# PROBLEMS IN THE QUATERNARY DEVELOPMENT OF THE THAMES VALLEY AROUND KINGSTON: A FRAMEWORK FOR ARCHAEOLOGY

J. S. PENN and J. D. ROLLS

## INTRODUCTION

Man's changing activities in the Thames Valley during both prehistoric and historic periods have taken place within a landscape that itself shows change in response to fluctuating climatic conditions. The area of the Middle Thames around Kingston lies about 20km south of the furthest limit of Anglian ice (see Fig. 1) and so may be expected to bear the imprint of that episode, while the cold Wolstonian and Devensian stages, when ice lay much further north, were probably associated with periglacial activity. The warm interglacials, Hoxnian and Ipswichian, were periods of 'temperate' surface activity, repeated on a small scale during the Upton Warren interstadial of the Devensian. This range of conditions affected both the nature of hillslope processes and the behaviour of the Thames, which may have been further modified as a result of the oscillating sea levels of the Quaternary. Recent investigations in the Kingston area have revealed evidence throwing light on the latest events in the history of the Thames, and show that environmental change has continued to the present day. The evidence of landscape alteration is largely contained in the succession of gravels and terraces left by the Thames.

## PRINCIPLES OF TERRACE DEVELOPMENT

Most rivers that are neither aggrading nor incising their channels to any marked degree flow in sinuous fashion across a floodplain of their own alluvium. This material is normally laid down as a point bar deposit left behind on the low energy convex side of a bend as the stream swings away. The thickness of such alluvium is normally equal to channel depth at the bankfull stage, which is defined as that stage when the channel is completely filled with flowing water. A greater thickness of alluvium suggests that the stream has recently aggraded its channel. A vertical section through river alluvium may show a dominance of well bedded sands and silts, together with fine gravel, the whole being capped by a thin horizon of fine silts and clays laid down during infrequent periods of over-bank flooding. A change in environmental conditions may cause incision, with the result that the former floodplain now becomes a terrace. If, over time, incision has been the dominant process (as opposed to aggradation) a flight of terraces may be left behind as evidence for reconstructing the stream's history. Chronological problems are often complicated by phases of aggradation when 'old' terraces may be overrun by new alluvium, and in the case of the Thames glacial intervention must also be taken

## QUATERNARY HISTORY OF THE THAMES AT KINGSTON
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| *British Stage (Substage)* | *Warm or Cold* | *Thames Valley Episodes* | *Archaeology* |
|---|---|---|---|
| *Flandrian* | W | Floodplain Alluvium, Hillwash | Neolithic Mesolithic |
| *Devensian* | C | Lower Floodplain Terrace; Coombe Rock and Solifluxion | *Levalloisian* |
| *(Upton Warren* | W | Organic deposits at Isleworth) | *Levalloisian* |
| *Ipswichian* | W | Upper Floodplain Terrace; Gravels, Sands and Silts of Trafalgar Square | *Levalloisian*; *Acheulian* |
| *Wolstonian* | C | Gravel and Coombe Rock of Taplow Station; Lynch Hill and Boyn Hill Terraces | *Levalloisian*; *Acheulian* |
| *Hoxnian* | W | Main Boyn Hill Terrace deposits | *Acheulian* |
| *Anglian* | C | Black Park and Winter Hill Terraces; Oxshott Heath and Wimbledon Gravels *Anglian Glaciation. (Finchley Till) and diversion of Mole-Wey and Thames*; St. George's Hill and Dollis Hill Gravels | *Acheulian* (- - -); *Clactonian* |

Based largely on: Shephard-Thorn and Wymer (1977); Gibbard (1979); Collins (1978).

Fig. 1. Tentative event sequence for the middle Thames.

into account. Morphological, sedimentological, palaeontological and archaeological studies are combined in the reconstruction of event sequences through terrace investigation.

THE NATURE OF THE EVIDENCE IN THE KINGSTON AREA (see Figs. 2 and 3)

Morphological and sedimentological investigations of the terraces have yielded information bearing on chronology. The heights and profiles of the lowest terraces imply that they are continuations of the appropriate terraces both up and down valley, but the status of the higher Wimbledon and Kingston gravels is less readily determined. Wooldridge (1938, 639) suggested that they were associated with the Winter Hill stage of the Middle Thames. However, Zeuner (1959, 154) pointed out that a correlation of the Wimbledon gravels with the Winter Hill Terrace involved an unacceptably steep descent of the Winter Hill from near Uxbridge. He suggested that the Wimbledon gravels formed a separate spread called the 'Kingston Leaf'. Hare's detailed mapping (1947, Pl. 13) of the terraces west of the Colne revealed a further unit between the Winter Hill and Boyn Hill spreads, and which he called the 'Black Park Terrace'. Wooldridge and Linton (1955, 134) accepted as preferable the correlation between the Black Park Terrace and the Wimbledon gravels, and Gibbard's recent investigations (1979, 39) have confirmed this correlation.

Investigations of ancient river gravels have thrown light on the conditions of their deposition, and have helped to place the associated terraces in chronological order. The Wimbledon gravels which reach a maximum thickness of some 7–9m are lithologically variable. They contain much material that is foreign to the London Basin syncline, including quartzites from the Bunter Pebble Beds of the Midlands, igneous material, and chert probably derived from the Lower Greensand beds of the Weald. Wooldridge and Linton (1955, 133) identified a contrast between the southern and northern units of the Wimbledon complex. They pointed out that the southern unit, at Kingston Hill, was largely made up of 'southern' debris, i.e. flint, Lower Greensand chert, and ironstone, with only about 10% of 'northern' constituents (Bunter quartzites and igneous rocks). This contrasted with the constituents of the northern unit, in Richmond Park, which were made up of some 50% 'northern' material. Wooldridge (1938, 660) suggested that the northern unit was derived from glacial outwash, but Solomon (in Wooldridge 1938, 664) asserted that the 'total absence' of 'Eastern Drift' material from the Wimbledon gravels ruled out a correlation with that glacial event. Work by Green and McGregor (1978, 153) and by McGregor and Green (1978, 203) on the Middle Thames and the Vale of St. Albans has suggested that high frequencies of far travelled material in pre-Anglian gravels may imply glaciations in the upper catchment of the Thames, and so it may be argued that the character of the northern Wimbledon unit relates to events in the upper Thames rather than locally. Gibbard (1979, 39) has pointed out that the Kingston-Wimbledon gravels may be correlated with the Oxshott Heath gravels to the south-west, and that the Dollis Hill gravel of the Finchley

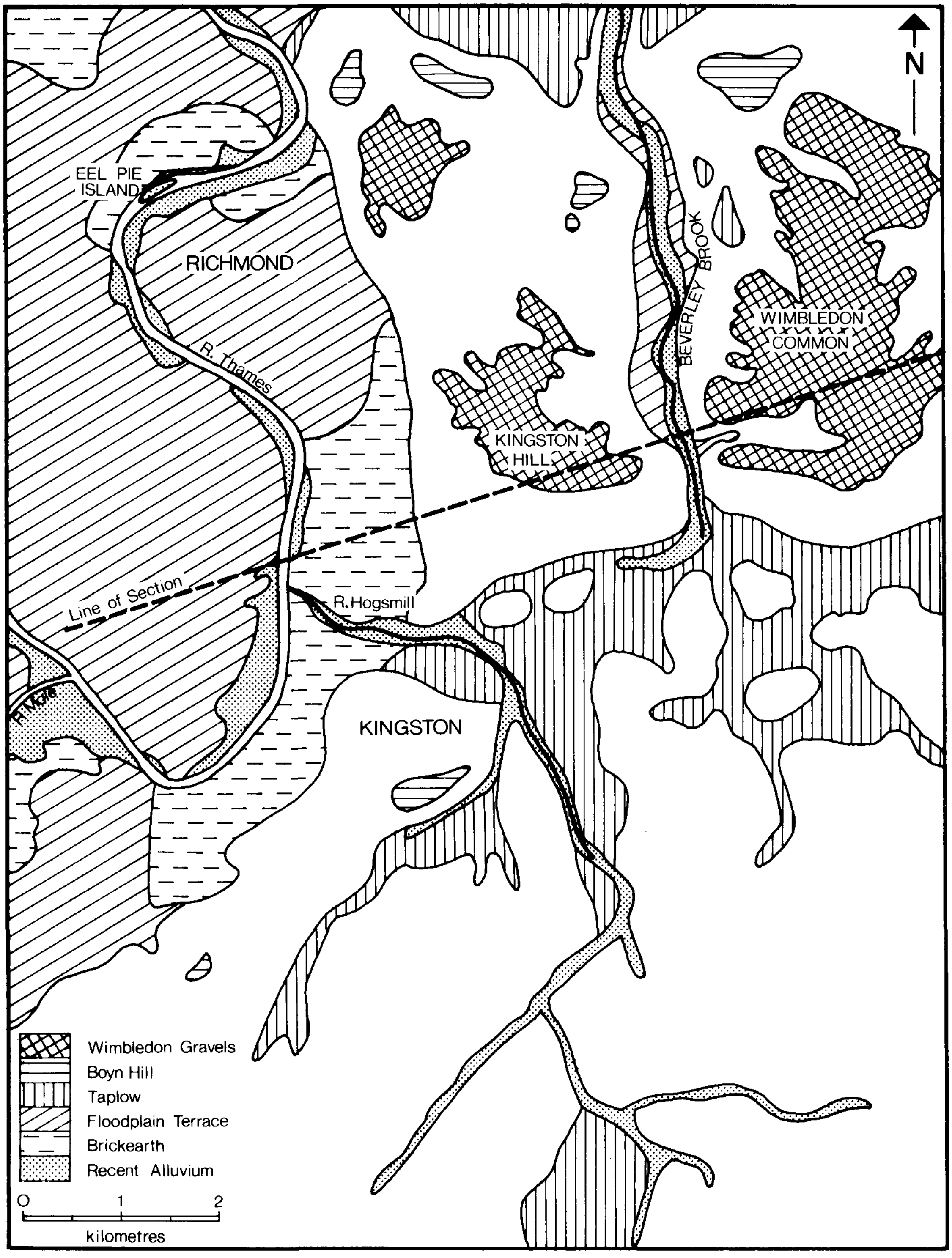


Fig. 2. Terraces and associated deposits in the Kingston District. (Based on O/S Geol. Surv. map of S. London, 1975).

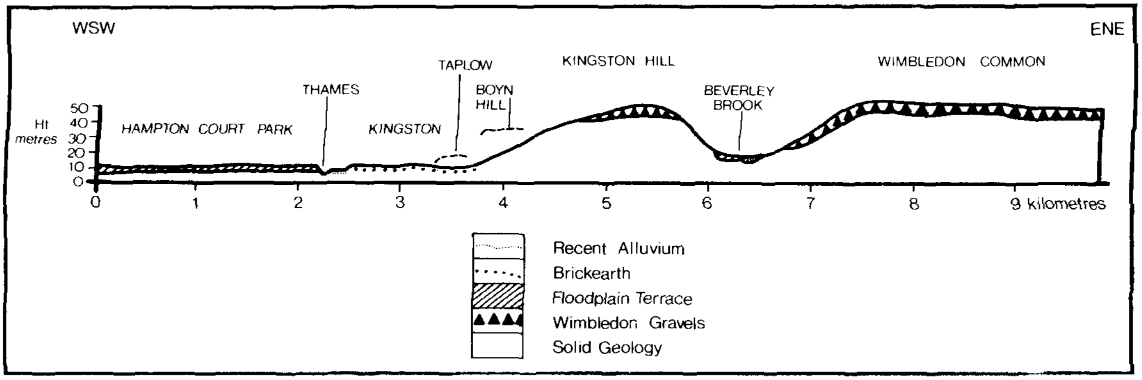


Fig. 3. Section showing terraces in the Kingston area and relative position of local Boyn Hill and Taplow deposits. (Based on O/S Geol. Surv. map of S. London, 1975).

Depression is a continuation of the St. George's Hill gravels south-east of Weybridge.

The constituents of the lower terraces in the Kingston area have received less examination. At Willments Pit, Isleworth (TQ 157746) plant remains from a silt bed beneath gravel of the Flood Plain terrace have yielded a $C^{14}$ date of $43140^{+1520}_{-1280}$ BC (Shotton and Williams 1973, 454). This suggests that Flood Plain Terrace deposits in the locality may belong to the Upton Warren interstadial of the Devensian. And at Brentford brickearth of the upper floodplain deposits have yielded 'Ipswichian' hyaena, hippopotamus, red deer, giant deer, bison and straight-tusked elephant (Zeuner 1959, 162, 324).

## CHRONOLOGY

The evidence suggests that the terraces of the Kingston area may be placed in chronological order but problems still remain over the dating of events and over details of river behaviour.

The classic investigation of Wooldridge suggested that the Thames was diverted to approximately its present course in two stages: from the Vale of St. Albans to the Finchley Depression, and then to its contemporary route. More recent work (e.g. Gibbard 1977, 473) suggests that the river was diverted directly from its St. Albans line towards its modern route by the action of Anglian ice. Gibbard has also (1979, 39) described the development of south bank tributaries. The St. George's Hill gravels may be correlated in terms of height and lithology with the Dollis Hill gravels of the Finchley Depression, and they support the view that the Wey and Mole were confluent near Weybridge and then flowed north-east in early Anglian times. The evidence of the younger Oxshott Heath gravels, of southerly origin, and their continuation as the composite Wimbledon gravels, suggests that the combined Mole-Wey met the Thames in the vicinity of Wimbledon during late Anglian (Black Park) times.

This phase was followed by a period of incision and the accumulation of Boyn Hill gravels at a new lower level. The local Boyn Hill bench is 9–12m below the bench of the 'Kingston Leaf' at Richmond. There is little evidence in the Kingston area as to environmental conditions during Boyn Hill times, but investigations at the type site (Barnfield Pit, Swanscombe) have yielded much information (see, for example, Shephard-Thorn and Wymer 1977, 38). Clactonian and Acheulian artifacts have been recorded for the lower Stage I and Stage II deposits at Swanscombe and these, together with floral and faunal evidence, suggest accumulation under temperate conditions. It appears that deposits of these stages represent distinct phases of a Hoxnian complex separated by a cold period. The upper deposits suggest the arrival of cold conditions, perhaps Wolstonian in age. However, correlation between Swanscombe and Kingston may be open to doubt (Collins 1978, 22) especially in the light of a possible crossing of the Black Park and Boyn Hill Terraces in the Lower Thames area (Bridgland 1980, 21).

The Boyn Hill episode was succeeded by erosion and then by the deposition of gravels of the Taplow stage. This is well displayed from Norbiton Common to Merton Park, and from East Sheen Common to Putney. The position of this stage within the chronology of the Thames Valley has again to be determined by reference to localities outside the Kingston region. Evidence suggests that the Taplow gravels were deposited under cold conditions. In 1854 a musk ox skull and bones of woolly rhinoceros and mammoth were found at the type site (near Taplow station, SU 919816). This evidence, together with the variety of palaeolithic artifacts, implies that the gravels were deposited under cold conditions, probably during the Wolstonian.

The Taplow stage was followed by erosion, and then by the accumulation of the Floodplain terrace gravels. This terrace is well developed along the borders of the contemporary Thames near Kingston, forming a band up to 5km wide between West Molesey and Mortlake. Its height above the modern floodplain is variable, and it may be subdivided into at least two levels. Early investigations of the Flood Plain Terrace gravels (Dewey and Bromhead 1921, 50) showed that the deposits had a composite origin. Early Flood Plain gravels had been dissected by a buried channel which was then aggraded to almost the same height. It was also suggested that, at least locally, a small bluff separated the two formations. King and Oakley (1936, 68) also describe both an upper and a lower floodplain terrace. Allen (1978, 9) has written that 'two different types of topography, which would seem to be equated with the upper and lower flood plain deposits . . . are undoubtedly present'. This may be illustrated by the situation within the great bend of the Thames at Kew, where the normally flat nature of the Flood Plain Terrace is diversified by a set of low, whale-backed ridges that rise to about 8m and which are separated by shallow valleys. These are former eyots: a modern analogue is Eel Pie island, Twickenham. A mantle of brickearth veneers the Flood Plain Terrace, especially between Long Ditton and Kingston.

The term 'brickearth' refers to fine-grained deposits of varying origin. It is used to describe wind-blown material, or loess, laid down at the margin of former ice sheets. Such material may then be reworked by hillslope processes, with the incorporation of coarser material, but it is still referred to as 'brickearth'. The term has also been used to describe the fine-grained sediment laid down in standing water.

Recent Flandrian (post glacial) alluvium occupies only a narrow strip bordering the Thames and its major local tributaries. Work on post Devensian changes has suggested that the Thames may have moved both laterally and vertically (Devoy 1979, 389) during the Flandrian. A lateral rate of shift of 1km/1000 years has been suggested by Nunn (pers. comm.) for Central London, and by inference the Thames at Kingston may have migrated by a significant amount.

## PROBLEMS OF RIVER BEHAVIOUR

Although a chronology has been devised which has a measure of support, there is much less agreement about the circumstances of terrace accumulation and incision. Several models have been proposed. Prior to Zeuner's work (1959, 45) most British workers had accepted a model that changes in sea level (a frequent Quaternary phenomenon) were felt throughout the basin: King and Oakley (1936, 54) attached particular importance to glacially controlled fluctuations of sea level. Aggradation was believed to occur as sea level rose during interglacials, and incision as it fell during glacial episodes. The presence of cold faunal elements in the Taplow gravels at Taplow is inconsistent with this interpretation, and later American work (Leopold, Wolman and Miller 1964, 261) showed that rises in base-level were felt only a short distance upstream. It now appears that during interglacial sea level 'highs' the Thames was only affected to the tidal limit of the time, and it may be inferred that the Kingston area was involved.

A second important model requires that beyond the marine influence the river's behaviour was controlled by climatic fluctuations (Zeuner 1959, 45). During periglacial phases large quantities of debris were supplied to the Thames, partly as a result of active hill slope processes. The river would be unable to transport this material due to a reduction in discharge. Aggradation would consequently have occurred, followed by incision during the next warm phase, producing a terrace. This theme has been developed in recent years by Wymer (1968, 24) and in a recent synthesis by Green and McGregor (1980, 196). These authors have elaborated the complex nature of river response to changing climate: Green and McGregor proposed eight distinct stages of river behaviour in the passage from interglacial to periglacial and then back to interglacial conditions.

Other writers have focused attention on the way in which channel pattern (and by inference depositional and erosional behaviour) may vary. Clayton (1977, 156) suggested that many alluvial gravels were deposited by meandering channels adopting a 'cut and fill' behaviour. Dissection then followed, with the development of terraces. Briggs and Gilbertson (1980, 63) in their work on the Upper Thames suggested that the river responded to periglacial and interglacial conditions by adopting contrasting channel patterns. Periglacial conditions gave rise to aggradation and braiding. The resulting sediments were angular to sub angular in shape and plane-bedded, reflecting hillslope transport with only slight river reworking. Cross-bedding would be rare. Interglacial conditions were characterised by the deposition of sands and silts in discrete, meandering channels.

A consensus seems to be emerging that the Thames behaved in braided fashion during its more active phases. A braided stream (see e.g. Miall 1973, 3) consists of a number of rapidly shifting channels and mid-channel bars, some of which may be stabilised by vegetation to become islands. It has a relatively steep gradient and tends to be wide and shallow. Sediments are coarser than for other stream types, and are dominated by sands and gravels. The major causes of braiding appear to be ample bed load of variable size, strongly fluctuating discharge, and a steep gradient.

## CHANGES IN THE THAMES AT KINGSTON

If the Geological Survey Map, Sheet 270 (South London) 1975 is examined it will be seen that between Thames Ditton and Petersham the right bank of the Thames is bordered by gravel. This strip varies in width from 500m to nearly 2km and over most of its length the gravel is labelled as Flood Plain Gravel. At Richmond a cliff of London Clay comes down to the river.

In places and notably between Long Ditton to just north of Kingston this gravel is overlain by brickearth. In Kingston this material ranges from a true silt to a clayey fine sand and may have been laid down in quiet water or as an overbank deposit. It should not be thought of as implying periglacial conditions. What is certain, however, is that the broad divisions of the 1:50,000 Geological Map do not reveal the details of the post Flood Plain Gravel and Brickearth sedimentation in the Kingston area. If this is true of this area, then it is equally likely to be true of other areas adjacent to the river in this part of the Thames valley.

Redevelopment of central Kingston since the early 1960s has provided much information on this pattern of sedimentation. It is only the linking of several sites together over a period of years which has enabled a reconstruction of stream pattern to be made. Various contractors have made their sites available for inspection, and in some cases have provided bore hole records as well. Their kindness is gratefully acknowledged.

In 1965 excavations in Eden Street, Kingston (Loc. 1 Fig. 4) exposed a variety of sediments channelled into coarse gravels. This was interpreted, on the basis of a limited section, as being a cut-off stream channel, probably belonging to the Hogsmill (Penn 1968, 2).

Later excavations during 1974–77 on Eden Walk (Loc. 2 Fig. 4) revealed much more of the sediments and confirmed the presence of a channel. They showed that the channel was much larger than originally thought and that it contained a sequence of archaeological deposits from the Neolithic period onwards. This major channel has divided the area containing All Saints Church and the Market Place from the land to the east.

There are gravels (those cut by the channels deposits) underlying the Market Place and these were not only seen in trenches in the Market Place but were also seen at the Bishops Hall Site, 29 Thames Street (Loc. 3 Fig. 4) and further north in Vicarage Road (Loc. 4 Fig. 4).

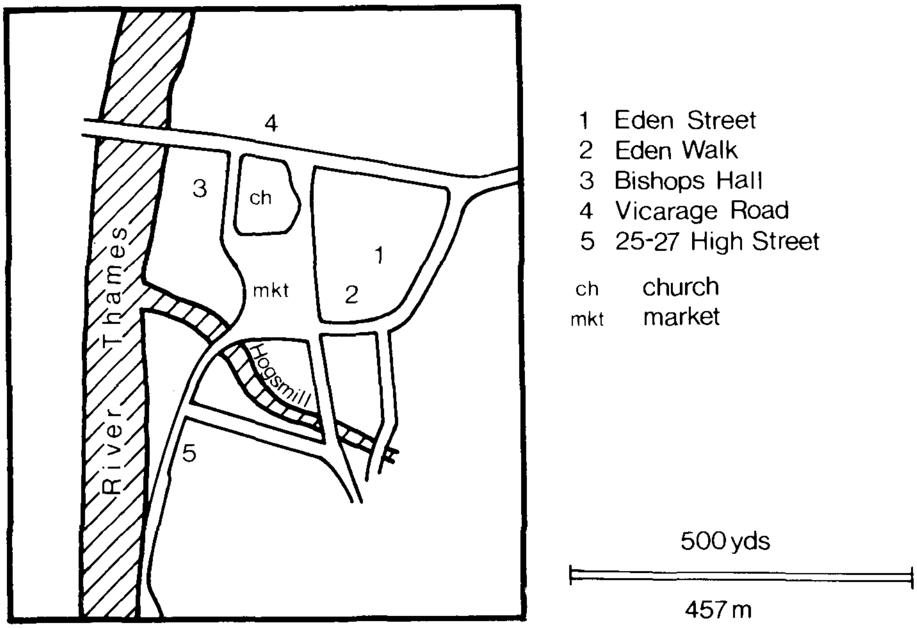


Fig. 4. Central Kingston location map.

Another important site was examined at 25–27 High Street, to the south of the Market Place (Loc. 5 Fig. 4). This showed Flood Plain gravel in situ in the southern part of the site. In the north eastern part, easterly dipping, ripple-drifted sands with fine clay stringers were found, perhaps representing late flow and deposition by the Thames.

It is probably these sites which give the clearest indication of the pattern of events in Kingston from about 3000 BC onwards. Analyses of sediment and fauna are not included in this account but the sequence suggested here is consistent with these results. It is possible, however, that the examination of later sites may alter at least part of this interpretation.

The proposed sequence is perhaps best explained by means of diagrams (Fig. 5 nos. 1–3). It is envisaged that instead of a single channel, the Thames was split into two channels by a gravel eyot. This eyot is an accretional feature accumulated around a local high point in the underlying London Clay, and is the area of gravel now occupied by the Church and the Market Place.

In the earliest situation (Fig. 5 no. 1), water was flowing in both branches of the river and the Hogsmill joined the Eastern branch. The erosive contact between the channel sediments and the Flood Plain Gravel described from the Eden Street site (Penn 1968, 1) strongly suggests flowing water in the early stages.

In the next stage (Fig. 5 no. 2), the eastern channel was abandoned as flow shifted to the western channel, this being the typical behaviour of a braided system. Flow would become intermittent and occur only at times of flood in the eastern channel, depositing relatively fine materials.

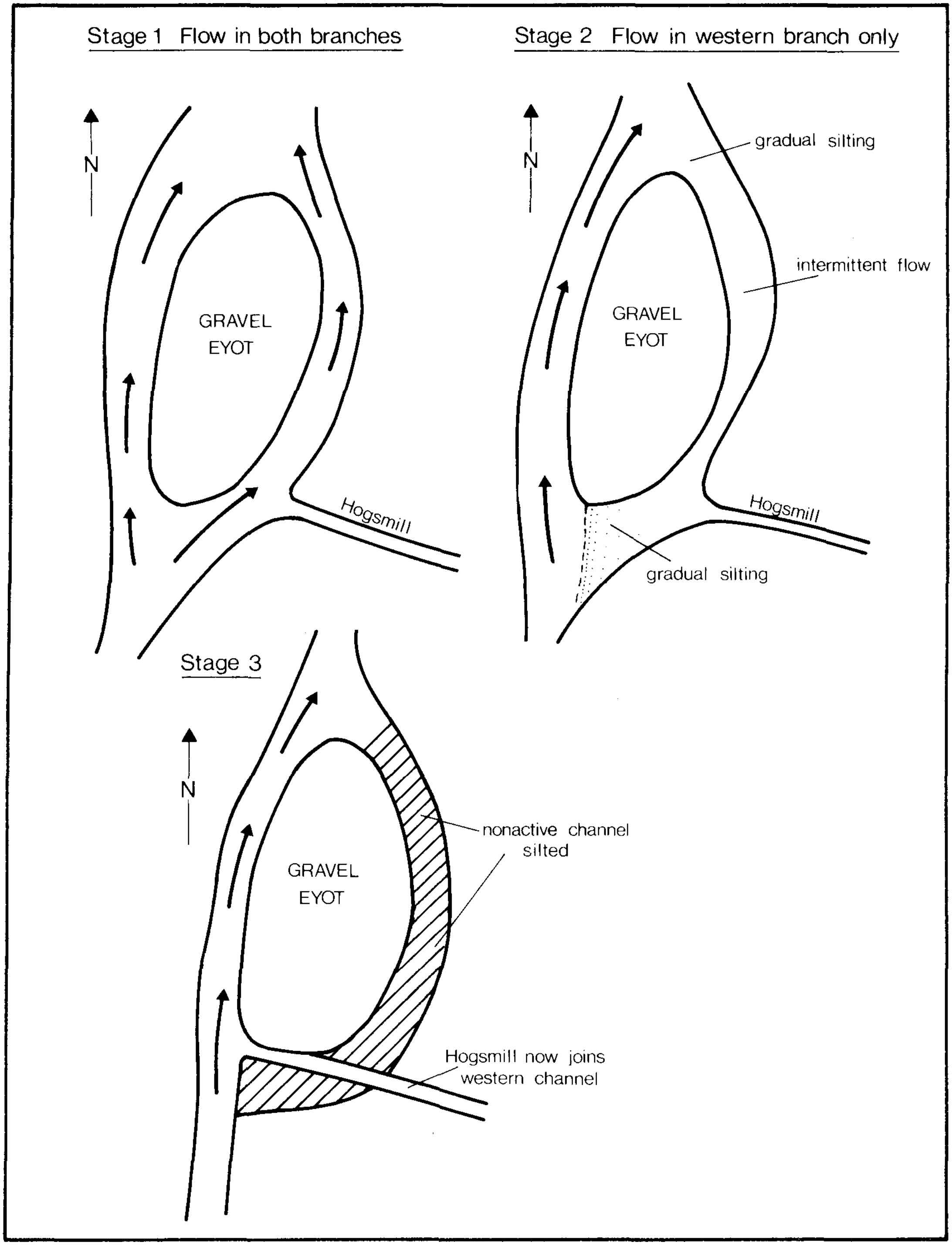


Fig. 5. Channel development in Kingston.

There is a two-fold vertical division of the channel fill at the Eden Street site. A lower unit is dominated by a molluscan fauna which prefers quiet water conditions, and an upper unit is dominated by a fauna preferring standing water. The silty sands, sandy silts and clays which form a major part of the deposits, as well as the organically rich, blue black muds correspond to the cut-off channel fills of Fisk (1944, 69; 1947, 70). They are also consistent with the views of Briggs and Gilbertson (1980, 63) regarding channel behaviour under non glacial conditions. All this suggests a closing of the eastern channel.

In the third stage (Fig. 5 no. 3) the western channel is the only active channel. The eastern channel is largely filled by muddy material from flood deposits and organic deposits from the growth of vegetation.

The sands overlying gravels seen at 25 High Street may represent late flow in the eastern branch before this became blocked. It may however represent a spread of material deposited by the Hogsmill as it joined the single active Thames channel.

Stage One may represent a time immediately pre-dating the Neolithic deposits found in the eastern channel, as a spread of archaeological material is found in the base of the channel. Stages Two and Three are much more difficult to date but closure may have occurred in Neolithic times if the faunal sequence is to be believed. The eastern channel has a sequence of archaeological deposits from Neolithic onwards, including Saxon and Mediaeval material, and the area almost certainly remained badly drained for a long period, perhaps into the 15th and 16th centuries.

The gravels at the southern end of the eyot, i.e. south of the Market Place, yield no evidence of occupation and the earliest material found to date on the gravels occurs on the Bishop's Hall site and is 9th-10th century in age. On the eastern side of the eyot the earliest material appears to be late Medieval. It is not surprising that little archaeological material has been found on the gravel area, for unless pits or something of a similar nature are dug, then very little material is likely to accumulate naturally.

Movement within the Thames itself should not be forgotten, for it is probable that some erosion of the right bank would be now still taking place as this is the concave side of the channel, were it not embanked. The left bank (above Kingston Bridge) is probably an area of deposition with a lateral rate of accretion of about 200m during 250 years.

## CONCLUSION

This paper has attempted to outline the varying behaviour of the Thames during the Quaternary, and to show that important changes have occurred locally well into historic times. It is believed that an awareness of landscape change is an essential element in our understanding of archaeological events.

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