Harrow Weald Common

[TQ 147 929]

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Highlights

One of the earliest 'drift' deposits preserved in the Thames catchment, the High-level or Stanmore Pebble Gravel, is exposed at Harrow Weald Common. Although a shallow-marine or beach origin has long been favoured, it is suggested here that this gravel was deposited by a south-bank tributary of the early Thames, probably in Pliocene or Early Pleistocene times.

Introduction

Old gravel workings on Harrow Weald Common provide a rare opportunity to study the Stanmore Pebble Gravel of North London. This deposit aroused interest around the turn of the century (Prestwich, 1890c; Monckton and Herries, 1891; Salter, 1896, 1901; Barrow, 1919a, 1919c). Terms such as '500 ft', 'High-level' or 'Higher Pebble Gravel' have been widely used (Wooldridge, 1927a, 1957, 1960; Wooldridge and Linton, 1939, 1955; Hey *et al.,* 1971) to distinguish the gravels of the Stanmore–Bushey plateau from the lower deposits, now termed Northaw Pebble Gravel (see above). Confusingly, the term 'Higher Pebble Gravels' has been used by Green and McGregor (1978a; McGregor and Green, 1978; Green *et al.,* 1982) in references to Pebble Gravel generally, to distinguish it from lower-level Thames formations.

Most early workers interpreted the Stanmore Gravel as marine, but a recent reinvestigation (Moffat, 1980; Moffat and Catt, 1986a) has suggested that it represents one of the oldest fluvial deposits to be preserved within the Thames Basin.

Description

Shallow pits covering the area of Harrow Weald Common mark the sites where gravelly material has been removed from beneath the plateau surface, which reaches *c.* 145 m O.D. Very little undug ground remains, but faces in the GCR site, at the edge of a residual causeway, reveal *c.* 2 m of gravel, composed predominantly of rounded flint pebbles set in a sandy and loamy matrix.

Whitaker (1864, p. 69) first reported that Pebble Gravel was spread 'over the whole of the hill-top' at Stanmore, in a quotation from the notebook of R. Trench. Prestwich (1890c) provided one of the earliest descriptions of the Stanmore Pebble Gravel at a brick pit that, according to Bromehead (1925), lay to the south of the present GCR site. Prestwich illustrated a section in which *c.* 2 m of unstratified gravel overlay what is now classified as Claygate Beds (then included in the London Clay), the contact being deformed by the loading or involution of the gravel into the underlying silty clay. Salter (1896) recorded the occurrence of 2 m of gravel, composed predominantly of rounded flint pebbles, at 'Harrow Weald', some 146 m (480 ft) above sea level. Unfortunately he did not provide details of its precise location and, in a later paper, listed the same locality, but at 122 m (400 ft) O.D., one mile to the south of Stanmore. The last-mentioned outlier is not identified on the New Series Geological Survey map (Sheet 256), which does, however, show a large spread of Pebble Gravel covering Bushey Heath, Stanmore Common and Harrow Weald Common. Barrow (1919c) described in some detail a section on Harrow Weald Common seen by a Geologists' Association excursion (in May, 1919) close to the Kilns, where he noted that a rare undug remnant of gravel survived. From the description given, the locality visited in 1919 seems likely to have been the GCR site. Barrow observed *c.* 2 m of unbedded gravel composed of large rounded flints with smaller clasts and sand filling the interstices. In the most recent investigation of the site, Moffat (1980) considered the gravel to be vaguely horizontally stratified. He carried out clast-lithological analysis of the material, confirming the preponderance of flint, particularly in the coarser gravel fractions (Moffat, 1980, 1986; Moffat and Catt, 1986a). Moffat's grid reference [TQ 147 932] and elevation (133 m) place his section on the slope of the hill 200 m to the

north of the GCR site, where *in situ* material would not be expected, although his description appears appropriate for the exposure under consideration here.

Interpretation

The Harrow Weald Common GCR site provides the best available section in the Stanmore Pebble Gravel (= 500 ft or High-level Pebble Gravel of earlier workers). The history of research on these high-level deposits is complex. Prestwich (1890c) regarded the Stanmore deposits as the residue of the Eocene Bagshot Beds, although he noted that materials foreign to the Palaeogene had been introduced into them. He assigned them to his 'Brentwood Group', associating them with similarly flint-dominated gravels in southern Essex. Prestwich (1881, 1890b) correlated the more widespread lower-level Pebble Gravel (Northaw Pebble Gravel) with his 'Westleton Beds', so he clearly differentiated the Stanmore deposits from the latter. This differentiation was questioned by Monckton and Herries (1891, p. 112), who were inclined to regard the Stanmore deposit as 'a variety of the Westleton Group'. Reid (1900), like Prestwich, also considered the Stanmore gravels to be disturbed Bagshot Beds. This view received further support from Bromehead (in Woodward *et al.,* 1922) and Sherlock (1929), although Bromehead (1925) later adopted the views of A.E. Salter (see below). Conversely, other early workers made no distinction between the Stanmore deposits and the more widespread, lower (400 ft) Northaw Pebble Gravel of south Hertfordshire (Hughes, 1868; Wood, 1868; Whitaker, 1889).

Salter (1896) cited the locality at 'Harrow Weald' as an example of his 'Barnet Gate Type' of 'pebbly gravel', thus associating it with deposits capping high ground at Shooters Hill (south-east London) and the Brentwood area. Salter (1896, 1901) showed that material foreign to the London Basin was a small but important constituent of these deposits and attributed them to the activities of post-Miocene consequent streams, regarding them as 'the first deposits of the Glacial Series' (Salter, 1896, p. 404). In this statement, Salter intended to convey the meaning that the deposits were Early Pleistocene fluvial or glaciofluvial accumulations, rather than remnants of a Pliocene beach, as was the popular view.

Despite Salter's interpretation, most workers continued to favour a marine origin for the Stanmore deposits. Barrow (1919c) considered that the gravel at Harrow Weald Common resembled a beach deposit. He thought it similar to that at Little Heath (see above) and suggested that the two were contemporaneous. Barrow (1919a) interpreted the higher (Stanmore) Pebble Gravel as a beach deposit of equivalent age to the similar, more widespread deposits at the lower level of *c.* 400 ft (122 m) in south Hertfordshire (Northaw Pebble Gravel), regarding the latter as sea-floor sediments (see above, Introduction to Part 1).

Wooldridge (1927a, 1957, 1960; Wooldridge and Linton, 1939, 1955) considered the '400 ft' (Northaw Gravel) deposits to be the true Pebble Gravel, recognizing that they contain more non-flint material than the higher-level outliers of the Stanmore area; in particular, he noted that Greensand chert is locally abundant in the former type. This led Wooldridge (1927a) to conclude that the '400 ft' (Northaw) Pebble Gravel was of fluviatile origin, although he later changed his view, subsequently favouring deposition on 'the emergent (?Sicilian) sea-floor' (Wooldridge, 1957, 1960, p. 119). However, Wooldridge consistently regarded the higher-level gravels of the Stanmore/Bushey area as marine, agreeing with Barrow that they were the same age as the Little Heath deposits.

The first attempt to test the various hypotheses for the origin of the high-level gravel of the type exposed at Harrow Weald Common was by Hey *et al.* (1971), whose studies of the surface textures of sand grains from various types of Pebble Gravel (*sensu lato*) included samples from the Stanmore Formation at Bushey Heath and Arkley. These showed evidence (v-shaped breakage patterns and straight, or nearly straight, grooves or fractures) of having formed in a fairly low-energy beach environment. Samples from the Northaw Pebble Gravel, on the other hand, contained sand grains showing additional evidence of modification in a fluvial environment, as well as the aforementioned marine features. These results were cited by Hey *et al.* as evidence of a marine origin for the Stanmore Pebble Gravel. However, the possibility exists that sand grain surface textures indicative of beach conditions have been inherited from the Palaeogene deposits that presumably supplied most of the sand in these gravels.

Moffat (1980, 1986) divided the various high-level Neogene gravels of North London and the Chilterns, on the basis of petrology, into four groups, two of which were subdivided (with a further group for Palaeogene gravels). His work

provided some support for Wooldridge's correlation of the Stanmore and Little Heath gravels: by comparison of the characteristics of their quartz components, both were classified in a group intermediate between the highly quartzose Westland Green-type Thames gravels and deposits containing little else but flint (the last are gravels of restricted local origins). However, the Stanmore Pebble Gravel, which he sampled at Harrow Weald Common, and the much higher gravel at Nettlebed, were separated by Moffat from other comparable deposits on the basis of particle size and mineralogy. Whereas other members of the group were interpreted as Pliocene/Early Pleistocene marine gravels, more or less in *situ* (see above, Little Heath), the Stanmore and Nettlebed deposits were attributed to Early Pleistocene fluvial activity (Moffat and Catt, 1986b).

Moffat (1986) cited variations in the distribution of different-sized quartz material ('quartz signatures') between types of high-level gravel as an indication that the quartz has come from three distinct sources. He found that the 'quartz signatures' from the supposed Pliocene/Early Pleistocene marine gravels at Little Heath and Lane End were similar to those from quartzose Reading Beds gravels and suggested that the latter had provided the quartz component of the former. Other quartzose gravels, including that at Harrow Weald Common, contain more quartz than could have been supplied by the Reading Beds, with a 'signature' suggesting a source rich in smaller clasts of quartz (4–8 mm), such as the Lower Greensand (see below). Gravels on the Chilterns dip slope, interpreted as remnants of the Stoke Row and Westland Green Formations of the Thames (Moffat, 1986; Moffat and Catt, 1986a), contain yet more quartz, with a third variety of 'quartz signature', indicating a supply of larger sized material. The association of this change with the appearance of 'Bunter quartzites' suggests that additional quartz in these gravels has come from sources outside the Thames catchment, adding support to the view that they were deposited by an early Thames flowing from the Midlands (see Part 2 of this chapter) and are clearly separable from the Pebble Gravel of North London (Stanmore and Northaw Gravels), which contains no material from the Midlands.

The plotting of the elevations of the high-level gravels discussed here against the projected downstream gradients of early Thames formations (see below) supports the interpretation of the Stanmore Gravel as fluviatile (Figure 3.6). In particular, the distinct west to east gradient, recognized but dismissed as unimportant by Wooldridge (1927a), is readily apparent. A similar gradient is observed between outcrops of the lower Northaw Pebble Gravel between Barnet and Northaw Great Wood. In both cases the gradient is higher than projections of the early Thames gravels on the Chilterns dip slope (Figure 3.6). Furthermore, gravels with larger quartz components and containing 'Bunter quartzites' have been recognized (Moffat, 1980; Moffat and Catt, 1986a) on the northern flanks of the Vale of St Albans at elevations well above the Westland Green Gravels of Hey (1965), which suggests an antiquity comparable to the North London Pebble Gravel. Moffat and Cat (1986a) suggested that gravels of this type at Bedmond [TL 104 037] and Sherrards Park Wood [TL 225 138] might be outliers of the Stoke Row Gravel of Gibbard (1983, 1985), a suggestion that is supported by their altitude (Figure 3.6). These gravels must be at least as old as the Northaw Pebble Gravel, since they are at a comparable altitude.

The composition and steeper gradients of the two North London Pebble Gravel formations, the Stanmore and Northaw Gravels (Figure 3.6), imply that they are the deposits of tributaries of the early Thames, not the Thames itself. This is supported by their location, well to the south of the earliest Thames route along the Chiltern dip slope. The distribution of these formations suggests north-eastward trending sediment bodies, now highly dissected, converging with the Thames route through the Vale of St Albans. Their composition is also consistent with deposition by a south-bank tributary of the Thames, a river draining the northern Weald and tapping sources of Greensand chert. The quartz component of these gravels, which is predominantly confined to the smaller size ranges, was probably secondarily derived from the Reading Beds and the Lower Greensand. Indeed, the 'quartz signature' determined by Moffat (1986) from the Harrow Weald Common gravel is suggestive of a Lower Greensand provenance. A similar quartz component has been encountered in (pre-Thames diversion) Mole–Wey deposits in the Finchley area, the Dollis Hill Gravel of Gibbard (1979) (see (Figure 3.1) and (Table 3.1) and (Table 3.2)). It seems likely, in fact, that several (as yet undifferentiated) left-bank terrace gravels of the erstwhile Mole–Wey river are represented in the area between the Lower Lea valley and the main Pebble Gravel outcrops of North London. The Northaw Pebble Gravel can be interpreted as a high-level element within this same terrace system; the term should be restricted to those outliers on the crest or the eastern side of the ridge, in which Greensand chert occurs ((Figure 3.1) and (Table 3.2)). Deposits at similar elevations further west, such as at Shenley, are unlikely to be *in situ* Mole–Wey deposits and may well be of colluvial origin, derived from the gravels capping the

ridge. In a stone count of the Shenley gravel, Hey (1965) found no Greensand chert.

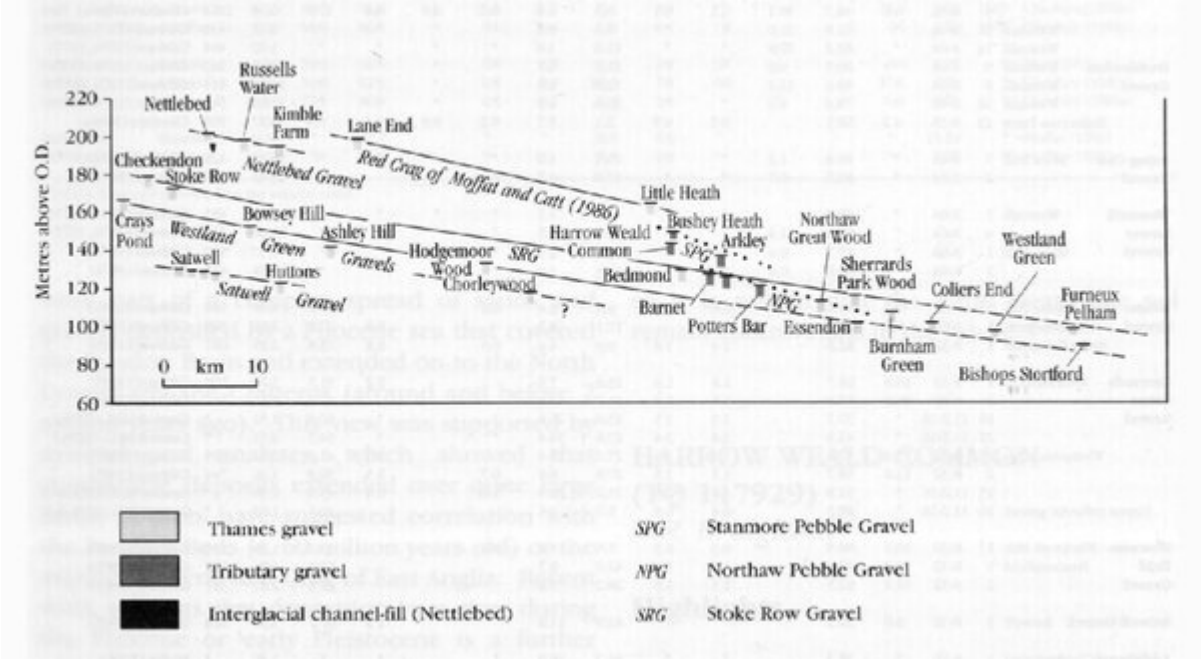
Small amounts of such chert are, however, recorded from the Stanmore Pebble Gravel (Wooldridge, 1927a; Moffat, 1980; Moffat and Catt, 1986a), suggesting that this deposit might represent the earliest evidence of the Mole–Wey drainage system. The altitudinal distribution and gradient of this deposit suggest correlation with the Stoke Row Gravel of the Thames, whereas the Northaw Gravel can probably be correlated with the Westland Green Gravels (see (Figure 3.6) and (Table 3.1)). Correlation of the deposit at Nettlebed with the Northaw Pebble Gravel, as suggested by Gibbard (1985) and Moffat and Catt (1986a), is not supported by this interpretation; the Nettlebed Gravel appears to be an older deposit than any part of the North London Pebble Gravel Subgroup (Table 3.1).

The exposure of the Stanmore Pebble Gravel at Harrow Weald Common is one of very few, in the Thames basin, in which Pliocene/Early Pleistocene deposits can be examined. The origin of this type of material has been a subject of considerable controversy but, until recently, most authors have favoured a shallow-marine origin. Recent reappraisal has considerably undermined the case for a Pliocene or Early Pleistocene marine episode in the London Basin, such that the Pebble Gravel Group is now generally thought to comprise fluviatile deposits, their marine characteristics having been inherited from earlier Cenozoic gravels. The suggestion, in this report, that the Stanmore Pebble Gravel represents a south-bank tributary of the early Thames is based on re-evaluation of published evidence. Further research on the deposit at Harrow Weald Common and other sites in the Stanmore and Northaw Gravels is required to test this theory and provide more information about the palaeogeography of the London Basin during the poorly understood Late Pliocene–Early Pleistocene period. The goal of such work would be a more complete understanding of the early history of the River Thames, prior to its acme, in the Early Pleistocene, as a huge river draining the West Midlands as well as the present catchment.

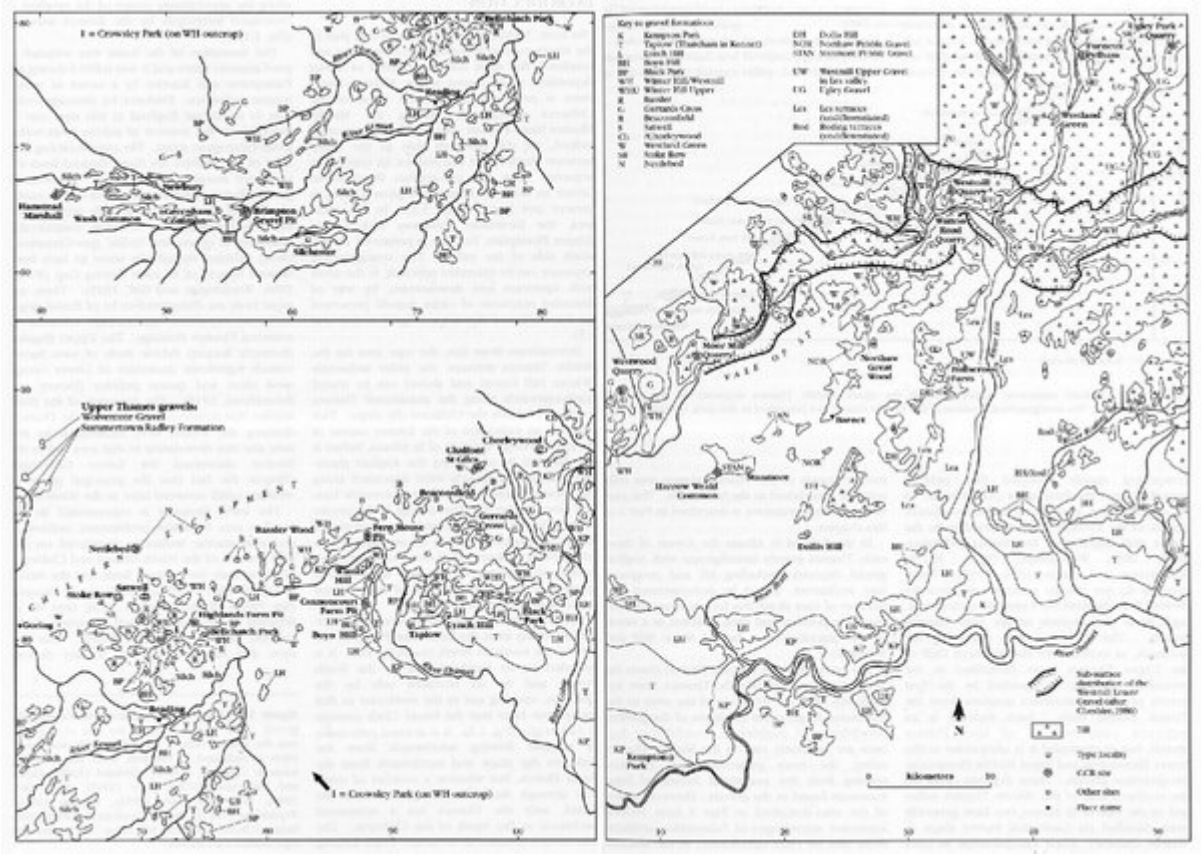
Conclusions

The gravel at Harrow Weald Common was once widely believed to have been deposited in a Pliocene sea, two million or more years ago. However, a reconsideration of the evidence from here and other sites suggests that these sediments are river deposits; their altitude and sedimentary characteristics are consistent with deposition by a south-bank tributary of the early Thames. This view stems from the application of more modern analytical methods, such as detailed studies of the constituent rock types and sand grains present in the gravels. The characteristic markings found on quartz grains when viewed under high magnification with a scanning electron microscope (SEM) provide a means of distinguishing between marine and fluviatile deposits. Such analyses suggest that the marine characteristics of the deposits were inherited from older sediments that have been incorporated in the fluviatile Stanmore Pebble Gravel. As a rare exposure of these early tributary deposits, the Harrow Weald Common site will be essential to any reinterpretation of the early history of the Thames catchment.

References



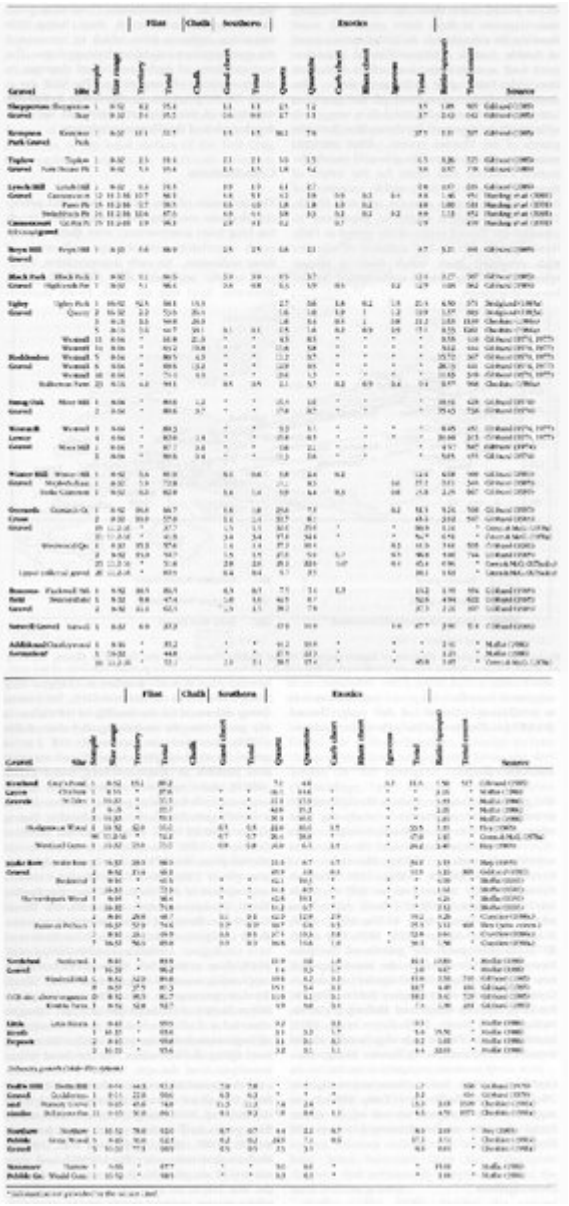
(Figure 3.6) Long-profile diagram of higher deposits in the Middle Thames and the Vale of St Albans, showing the North London Pebble Gravels, attributed in this volume to deposition by a south-bank tributary of the early Thames.



(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.

Thames formations	Tributary formations (Mole-Wey catchment?)	Group
Winter Hill Gravel	Dollis Hill Gravel	
Gerrards Cross Gravel	Equivalents may be represented within undifferentiated gravels west of Lower Lea valley	
Rassler Gravel		
Beaconsfield Gravel		
Satwell Gravel		
Chorleywood Gravel		Pebble Gravel
Westland Green Gravel	Northaw Pebble Gravel (400 ft)	
Stoke Row Gravel	Stanmore Pebble Gravel (500 ft)	
Nettlebed Gravel		

(Table 3.1) Correlation of tributary and main Thames formations within the Pebble Gravel Group and other pre-diversion gravels in the Middle Thames and Vale of St Albans regions.



(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)).