuvenation event				
		Taplow Gravel	Mucking Gravel			
186	Stanton Harcourt Channel Deposits, interglacial Magdalen Grove, Summertown etc.	Interglacial deposits at Redlands Pit, Reading	Interglacial deposits at Aveley, Ilford (Uphall Pit), West Thurrock, Crayford and Northfleet	Submerged	Intra-Saalian temperate episode	7
245	Basal Summertown-Radley Formation at some sites?	Basal Taplow Gravel?	Basal Mucking Gravel	Submerged		
		Rejuvenation event			mid-Saalian	8
	Wolvercote Gravel at some sites?	Lynch Hill Gravel	Corbets Tey Gravel	Barling Gravel		
303	Wolvercote Channel Deposits		Interglacial deposits at Ilford (Cauliflower Pit), Belhus Park, Purfleet and Grays	Shoeburyness Channel interglacial deposits	Intra-Saalian temperate episode	9
339	Basal Wolvercote Gravel	Basal Lynch Hill Gravel?	Basal Corbets Tey Gravel	Shoeburyness Channel - basal gravel		
		Rejuvenation event			early Saalian	10
	? Moreton Drift (Arkell, 1947a)					
	Hanborough Gravel	Boyn Hill Gravel	Orsett Heath Gravel	Southchurch/Asheldham/Mersea Island/Wigborough Gravel		
?	Reworked mammalian fauna in Hanborough Gravel		Swanscombe deposits	Southend/Asheldham/Cudmore Grove/Clacton Channel Deposits	Hoxnian (sensu Swanscombe)	11
423	Basal Hanborough Gravel?	Basal Boyn Hill Gravel?	Basal Orsett Heath Gravel (incl. Basal Gravel at Swanscombe)	Southend/Asheldham/Cudmore Grove/Clacton Channel - basal gravel		
	Rejuvenation event					
	Freeland Formation	Black Park gravel				
	Moreton Drift?	Anglian glacial deposits	Hornchurch Till	U St Osyth/U Holland Gravel	Anglian	12
	Freeland Formation	Winter Hill/Westmill Gravel	Valley did not exist as a Thames course prior to this	St Osyth/Holland Formation		
478	Sugworth Channel Deposits	Rassler Gravel?		Wivenhoe/Cooks Green Pit Ardleigh/St Osyth Formation Waldringfield Gravel	Cromerian Complex	21-13
?	Combe Formation Higher divisions of the Northern Drift Group	Gerrards Cross Gravel Beaconsfield Gravel Satwell Gravel gravel at Chorleywood Westland Green Gravels Stoke Row Gravel Nettlebed Gravel Nettlebed interglacial deposits		Bures Gravel* Moreton Gravel* Stebbing Gravel*	Early Pleistocene	pre 21

* Nomenclature for High-level Kesgrave Subgroup in Essex follows Whiteman (1990).

(Table 1.1) Correlation of Quaternary deposits within the Thames system. Rejuvenations that have occurred since the Anglian glaciation are indicated.