Chalfont St Giles Brick Pit and Furneux Pelham Gravel Pit

[SU 977 942] and [TL 442 267]

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Highlights

The Chalfont St Giles and Furneux Pelham pits are important sites that provide evidence for the early history of the River Thames. Such evidence has been used to reconstruct the river's former course across Hertfordshire and into East Anglia, prior to its southward deflection by Anglian Stage ice.

Introduction

Sites at Chalfont St Giles and Furneux Pelham are important in establishing the route taken by the Thames during the formation of the Early Pleistocene Westland Green Gravels, as defined by Hey (1965). These gravels have been traced from the Middle Thames through the Vale of St Albans towards East Anglia (Hey, 1965, 1980). The Chalfont St Giles pit lies within the Middle Thames region, at the northernmost and highest edge of the classic 'staircase' of terrace deposits preserved between the Thames and Colne valleys (Figure 3.1). The pit at Furneux Pelham, on the other hand, lies at the eastern end of the Vale of St Albans, only 6 km from the type locality of the Westland Green Gravels (Hey, 1983). The deposits contain rocks derived from the West Midlands and, it is believed, North Wales, the latter suggesting that glaciation of upland areas may have occurred at this early stage of Thames evolution (Green *et al.,* 1980; Hey, 1980; Bowen *et al,* 1986a).

The Westland Green Gravels were the first Thames deposits to be traced across the London Basin from the Reading area to East Anglia (Hey, 1980, 1982; Bowen *et al.,* 1986a). Allen (1983, 1984) and Gibbard (1983, 1985) later proposed subdivisions of this unit in Suffolk (Chapter 5, Part 1) and the Middle Thames respectively. Gibbard (1983, 1985) concluded that the westernmost outlier recognized by Hey (1965), at Stoke Row [SU 686 834], represents a higher and even earlier Thames aggradation, which he termed the Stoke Row Gravel. Re-evaluation of the various outliers in Hertfordshire identified by Hey (1965, 1980) as Westland Green Gravels suggests that some, including that at Furneux Pelham, may represent the earlier Stoke Row Gravel (Figure 3.6).

Recent work by Whiteman (1990) indicates that the deposits classified as Westland Green Gravels in the Middle Thames and East Anglia do not belong to the same formation, although the basic conclusion that the Thames followed the route envisaged by Hey is upheld (see Chapter 5).

Description

Chalfont St Giles Brick Pit, Buckinghamshire

This site is an intermittently worked brick pit exploiting the silty clays of the Reading Beds. Up to 2 m of poorly stratified Westland Green Gravels occur as overburden above the Reading Beds. The site lies near the north-eastern edge of a small plateau, occupied by Hodgemoor Wood, at about 140 m O.D. The Geological Survey showed 'Glacial Gravel' overlying Reading Beds in the area of the brick pit (Old Series, Sheet 7, 1871; New Series, Sheet 255, 1922). An early description of the site was provided by Barrow (1919a). According to Barrow (1919a, p. 38), the Chalfont St Giles pit showed 'quartz pebble gravel … somewhat churned up by the passage of ice over it, and in consequence mixed with a considerable number of far-travelled stones'. Despite this supposed glacial contamination, Barrow included the Hodgemoor Wood outlier in the Pebble Gravel. Hey (1965) recognized that the Hodgemoor Wood plateau represents one of the largest remnants of the Westland Green Gravels. He pointed to the occurrence in these deposits of quartzites and Carboniferous chert from the Midlands as evidence of a Thames origin; such materials are common constituents of the Northern Drift of the Upper Thames catchment (see Chapter 2), leading Hey to conclude that they were introduced into

the London Basin, through an early Goring Gap, by the ancestral Thames. Green and McGregor (1978a) published the results of a stone count of a sample that appears, from their map and profile diagram, to be from this site or nearby, their sample 86 (see (Table 3.2)). The Chalfont St Giles pit was reinvestigated by Moffat (1980, 1986; Moffat and Can, 1986a), who confirmed that Westland Green Gravels occur there.

Furneux Pelham Gravel Pit (Hillcollins Pit), Hertfordshire

This site lies in the present catchment of the River Lea, 10 km north of Ware, where that river turns south from the Vale of St Albans into the lower part of its valley, towards its confluence with the Thames in east London (see (Figure 3.1)). The pit is 6 km north of the Westland Green type locality, which is now overgrown. As at Chalfont St Giles, Geological Survey maps (Old Series, Sheet 18) indicate 'Glacial Gravel' at Furneux Pelham (showing that the early mappers separated these deposits from the Pebble Gravel). The pit exposes 3–4 m of well-bedded sandy gravel, aggraded to *c.* 107 m O.D. and showing the abundance of quartzites and flint pebbles reworked from the Palaeogene that characterizes the Westland Green Gravels. Matrix-supported gravel is interbedded with cross-stratified sand lenses. Over much of the pit, the deposits appear to dip sharply to the north-west, perhaps towards a solution hollow in the underlying Chalk. Hey (1983) described the following section:

	Thickness
4. Wind-blown sand	up to 1m
3. Coarse, poorly sorted gravel, the uppermost beds clay■ enriched and reddened	6 m
2. Yellow sand, with one band of flint pebbles	2 m
1. Dark purplish-brown clayey sand	1 m
Base not seen	

A hitherto unpublished stone count of the gravel at this site (bed 3) shows *c.* 77% flint, over two-thirds of which consists of reworked Palaeogene pebbles, with 19% quartz and 6% quartzite and sandstone (R.W. Hey, pers. comm.; (Table 3.2)). This analysis falls within the range of counts from the Westland Green Gravels previously published by Hey (1965). (Table 3.2) also includes clast-lithological data from this site supplied by Cheshire (1986a).

Interpretation

The recognition by Hey (1965) of an Early Pleistocene 'Westland Green Gravels' aggradation, extending across an area from the Goring Gap to Hertfordshire, was a landmark in Thames research. Salter (1896, 1905), who had attempted to trace various types of gravel from the Chiltern dip slope to East Anglia, had previously included many of the Westland Green Gravels outcrops in his 'Bell Bar type', although he was apparently not aware of the outlier at Hodgemoor Wood. Hey traced the Westland Green Gravels from Stoke Row, on the Chilterns, via Ashley and Bowsey Hills and across Hertfordshire, where it occurs at Hodgemoor Wood, Hatfield Park, Essendon, Little Berkhamsted, and several sites between the Mimram and Stort valleys. The last included the best exposure available at the time of his survey, at Westland Green [TL 422 215], near Little Hadham. He renamed the deposits after this locality, since he had observed that the sediments at Bell Bar, taken as the type section for this gravel by Salter (1896), were not *in situ.* Warren (1945, 1957) had previously attributed the gravel at Westland Green to the early Thames.

Support for the fluvial origin of the Westland Green Gravels was derived from their regional and altitudinal distribution, shown by Hey (1965) to closely resemble the long-profile of a river. The steep upstream part of Hey's reconstructed long-profile was, however, removed when Gibbard (1983, 1985) redefined the highest outlier, at Stoke Row, as part of an earlier formation (see below). A study of sand grain surfaces, using scanning electron microscopy, provided confirmatory evidence that the Westland Green Gravels are of fluviatile origin (Hey *et al.,* 1971). The distribution and composition of the gravels, which contain a similar suite of pebbles to later Thames terrace deposits, led Hey (1965) to claim that the Westland Green Gravels were the earliest product of the River Thames. The further suggestion that deposition of the Westland Green Gravels corresponded with glaciation in areas to the north-west of the Thames catchment (Hey, 1965) found favour with later authors, notably Bowen *et al.* (1986a). This was based on the occurrence in these deposits of volcanic rocks thought to be derived from Wales, although these appear to be more common in the lower pre-Anglian

gravels (Green *et al.,* 1980).

Evans (1971, fig. 50), in his early attempt to relate the various Thames terrace aggradations to the cold and warm cycles of the deep-sea oxygen isotope record, allocated the Westland Green Gravels to his cycle 16W and suggested an age of about 620,000 years for this formation. Evans's cycle 16W would appear to equate with Stage 31 of the current oxygen isotope chronological nomenclature (see Chapter 1). According to the latest estimates (Ruddiman *et al.,* 1989), a correlation with Stage 31 would imply an age of just less than one million years. Evans, however, based his correlations on extrapolated interglacial sea levels, which he took to have fallen progressively during the Pleistocene. He considered the major terrace formations to have aggraded during interglacials, an idea largely superseded by the modern view that they were predominantly deposited during cold episodes. His model implied a sea level of 103 m above present ordnance datum during Westland Green times. This would require that the type area in Hertfordshire, where the gravels fall below 110 m O.D., lay close to the contemporary coastline. The modern association of gravel aggradation with cold episodes renders Evans's sea-level prediction obsolete (Chapter 1), but the broad correlation between climatic cycles and terrace sequences that he envisaged, essentially one of counting backwards, compares quite closely with more recent interpretations based on the oxygen isotope chronology (see Chapter 1). Only a very crude approximation of the age of the Westland Green Gravels would be claimed from this type of correlation today, however.

Hey (1976b, 1980) went on to address the problem of correlating the Westland Green Gravels of the Middle Thames with the Pleistocene sequence in East Anglia, attempting to trace the unit to north Norfolk. He recognized (1980) that deposits of Westland Green type occur within the higher levels of the Kesgrave Group (Rose *et al.,* 1976). He noted that a marine gravel on the foreshore at Beeston Regis, Norfolk [TG 260 402], ascribed to the 'Pre-Pastonian a' Stage, contains a similar range of clast types to the Westland Green Gravels. Hey (1980) suggested that the Westland Green Gravels were the terrestrial equivalent of this marine gravel. Subsequent work has shown that the Kesgrave Group deposits in Norfolk that were correlated by Hey with the pre-Pastonian marine gravel at Beeston belong to a later Thames formation than the Westland Green Gravels, implying that the latter may be even older than the 'Pre-Pastonian a' Stage (Whiteman, 1990; Chapter 1).

Gibbard (1983, 1985) concluded that the deposit at Stoke Row on the Chilterns dip slope, the furthest upstream of Hey's Westland Green outliers, probably represents an earlier aggradational phase. He assigned this outlier to the newly defined Stoke Row Gravel. Hey (1965) had noticed that this remnant was, at 174 m O.D., some 6 m above the projected long-profile (thalweg) reconstructed from the other occurrences of Westland Green Gravels. He suggested an increased gradient in the upstream part of the river system as a possible explanation. Gibbard, however, found gravel at the expected elevation of the Westland Green Formation, lower down the dip slope in this area, around Crays Pond [SU 637 805]. Remnants of gravel, generally similar in composition to the Westland Green Formation but at a higher level, have subsequently been identified at Bedmond [TL 104 037] and Sherrards Park Wood [TL 225 138]. These have been assigned to the Stoke Row Formation (Moffat, 1980; Cheshire, 1986a; Moffat and Catt, 1986a). Moffat and Catt (1986a) suggested that these outliers have larger quartz : quartzite + sandstone ratios than samples of the Westland Green Gravels; their clast-lithological data supports this view, but it is difficult to determine whether the same is true of the data published by Hey (1965) and Gibbard (1985), largely because of differences between the categories and size fractions used by these various workers (Table 3.2).

Plotting the remnants of Westland Green Gravels and Stoke Row Gravel along the generalized early-Thames route from the Goring Gap to eastern Hertfordshire (Figure 3.6) suggests that a vertical separation of 12–15 m, as demonstrated by Gibbard in the Goring Gap area, is maintained as far downstream as Essendon. However, the various outliers in the Westland Green type area fall somewhat randomly between the projected Westland Green and Stoke Row levels, so that all are higher than would be expected for the former and lower than for the latter. In particular, the gravel at Furneux Pelham, with a surface height of 107 m O.D., plots significantly higher than the other remnants, given its position at the downstream end of (Figure 3.6); it is only a few metres below the projected Stoke Row level (based on the two sites at Bedmond and Sherrards Park Wood). It therefore seems likely that the fluvial deposit at the Furneux Pelham GCR site does not represent the Westland Green Gravels, as was asserted by Hey (1983), but is instead a degraded remnant of the Stoke Row Formation.

There is some support for this interpretation from clast-lithological data from the Furneux Pelham site. The ratios of quartz to quartzite + sandstone at Furneux Pelham, indicated by the available stone-count data, are amongst the highest recorded from gravels of Westland Green type in Hertfordshire (Table 3.2). Although the suggestion that higher ratios of this type might characterize the Stoke Row Gravel (Moffat and Cat, 1986a) has yet to be confirmed, the figures from Furneux Pelham appear to support the altitudinal evidence for correlation with that formation.

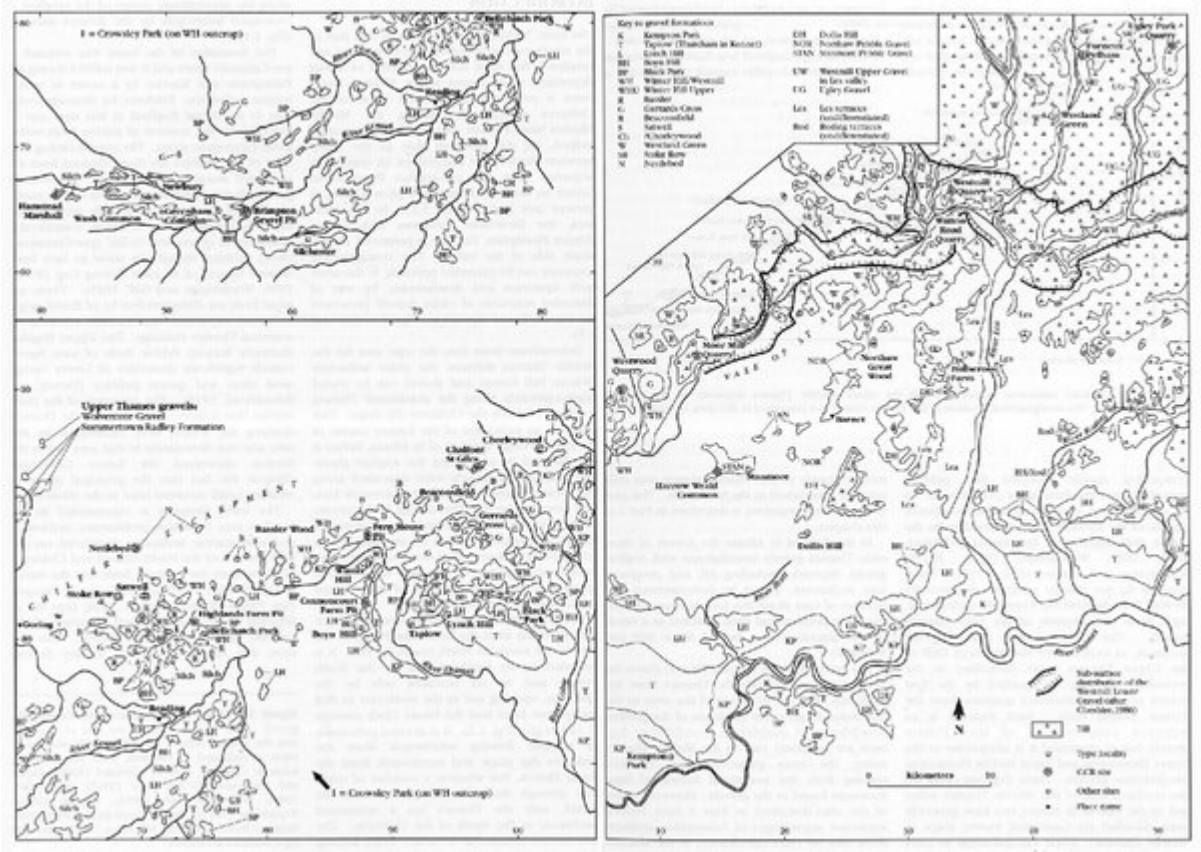
Further work is required to clarify the distribution of the earliest Thames gravels in and downstream from eastern Hertfordshire, in order to determine whether the division into Stoke Row and Westland Green Formations can be continued north-eastwards. There is some indication that the long-profiles of these formations converge downstream, as a result of a shallowing of the Westland Green gradient, a steepening of the Stoke Row gradient, or perhaps both (Figure 3.6). Moffat and Catt's (1986a) observation that the Stoke Row Gravel may have larger quartz : quartzite + sandstone ratios than are typical of the Westland Green Gravels hints at a possible method, independent of altitude, for distinguishing the two aggradations.

The GCR sites at Chalfont St Giles and Furneux Pelham thus represent an extremely important period in the history of the River Thames, close to the time when the river was first initiated as a drainage route from the Midlands into the London Basin. Although both were originally ascribed to the Westland Green Gravels, reappraisal of the deposits in eastern Hertfordshire suggests that the Furneux Pelham site exposes the earlier Stoke Row Gravel. The latter appears at present to be the earliest Thames deposit containing abundant material from the Midlands, indicating that a link with the present Severn catchment may have existed across the Cotswolds (see above; Chapters 1 and 2). The two GCR sites provide rare opportunities for studying exposures in these formations and as such are of significant value to British Pleistocene stratigraphy.

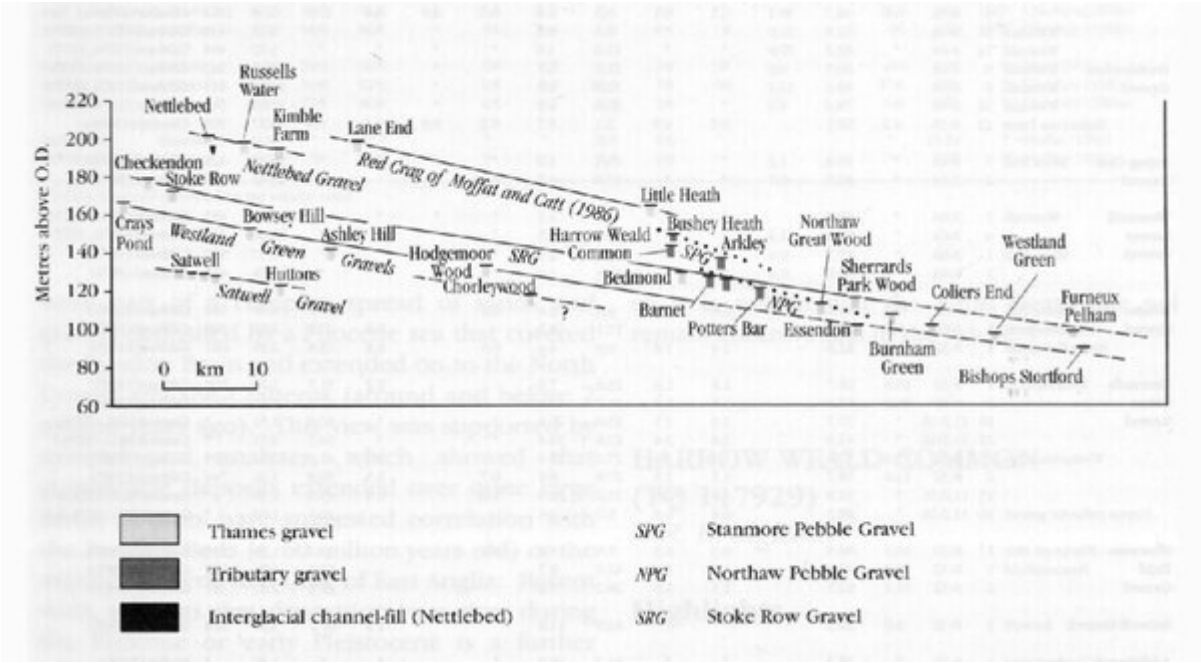
Conclusions

The gravels exposed at these sites provide evidence for the early history of the River Thames. Their height, distribution and gravel content have all been used as evidence in tracing the river's early course. These sites show that the Thames once flowed along a more northerly course across Hertfordshire and eventually into East Anglia. Although both sites were thought to show gravels of the same type and age, differences in their topographical position and stone content suggest that deposits of somewhat different ages may be present at each site. The oldest of these (the Stoke Row Gravel), at Furneux Pelham, is possibly the earliest gravel to contain material carried by the early Thames from beyond the Cotswolds escarpment. Both gravels were deposited at a time when the river had a much larger catchment than at present, probably extending into the West Midlands and possibly as far as Wales.

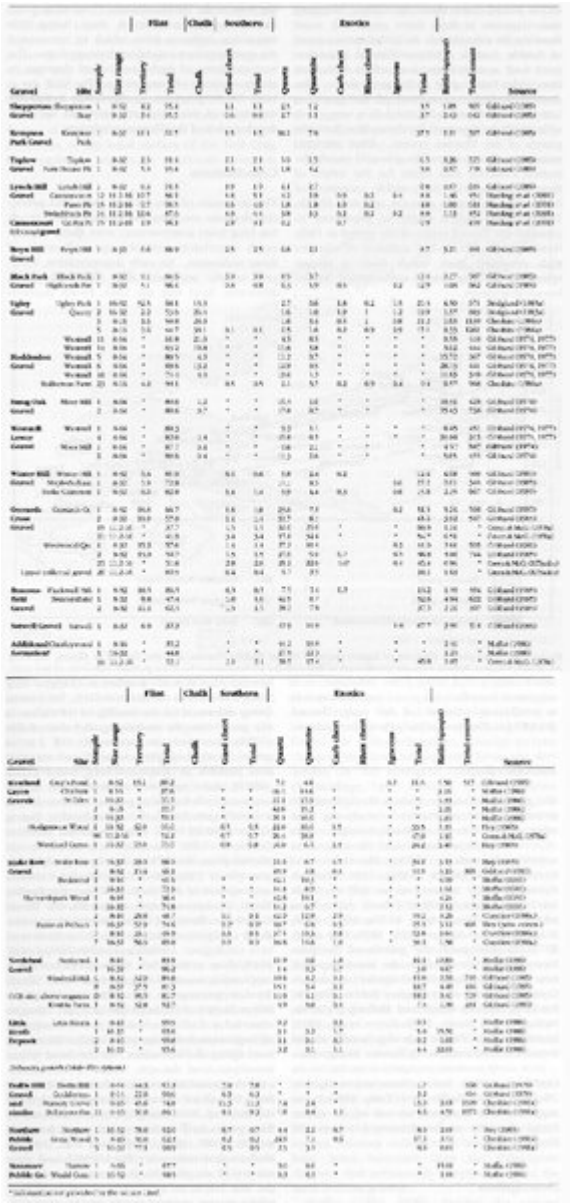
References



(Figure 3.1) (Following two pages) Map showing the gravels of the Middle Thames, the Vale of St Albans and the Kennet valley. Compiled, with reinterpretation as indicated in the text, from the following sources: Cheshire (1986a), Gibbard (1985), Green and McGregor (1978a), Hare (1947), Hey (1965, 1980), Sealy and Sealy (1956), Thomas (1961), Wooldridge (1927a) and the Geological Survey's New Series 1:50,000 and 1:63,360 maps. GCR sites and type localities are 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.



(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)).