The Wolvercote Gravel and Wolvercote Channel Deposits

Although no GCR site exists there, it is necessary, because of its importance to the Quaternary history of the Upper Thames, to discuss the evidence from Wolvercote (type locality of the Wolvercote Gravel and the Wolvercote Channel Deposits) at this point in the text.

During the latter part of the 19th century, a large channel was revealed in a brick pit at Wolvercote [SP 498 105], apparently cut through the gravel of the Wolvercote Terrace into Oxford Clay (Figure 2.10) and (Figure 2.11). This channel was found to contain a sequence of Pleistocene sediments that have yielded molluscan and mammalian remains, plant macrofossils and the largest Palaeolithic assemblage from the Upper Thames basin (Bell, 1894a, 1904; Sandford, 1924, 1926; Arkell, 1947a; Wymer, 1968; Roe, 1981; Tyldesley, 1986a, 1986b, 1988). The pit is now an ornamental lake surrounded by residential development, making reinvestigation difficult. Temporary exposures in the channel deposits were recently observed on the eastern side of the pit (Briggs *et al.,* 1985; Tyldesley, 1986b), but attempts to locate the channel in a railway cutting immediately to the west revealed only Oxford Clay with pockets of gravel at the surface (Bridgland and Harding, 1986). Work is continuing in open areas close to the brick pit to locate further remnants of the fossiliferous sediments, if any exist. So far no GCR site has been identified at Wolvercote, but it is hoped that future investigations will reveal Wolvercote Channel Deposits at a potentially conservable location.

Sections were open in the Wolvercote brick pit until the 1930s, but the lack of later opportunities to study the site has led to contrasting interpretations in the ensuing years, with both Hoxnian and Ipswichian ages being proposed for the channel deposits (Bishop, 1958; Wymer, 1968; Evans, 1971; Shotton, 1973a; Roe, 1981; Briggs *et al.,* 1985).

Many of the Wolvercote palaeoliths are of a highly distinctive, technologically advanced type, a fact that has caused some authors to argue for a Late Pleistocene age (for example, Roe, 1981), irrespective of the position of the Wolvercote Formation within the Upper Thames terrace sequence. The Wolvercote Terrace deposits have generally been attributed to the Saalian Stage (Bishop, 1958; Tomlinson, 1963; Shotton, 1973a; Briggs and Gilbertson, 1974, 1980), an interpretation based on the supposed first appearance in these gravels of material (in particular, fresh flint) from the 'Chalky Till' glaciation of the Cotswolds (Bishop, 1958; Goudie and Hart, 1975). It has been suggested recently that the 'Chalky Till' of the Cotswolds area might be of Anglian age (Bowen *et al.,* 1986a; Rose, 1987), raising the possibility that the Wolvercote Gravel is pre-Saalian and adding further fuel to the controversy over the age of the Wolvercote Channel.

The sequence at Wolvercote

It is difficult to determine the precise location of the Wolvercote Channel deposits from the early descriptions of the brick pit (Bell, 1894a, 1904; Pocock, 1908; Sandford, 1924, 1926), although they were clearly present in the southern and eastern faces. However, Bell (1894a, 1894b, 1904) provided detailed descriptions of the sections, including several illustrations, and Sandford (1924) provided an east-west section through the channel that has been repeatedly reproduced in subsequent publications (Sandford, 1926; Dines, 1946; Wymer, 1968; Roe, 1981; Tyldesley, 1986a) and which forms the basis for (Figure 2.11). Recent summaries have been provided by Wymer (1968), Roe (1981) and Tyldesley (1986a). The sequence at Wolvercote can be summarized as follows:

		Thickness (where known)
'warp sand'	6. Clayey gravelly sand, yellow-brown, in involutions	1–2 m

	5. Silt and clay, laminated	up to 4.5 m
	4. Peat, thin and localized within base of bed 5	
	Iron-pan	
Wolvercote Channel Deposits	3. Sandy gravel, current-bedded, with shells	
	Iron-pan	
	2. Calcareous gravel containing bones and artefacts	
Wolvercote Gravel	1. Bedded gravel, truncated by the channel deposits	
Oxford Clay		

Fresh flint, derived from the Cotswolds glaciation, is claimed to be present in beds 1–3.

According to the published records, the channel deposits overlie, at their margins, a gravel (bed 1) attributed by Sandford (1924) to the Wolvercote Terrace, although Bishop (1958) considered this to be part of an older aggradation (see below). The basal channel deposits comprise calcareous gravels (bed 2), containing bones and artefacts, that fill and overlie small hollows in the surface of the Oxford Clay. First described by Bell (1904), these features have been interpreted as potholes or 'swirl-holes' (Sandford, 1924; Arkell, 1947a). This appears to be an early record of scour features similar to those described recently beneath Pleistocene gravels (1) overlying London Clay at Stoke Newington (Harding and Gibbard, 1984), (2) overlying Pleistocene silt (Lower Loam) at Swanscombe and (3) overlying Thanet Sand at Globe Pit (see Chapter 4). Sandford (1924) noted that many of the large vertebrate bones were obtained from gravel within these scour features.

Above the basal gravel a series of ferruginous, cross-bedded sands and gravels was recorded (bed 3). Certain layers, predominantly at the base and top of the bed, were cemented into iron-pans. Between the lower and upper iron-pans, Sandford (1924, 1926) recorded shelly sands and a lens of clay containing shells and organic material. In the most comprehensive record, Kennard and Woodward (1924) recorded seventeen molluscan species from these beds. These gravelly deposits were separated by an erosive contact from the main infill of the channel, which comprised laminated silty clay (bed 5). A peat horizon (bed 4), which occurred locally at the base of this deposit, yielded plant fossils and beetles (Bell, 1894a, 1904; Reid, 1899; Blair, 1923; Duigan, 1956).

The channel sequence was capped by an upper sand (bed 6), up to 2 m thick, which, with the top of bed 5, was deformed by cryoturbation. This sand, with only a small clay component (Spiller, in Sandford, 1924), has generally been called 'warp sand'. It has also been recognized above the Wolvercote Terrace gravel away from the channel. Most authors have attributed this bed, directly or by implication, to solifluction, although Sandford (1925) thought it might result partly from the decalcification of the underlying sediments. It is also possible that an input of wind-blown, originally fluviatile, sands occurred. Spiller (in Sandford, 1924) showed from its heavy-mineral content that the 'warp sand' has closer affinities to the local fluvial deposits than to the bedrock.

Most of the palaeoliths from the Wolvercote site came from the basal gravel (bed 2) of the channel-fill or from the overlying cross-bedded ferruginous gravel. Some artefacts are considerably stained by iron, suggesting derivation from in or near one of the iron-pans (Sandford, 1924). The assemblage comprises mainly pointed hand-axes of a particularly well-made and characteristic type, although there is a fair representation of both primary and finishing flakes. About two-thirds of the material is in an unpatinated sharp or mint condition, suggesting that it was knapped at the site (Wymer, 1968). Palaeoliths have also been found in the Wolvercote Terrace gravel, both here and at Pear Tree Hill [SP 494 111] to the north (Bell, 1904; Wymer, 1968). These are predominantly heavily abraded and patinated hand-axes, of the pointed type.

The Wolvercote Gravel (bed 1) is preserved, in the area of the Wolvercote brick pit, predominantly in pockets in the surface of the Oxford Clay, described as 'somewhat flask-shaped holes' by Bell (1904, p. 126). These were noted particularly on the western side of the pit (Pocock, 1908) and have been observed at the top of sections in the adjacent railway cutting (Bridgland and Harding, 1986). According to Sandford (1926), the terrace gravel was better represented in temporary sections to the south and east than in the brick pit. Bishop (1958) described temporary sections to the south-east of the pit in deposits that he ascribed to the Wolvercote Terrace and from which he obtained molluscs and ostracods.

Stratigraphy, age and correlation of Wolvercote deposits

Bell (1894a, p. 198) noted that the gravel of the Wolvercote area was older than the 'Summertown and Oxford gravel'. Pocock (1908) classified the former under the title 'Third Terrace', part of a sequence of four terraces numbered topographically upwards. Sandford (1924, 1926) redefined this as his Wolvercote Terrace. The deposits forming this terrace are here classified as the Wolvercote Gravel Formation, of which the Wolvercote Channel Deposits are a member.

The stratigraphical position of the Wolvercote Channel, particularly in relation to the Wolvercote Terrace gravel, has been a topic of a prolonged controversy. According to Sandford (1924, 1926), the Wolvercote Channel cuts through gravel of the Wolvercote Terrace, a view accepted by most authors. As the Wolvercote Gravel has generally been correlated with the Saalian, the temperate-climate channel deposits have been ascribed to the Ipswichian Stage (Shotton, 1973a; Roe, 1981). A conventional interpretation of terrace stratigraphy in the Upper Thames basin would place the Wolvercote Terrace and Channel earlier than the Summertown-Radley Terrace (Figure 2.2) and (Figure 2.3), which has also yielded temperate-climate fauna and flora (see below, Stanton Harcourt and Magdalen Grove). A similar conclusion was reached, following the interpretation of molluscan faunas from various sites in the Upper Thames, by Kennard and Woodward (in Sandford, 1924). Despite this, Sandford (1925, 1926, 1932) concluded that the Wolvercote Channel Deposits post-date the temperate-climate sediments representing the upper part of the Summertown-Radley aggradation (the Eynsham Gravel — see below, Stanton Harcourt and Magdalen Grove), although he considered that both originated in the same interglacial. His correlation table (Sandford, 1932, p. 10) makes it clear that he considered this warm interval to immediately pre-date the last glaciation, implying correlation with the last interglacial (Ipswichian), but he also suggested that the lake beds at Hoxne, later to become the type site of an earlier interglacial in Britain (Mitchell et al, 1973), were of equivalent age. This led some later authors, notably Bishop (1958), to claim that Sandford regarded the channel as Hoxnian.

Sandford's view, that the Wolvercote Channel Deposits post-dated the upper Summertown-Radley aggradation, was later consolidated by Dines (1946) and Arkell (1947a), although the latter placed both in the 'Great Interglacial' (Hoxnian Stage). Most subsequent authors who have concurred with Sandford's stratigraphical interpretation (Shotton, 1973a; Briggs and Gilbertson, 1974) have considered the Wolvercote Channel sequence to belong to the Ipswichian Stage. Evidence for climatic cooling, from plant macrofossils in the peat (see below), implies that the latter part of an interglacial is represented. The stratigraphical relations of the Wolvercote Channel have become a major point of controversy, however, since Bishop (1958) suggested that the channel deposits were older, rather than younger, than the Wolvercote Gravel. He believed the channel-fill to be of late Hoxnian to early Saalian age, an interpretation that also found favour with Wymer (1968).

Briggs (1976b) presented a summary of the various possible stratigraphical interpretations of the Wolvercote Channel Deposits. These are: (1) the channel post-dates the Wolvercote Gravel but pre-dates the Summertown-Radley Formation (the view of Kennard and Woodward (in Sandford, 1924)); (2) the Wolvercote Channel Deposits immediately post-date the upper Summertown-Radley aggradation (the later suggestion by Sandford (1925, 1926, 1932)); (3) the Wolvercote Channel is a pre-Wolvercote Terrace feature (the interpretation of Bishop (1958)) and (4) the Wolvercote Channel Deposits are contemporaneous with the upper Summertown-Radley aggradation, but laid down in a steeply sloping tributary valley and, therefore, at a greater elevation. The last view corresponds with the idea of formation in a 'hanging' tributary valley, possibly an early River Ray, suggested by Arkell (1947a). Whereas the earlier reconstructions (1 and 2) implied an Ipswichian age, Bishop (1958) interpreted the channel as Hoxnian. Briggs (1976b) favoured the first or third of the above hypotheses, considering that deposition of the Wolvercote Channel Deposits before the Summertown-Radley sediments, in line with conventional terrace stratigraphy, was inherently more likely than alternative models requiring complex sequences of erosion and aggradation. The larger number of climatic fluctuations now recognized in the late Middle Pleistocene allows a more straightforward interpretation of the Wolvercote sediments, as in option 1 above; they do not necessarily correlate with any other interglacial sediments recorded from the Upper Thames basin (see below, correlation).

Palaeontological evidence

Information on the faunal content of the Wolvercote Gravel and Wolvercote Channel Deposits is rather sparse. The Wolvercote Gravel has yielded scanty remains of mammals; the only such records appear to be horse, from Spelsbury (Sandford, 1924, 1926, 1939), and a wolf s tooth from Pear Tree Hill (Bell, 1904), where the gravel was regarded by Sandford (1924) as part of the Wolvercote Terrace (although the provenance of the tooth must be regarded as dubious). The fauna from the Wolvercote Channel Deposits comprises *Palaeoloxodon antiquus, Dicerorhinus hemitoechus, Bos primigenius, Cervus elaphus* and *Equus caballus* L., with bison, reindeer and bear recorded with less certainty (Sandford, 1924, 1925, 1926). Molluscan faunas were recorded from both the channel deposits (Kennard and Woodward in Sandford, 1924) and the Wolvercote Gravel (Bishop, 1958), in each case dominated by *Trichia bispida.* None of the species recognized give a useful indication of climate (Bishop, 1958), although Gilbertson (1976) claimed that the fauna from the channel showed greater temperate affinities than that from the terrace gravel; however, he considered it unlikely that either represented exceptionally cold conditions. The source of the molluscan fauna attributed by Bishop (1958) to the Wolvercote Terrace lies less than 200 m from the brick pit and, although the deposits recorded there by Bishop were dominated by gravel, it seems likely that they represent a continuation of the channel-fill rather than the cold-climate terrace deposits (Figure 2.10).

Plant macrofossils (Bell, 1894a, 1904; Reid, 1899; Duigan, 1956) and beetle remains (Blair, 1923) from the peaty horizon (bed 4) at the base of the silty clay (Figure 2.11) indicate cool-temperate conditions (Duigan, 1956), probably colder than during the deposition of the gravels (beds 1–3) (Briggs *et al.,* 1985; Briggs, 1988). This interpretation is based on the presence of the arctic-alpine plant *Draba incana* L. (Duigan, 1956), the northern weevil *Notaris aethiops* (Fabricius) and a number of mosses of cold-climate affinities (Bell, 1904). Confirmation of progressive cooling during the infilling of the Wolvercote Channel was recently obtained from sparse pollen, probably from bed 5, from temporary sections near the eastern edge of the pit (Briggs *et al.,* 1985; Briggs, 1988). These showed a change from pine-dominated forest to open conditions, a sequence suggestive of the later part of an interglacial cycle. None of the palaeontological data provides any clear indication of the age of the channel-fill, except that the mammalian and molluscan species indicate deposition during the late Middle Pleistocene or Late Pleistocene.

The archaeological evidence

Both Wymer (1968) and Roe (1981) singled out Wolvercote brick pit as the most important Palaeolithic site in the Upper Thames, valley. It is, in fact, the only locality in this region to have yielded a large collection of well-made Lower Palaeolithic tools, fashioned from good quality flint (presumably imported from the Chilterns), in a condition suggesting the proximity of a working site. Moreover, the site is of great Palaeolithic and Pleistocene significance as the source of an industry that is possibly unique in Britain. This claim is based on the characteristic and unusual form of certain of the best-made artefacts within the assemblage, which have been • compared with some of the most recent hand-axe industries on the continent (Roe, 1981; Tyldesley, 1986a). Not all of the Wolvercote material is flint; artefacts made from quartzite and greywacke are included in the collections (Wymer, 1968; Roe, 1976, 1981; Tyldesley, 1988).

Summaries of the Palaeolithic assemblage from Wolvercote have been provided by Sandford (1924), Roe (1964, 1976, 1981), Tyldesley (1986a) and Wymer (1968). The typological harmony of the unabraded implements suggests that a single industry is represented, supporting the notion that a working site existed in the vicinity (Wymer, 1968; Roe, 1981). These hand-axes are characteristically large, finely made tools, showing evidence for soft-hammer working and often with a markedly plano-convex cross-section. This type of implement from Wolvercote, sometimes referred to as 'tongue-shaped' (Evans, 1897) or 'slipper-shaped' (Sandford, 1924, 1926), has been compared to the continental Micoquian industries, which are generally attributed to the last glaciation or the last interglacial (Sandford, 1924, 1925; Roe, 1981). Tyldesley (1986a) noted that classic Wolvercote Channel style' hand-axes formed a small proportion of the assemblage from the brick pit, eight specimens in all, but that there was a considerable cluster of other implements sharing many of the 'classic' features.

In his analysis of British hand-axe assemblages on the basis of implement typology, Roe (1964, 1968a) allocated the Wolvercote collection to a group of its own, it being the only British assemblage dominated by piano-convex bifacial tools, which Roe thought likely to be of relatively late inception. Wymer (1968), on the other hand, considered the Wolvercote industry to be broadly comparable to that from the Swanscombe Middle Gravel, both sites lacking ovate hand-axes and Levallois flakes and cores. Wymer recognized that the large plano-convex implements from Wolvercote were exceptional, but was prepared to accept the conclusion of Bishop (1958) that the Wolvercote Channel was pre-Saalian (see above). Roe (1981) disputed Wymer's view both of the affinities of the implement assemblage and of the likely age of the channel deposits. He cited the occurrence of typologically comparable Micoquian hand-axe assemblages at continental sites such as La Micoque in France and Bocksteinschmiede in Germany, both attributed to the last interglacial/glacial cycle. For the Wolvercote Channel Deposits to be as late as these continental industries, they would have to post-date much, if not all, of the Summertown-Radley Formation. This view, advocated by Roe (1981) and tentatively supported by Tyldesley (1986a, 1986b), would appear to conform with the later stratigraphical interpretation of Sandford (1925, 1932).

A detailed study of the Wolvercote Palaeolithic collections has been completed recently by Tyldesley (1986a, 1986b, 1988). Amongst her observations, she noted that the characteristic Wolvercote implements could be the work of a single craftsman who, given the limited size of the assemblage, could have made all the surviving artefacts in a single day. She also noted that tools similar to the characteristic Wolvercote types occurred within some French Micoquian industries, although they formed a less important part of these assemblages than at Wolvercote. She found that German Micoquian industries generally lacked such forms, however, and concluded (1986a) that the similarity of the Wolvercote hand-axes to the French material could have resulted from coincidence.

Briggs *et al.* (1985) questioned the value of typological refinement as an indication of a relatively recent age for the Wolvercote Channel Palaeolithic assemblage. This reflects recent thinking amongst archaeologists, which results largely from the recognition, at sites such as Boxgrove (Sussex), that relatively advanced knapping techniques were used in Britain in the early Middle Pleistocene (see Chapter 1). It is therefore apparent that the Palaeolithic assemblage from Wolvercote brick pit, though forming an important part of the scientific interest at the site, is of little value for relative dating.

Correlation

Since they lack diagnostic biostratigraphical evidence, determination of the age of the Wolvercote deposits relies heavily on the interpretation of the Upper Thames sequence as a whole. It is now widely believed that the deposits underlying the Summertown-Radley Terrace contain evidence for two separate interglacials, correlated with Oxygen Isotope Stages 7 and 5 (Briggs and Gilbertson, 1980; Shotton, 1983; Briggs *et al.,* 1985; Bowen *et al.,* 1989; Chapter 1; see also below, Stanton Harcourt and Magdalen Grove). These deposits are lower within the Upper Thames terrace sequence, and therefore younger, than the Wolvercote Gravel. According to the climatic model for terrace formation favoured in this volume, this implies that the Wolvercote Formation represents an earlier climatic cycle (cold-temperate-cold) than any part of the Summertown-Radley Formation (see Chapter 1). This model holds that the time interval represented by a typical terrace aggradation straddles a temperate climatic half-cycle, so that interglacial sediments, where preserved, are commonly underlain and overlain by deposits representing different cold episodes. The later, overlying, cold-climate sediments (phase 4 of the climatic model) are usually dominant, if only because they are the last to be deposited prior to rejuvenation. At Wolvercote, however, the pre-interglacial (phase 2) cold-climate aggradation appears to dominate (according to Sandford's interpretation of the relations between the Wolvercote Channel and Wolvercote Gravel). It is likely that a post-interglacial (phase 4) part of the Wolvercote aggradation was deposited elsewhere, although it will be impossible to distinguish it from the earlier phase 2 gravels in the absence of intervening interglacial (phase 3) sediments.

It is apparent that the 'Chalky Till' glaciation of the Cotswolds occurred prior to the deposition of the Wolvercote Channel sediments, since it supplied the fresh flint clasts that occur in the underlying Wolvercote Gravel. The glaciation therefore provides a maximum age for the Wolvercote Channel Deposits (it does not, however, indicate that the Wolvercote Gravel is of similar age to the Cotswolds glaciation — see Long Hanborough and Chapter 1). If the reinterpretation of this glaciation as an Anglian event (Rose, 1987, 1989) is accepted, it is possible to accommodate the Wolvercote Channel in one of two temperate episodes between the Anglian (Oxygen Isotope Stage 12) and the older of the two Summertown-Radley interglacials (Oxygen Isotope Stage 7). Correlation of the Wolvercote Channel Deposits is possible, on this basis, with either Stage 11 or Stage 9 of the oxygen isotope record. However, mammalian bones reworked into the Hanborough Gravel have been attributed to the Hoxnian Stage *sensu* Swanscombe, which is correlated with Oxygen Isotope Stage 11 (Table 1.1), and the Hanborough Gravel itself to Stage 10. Since the Wolvercote Formation clearly post-dates the rejuvenation event that followed the deposition of the Hanborough Gravel, correlation of the Wolvercote Channel Deposits with Oxygen Isotope Stage 9 (rather than 11) is strongly indicated. The stratigraphical correlations advocated here are summarized in (Table 2.2).

The correlation of the Wolvercote Formation with the terrace sequence in the London Basin has been attempted by relatively few authors. Both Sandford (1932) and Arkell (1947a) suggested a correlation of the silty infill of the Wolvercote Channel (bed 5) with the Crayford 'brickearth', implying correlation with the Taplow aggradation. Evans (1971) similarly correlated the Wolvercote Terrace and Wolvercote Channel with the Taplow Terrace, considering them to have aggraded in his cycle 4W (equivalent to Oxygen Isotope Stage 7). This correlation was largely based on projection of the terraces through the Goring Gap. Gibbard (1985), using the same method, proposed the same correlation. However, the deposits in the Reading area, immediately downstream from the gap, that were ascribed by Gibbard to the Taplow Formation are reinterpreted in this volume (Chapter 1) as degraded Lynch Hill Gravel, thus implying a correlation between the Wolvercote and Lynch Hill Formations. In the scheme for terrace correlation presented in Chapter 1, the equivalence of the Wolvercote and Lynch Hill Formations was proposed (Figure 1.3). This provides further support for correlation of the Wolvercote Channel sediments with Oxygen Isotope Stage 9, since the Lower Thames equivalent of the Lynch Hill Formation, the Corbets Tey Gravel, incorporates bodies of temperate-climate sediment at a number of sites that are also ascribed to this stage ((Table 1.1); Chapter 4).

Attribution of the Wolvercote Gravel to the Anglian Stage, as suggested by Bowen *et al.* (1986b), is rendered untenable by the correlation of the Wolvercote and Lynch Hill Formations. The projection of the long-profile of this formation downstream into the London Basin (Chapter 1 and (Figure 1.3)) shows the Wolvercote/Lynch Hill Gravel to be considerably lower (and therefore later) within the terrace sequence than either of the two Anglian formations, the Winter Hill and Black Park Gravels. Bowen *et al.'*s suggestion was based on the assumption that the Wolvercote Gravel was fed by flint-rich outwash from the Cotswolds glaciation, as suggested by Tomlinson (1929) and Bishop (1958). This assumption, although almost universally accepted in recent years, has now been seriously challenged by Maddy et al(1991b). They have reviewed the published clast-lithological data from the Wolvercote and Hanborough Gravels, which is in any case rather scanty, and concluded that there is no unequivocal indication of an input of flint into the Upper Thames system between these two formations. They found that, in comparison with other material foreign to the modern catchment, the highest percentage of flint actually occurred in a sample of Hanborough Gravel. This led them to suggest that the observed paucity of flint in the Hanborough Gravel, in comparison with the Wolvercote Formation, is the result of the greater incorporation of local limestone material in the older gravel. This evidence, as well as historical records of fresh flint in gravels later ascribed to the Hanborough Formation (Gray, 1911; Tomlinson, 1929; see above, Long Hanborough), suggests that the Cotswolds glaciation occurred during or before the aggradation of the Hanborough Gravel and, therefore, significantly earlier than the deposition of the Wolvercote Gravel. As stated above (see Long Hanborough), the outstanding problem is the relation of the Hanborough Gravel to the Moreton-in-Marsh glacial deposits; however, the dating and correlation of the Wolvercote Formation is in no way affected by the continuing dispute over this relation and the age of the Cotswolds glaciation.

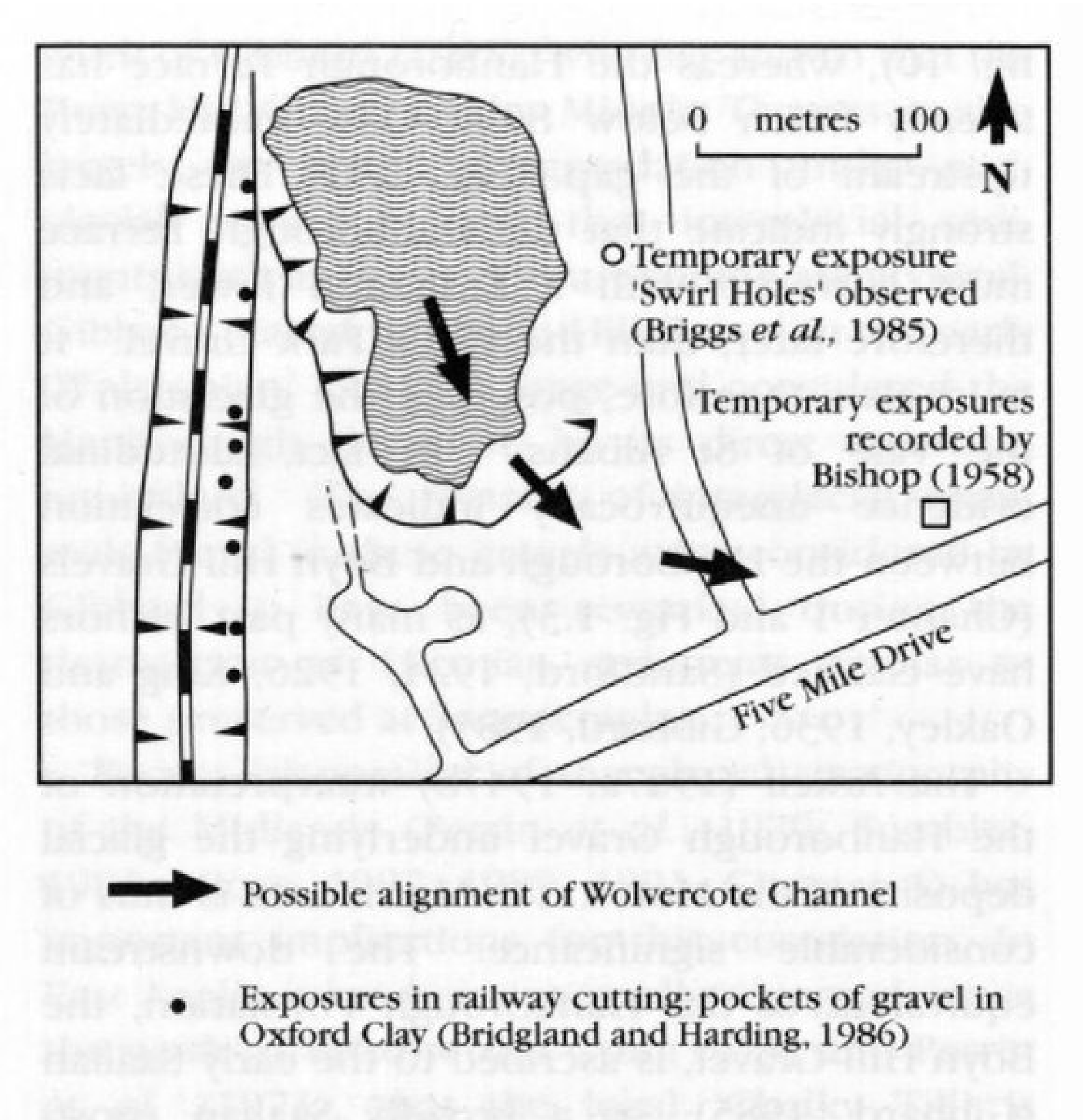
(Table 2.2) Stratigraphical interpretation of the Upper Thames deposits advocated in this volume.

Temperate	Stage 7	Stanton Harcourt Channel Deposits Basal Stanton Harcourt Channel Deposits and equivalents
Cold	Stage 8	Wolvercote Gravel (phase 4)
		Uppermost Wolvercote Channel Deposits

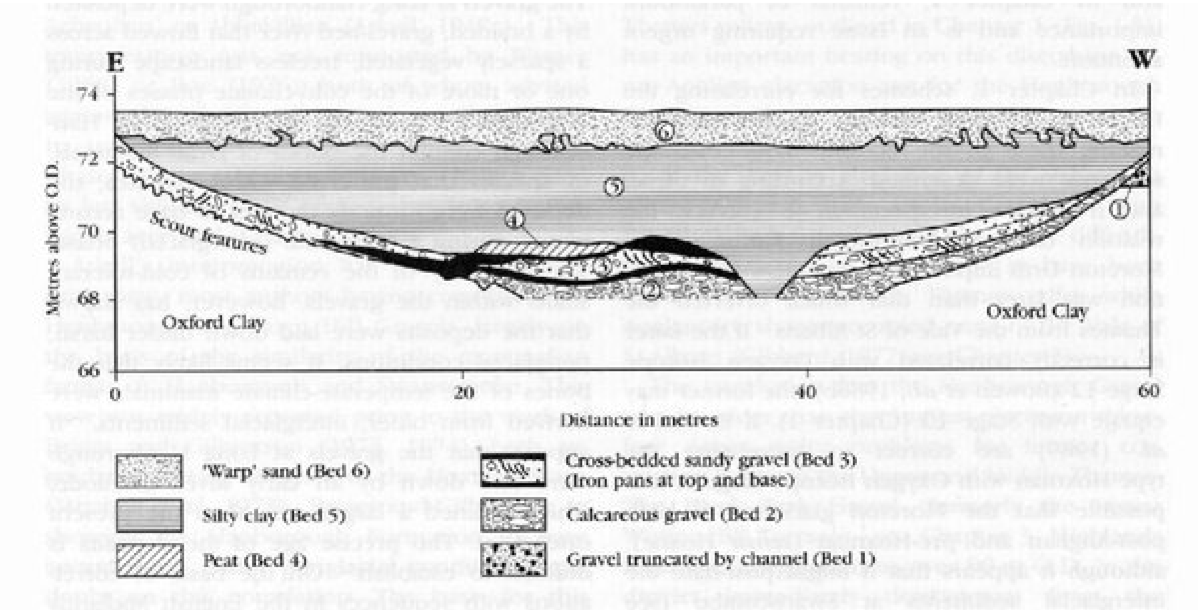
Temperate	Stage 9	Wolvercote Channel Deposits Wolvercote Gravel (phase 2)
Cold	Stage 10	Hanborough Gravel Moreton-in-Marsh glaciation?
Temperate	Stage 11	Mammalian fauna (derived) in Hanborough Gravel
Cold	Stage 12	Hanborough Gravel (pre-bones)? Moreton-in-Marsh glaciation?

It is widely agreed that a modern study of the Wolvercote deposits is urgently required before a complete understanding of the site's chronostratigraphical position within the Pleistocene can be achieved. Given that Wolvercote brick pit has yielded the largest collection of artefacts from any site in the Upper Thames, and it is the only locality in that area to have yielded Palaeolithic material in association with a temperate fauna, the importance of the site cannot be questioned. The interpretation, presented here, of the temperate-climate deposits at Wolvercote and their included fossils and palaeoliths as representing Oxygen Isotope Stage 9 has been argued almost entirely from stratigraphical evidence derived from other sites in the Thames sequence. A new opportunity for an examination of the Wolvercote Channel Deposits themselves must be awaited in order to test this hypothesis.

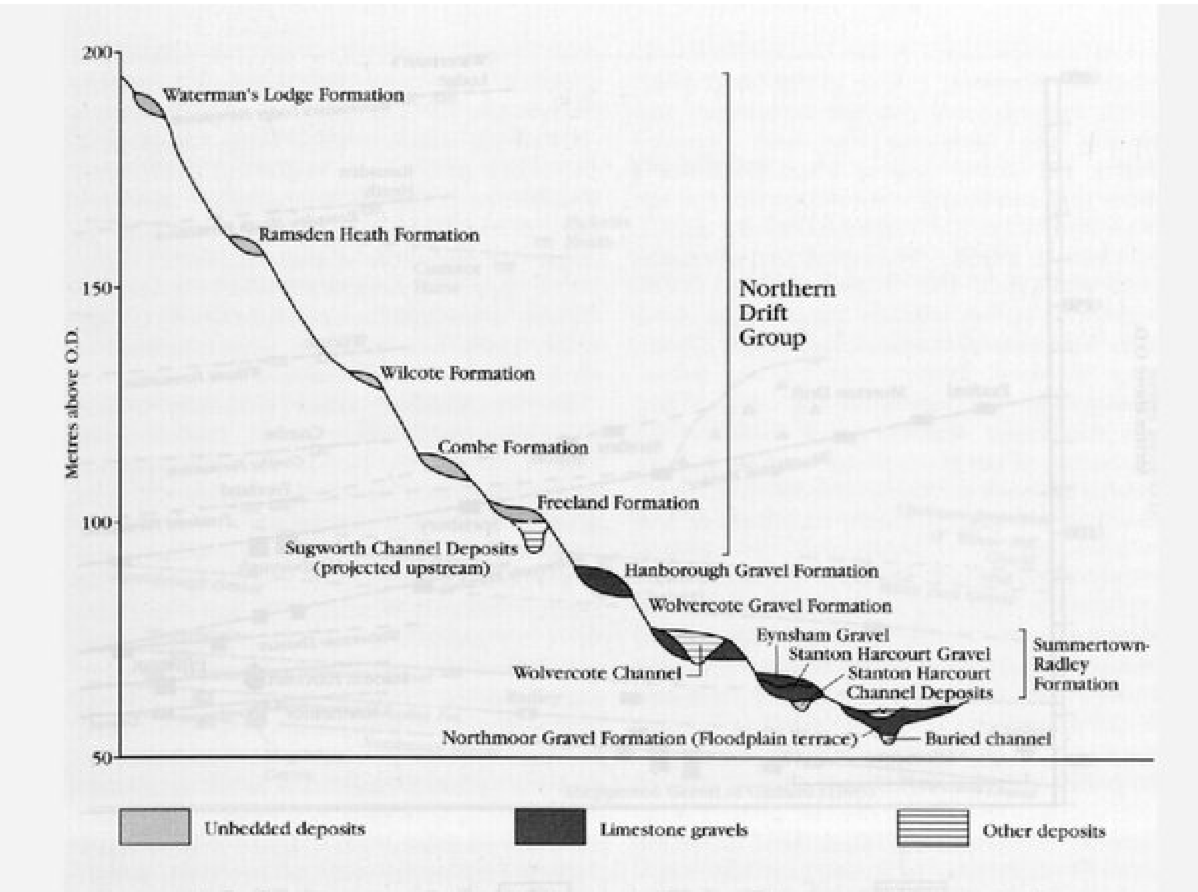
References



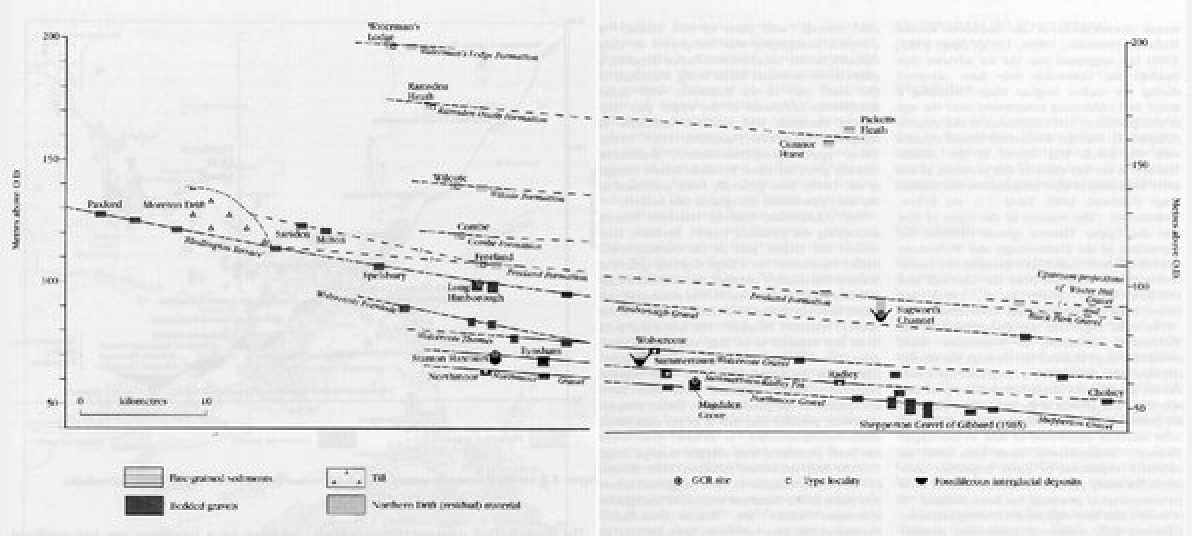
(Figure 2.10) Map of Wolvercote brick pit and the surrounding area, showing the possible alignment of the Wolvercote Channel.



(Figure 2.11) Section through the Wolvercote Channel (after Sandford, 1924). now an ornamental lake surrounded by residential development, making reinvestigation difficult. Temporary exposures in the channel deposits were recently observed on the eastern side of the pit (Briggs et al., 1985; Tyldesley, 1986b), but attempts to locate the channel in a railway cutting immediately to the west revealed only Oxford Clay with pockets of gravel at the surface (Bridgland and Harding, 1986). Work is continuing in open areas close to the brick pit to locate further remnants of the fossiliferous sediments, if any exist. So far no GCR site has been identified at Wolvercote, but it is hoped that future investigations will reveal Wolvercote Channel Deposits at a potentially conservable location.



(Figure 2.2) Idealized transverse section through the terrace deposits of the Upper Thames (Evenlode).



(Figure 2.3) Longitudinal profiles of the Upper Thames terrace deposits. Compiled from the following sources: Arkell (1947a, 1947b); Bishop (1958); Briggs and Gilbertson (1973); Briggs et al. (1985); Evans (1971); Kellaway et al. (1971); Sandford (1924, 1926); Tomlinson (1929).

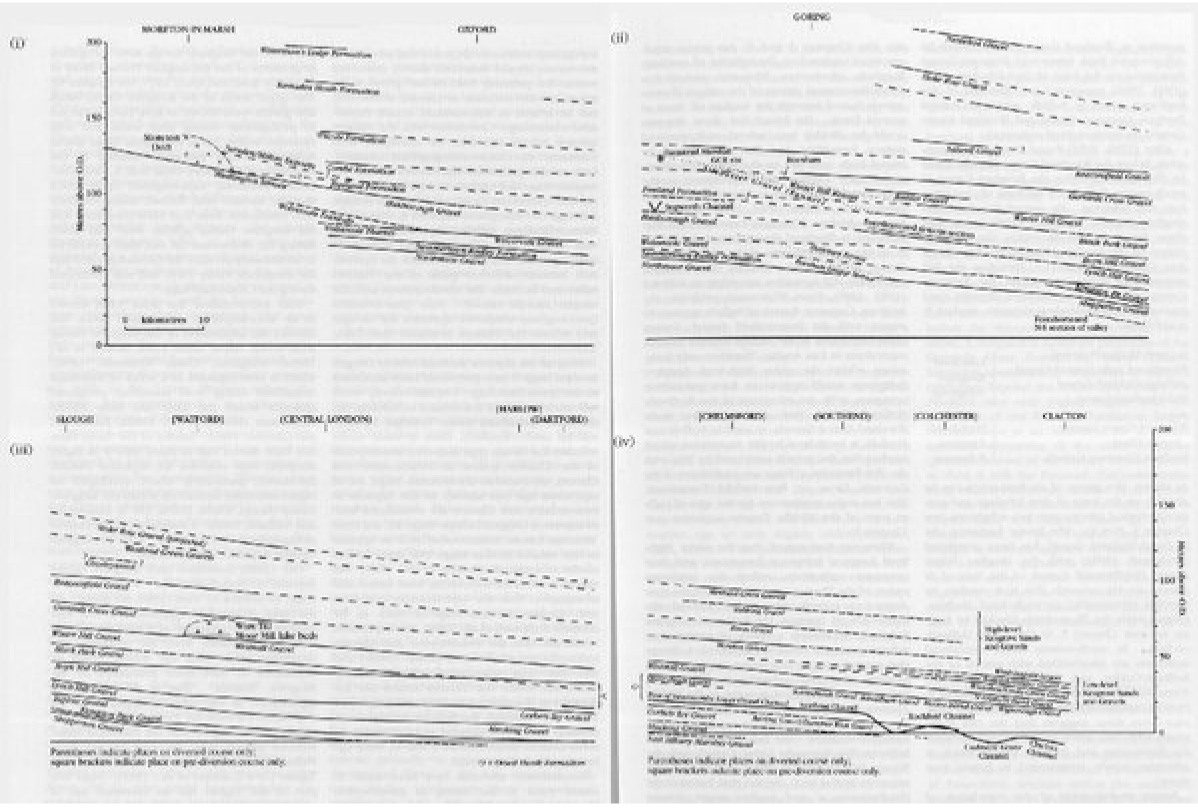
Age (in thousands of years)	Upper Thames	Middle Thames	Lower Thames	Essex	Stage	^{18}O
	Recent floodplain and channel deposits. Holocene alluvium of floodplain and coast				Holocene	1
10	Northmoor Gravel	Shepperton Gravel	Submerged	Submerged	late Devensian	2-4
	Rejuvenation event					
71		Temperate climate deposits at South Kensington (Isleworth centre), Isleworth and Kempton Park	Submerged	Submerged	early/mid-Devensian? interstadial(s)	5a &/or 5c?
?	Cold climate gravels above Eynsham 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 Fm Ardleigh/St Osyth Formation Waldringfield Gravel	Cromerian Complex	21-13
?	Combe Formation	Gerrards Cross Gravel		Bures Gravel*	Early Pleistocene	pre 21
	Higher divisions of the Northern Drift Group	Beaconsfield Gravel, Satwell Gravel, Gravel at Chorleywood, Westland Green Gravels, Stoke Row Gravel, Nettlebed Gravel, Nettlebed interglacial deposits		Moreton Gravel*, Stebbing Gravel*		

* 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.

Temperate	Stage 7	Stanton Harcourt Channel Deposits
Cold	Stage 8	Basal Stanton Harcourt Channel Deposits and equivalents Wolvercote Gravel (phase 4) Uppermost Wolvercote Channel Deposits
Temperate	Stage 9	Wolvercote Channel Deposits
Cold	Stage 10	Wolvercote Gravel (phase 2) Hanborough Gravel Moreton-in-Marsh glaciation?
Temperate	Stage 11	Mammalian fauna (derived) in Hanborough Gravel
Cold	Stage 12	Hanborough Gravel (pre-bones)? Moreton-in-Marsh glaciation?

(Table 2.2) Stratigraphical interpretation of the Upper Thames deposits advocated in this volume.



(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.