Sugworth Road Cutting

[SP 513 007]

Highlights

This is the only Cromerian site discovered to date in the modern Thames valley. It provides critical evidence for interpreting terrace stratigraphy in the Upper Thames basin, as well as an important record of pre-Anglian fauna and flora.

Introduction

The Sugworth interglacial site, discovered during the construction of the A34 Abingdon by-pass in 1972–3, provides important information about the Quaternary evolution of the Upper Thames basin. The sequence at Sugworth comprises fossiliferous clays, silts, sands and gravels in a channel cut into Kimmeridge Clay, capped by an unstratified sandy clayey gravel. The site is remarkable in that, unlike all previously described interglacial sediments in the Upper Thames, it lies at a higher level than the various limestone-rich terrace gravels, apparently falling within the Northern Drift Group (Briggs *et al.,* 1975b; Goudie and Hart, 1975; Shotton *et al.,* 1980; see Introduction to this Chapter).

Synonymous terms for the Northern Drift are 'Triassic Drift' (Harmer, 1907), Plateau Drift' (Sandford, 1924, 1926; Goudie, 1976; Briggs *et al.,* 1985) and 'Unbedded Drift', (Dines, 1928). These deposits have generally been interpreted as weathered till (Callaway, 1905; Tomlinson, 1929; Dines, 1946; Briggs and Gilbertson, 1974; Goudie, 1976), although Arkell (1947a, 1947b) considered the lower-level elements of the Northern Drift to include degraded terrace gravels (of proglacial origin). Shotton *et al.* (1980) concluded that much of the Northern Drift might be of fluvial origin, but that glacial transport must have originally carried the material into the Upper Thames basin. Hey (1986) divided the entire Northern Drift into individual fluvial aggradations on the joint bases of elevation and clast composition. He disputed the glacial origin of the material, concluding instead that the Evenlode branch of the Upper Thames once drained a considerably larger catchment, including much of the West Midlands, and that the Northern Drift was the decalcified remains of terrace gravels laid down by this river. Hey's conclusions have been supported by Bowen *et al.* (1986a), Bridgland (1988c) and Whiteman (1990).

The elevation of the Sugworth deposit in relation to the terrace sequence of both the Upper Thames and the Thames system in general, according to the correlation scheme outlined in Chapter 1 (Figure 1.3), indicates that it is one of the earliest interglacial remnants to survive. This is confirmed by biostratigraphical evidence, particularly from molluscs (Gilbertson, 1980; Preece, 1989) and vertebrates (Stuart, 1980, 1982a), which points to a Cromerian age. Problems of terrace correlation between the Upper and Middle Thames have led to this evidence being questioned (Gibbard, 1983, 1985; Hey, 1986; Chapter 1), but the reinterpretation of the Middle Thames sequence in the Reading area proposed in this volume (Chapter 1) appears to resolve these difficulties.

Description

In 1972–3, the excavation of a cutting for the A34 Abingdon by-pass revealed a number of channels cut into the Kimmeridge Clay and infilled with Pleistocene sediments to a height of 40 m above present river level (Figure 2.4). These sediments are predominantly medium-coarse orange sand with seams of gravel. One of the channel-fills, in a section cut during realignment of Sugworth Lane (Figure 2.4), also includes a sequence of grey organic sands, silts and clays (Figure 2.5). These were found to be richly fossiliferous, yielding beetles, molluscs, ostracods, vertebrates and macroscopic plant remains, as well as poorly preserved pollen (Briggs *et al.,* 1975b; Gibbard and Pettit, 1978; Shotton *et al.,* 1980; Holman, 1987). Other channel features (Figure 2.4) to the north, at Bagley Wood, and to the south, at Lodge Hill, contain only unfossiliferous sand. Overlying these channel-fills and overlapping them onto the Kimmeridge Clay is a layer of unbedded clayey gravel, 1–2 m thick, containing a similar assemblage of pebbles to the Northern Drift of the district. This is apparently part of a large spread of such 'Plateau Drift' mapped by the Geological Survey in the area (New Series, Sheet 236). Both the fossiliferous channel sediments and the overlying unbedded clayey gravel contain the range of clast-types characteristic of the Northern Drift: predominantly quartz and quartzites, with Carboniferous chert, patinated flint and occasional igneous and metamorphic rocks.

The fossiliferous deposits were concentrated within the central section of the Sugworth Channel, the organic sediments passing laterally into unfossiliferous sands like those filling the Bagley Wood and Lodge Hill channels. Part of this central area was well-exposed in excavations for the Sugworth Lane bridge abutments (Figure 2.5). Material was collected here from both sides of the A34 cutting, but most of the work was carried out in the excavation for the eastern bridge abutment. Unfortunately, this section is now sealed beneath the concrete bridge structure and its immediate continuation eastwards presumably lies beneath the new alignment of Sugworth Lane.

Interpretation

According to the model for terrace formation and the stratigraphical scheme for terrace correlation presented in this volume (Chapter 1), the sequence at Sugworth may be ascribed to the Freeland Formation and the Sugworth Channel Deposits regarded as a member of that formation. The latter are therefore also included within the Northern Drift Group (Figure 2.2). They represent deposition under temperate-climate conditions (phase 3 of the terrace model — see Chapter 1), during a temperate episode within the 'Cromerian Complex' (see Chapter 1), whereas the overlying clayey gravel is regarded as the decalcified remains of the subsequent cold-climate (phase 4) aggradation, which is correlated with the Winter Hill and Black Park Gravel Formations of the Middle Thames, both attributed to the Anglian Stage.

Implications of the Sugworth deposit for terrace stratigraphy

The apparent occurrence of Northern Drift material overlying the Sugworth deposit was taken as evidence for the considerable antiquity of the latter in the preliminary reports of the site. The consensus of opinion at that time held that the Northern Drift was a glacial deposit of Anglian age (Briggs and Gilbertson, 1973, 1974; Shotton, 1973a), implying a broadly pre-Anglian age for the Sugworth Channel Deposits. Biostratigraphical evidence from Sugworth appeared to confirm this view by pointing to deposition during the Cromerian (Briggs *et al.,* 1975b; Goudie and Hart, 1975). It was, however, pointed out by these authors that clasts of lithologies characteristic of the Northern Drift occurred within the Sugworth Channel Deposits, posing difficulties for the existing stratigraphical model, which hinged upon the acceptance of a single period of Northern Drift deposition, during the Anglian Stage.

The results of more extensive analyses of the Sugworth deposits have since been published, including detailed reports on the palaeobotany (Gibbard and Pettit, 1978) and faunal content (Shotton *et al.,* 1980). The assemblages of mammal remains (Stuart, 1980 and in Shotton *et al.,* 1980) and Mollusca (Gilbertson, in Shotton *et al.,* 1980) provide particularly good evidence in support of deposition during the Cromerian (see below).

Osmaston (in Shotton *et al.,* 1980) concluded, from its size and the sedimentology of the deposits filling it, that the channel at Sugworth was the product of the Thames and not of a tributary stream. He calculated that the river responsible for cutting the Sugworth Channel had a considerably larger discharge than the present Thames south of Oxford, probably around seven times the size. The three channels exposed by the A34 cutting have been interpreted as related features, probably repeated intersections with the same meandering course of an early Thames channel (Briggs *et al.,* 1975b; Goudie and Hart, 1975; Goudie, 1976).

Shotton *et al.* (1980), elaborating on the earlier observations of Briggs *et al.* (1975b) and Goudie and Hart (1975), concluded that the simple explanation of the Northern Drift as an Anglian deposit, glacial or otherwise, is untenable. They found that the Sugworth Channel contains both calcareous Jurassic material and typical Northern Drift erratics from beyond the Thames catchment. They interpreted the presence of the latter as an indication that Northern Drift deposits were already in existence during the Cromerian, to provide a source for the erratics in the Sugworth Channel. They therefore concluded that some or all of the Northern Drift was pre-Cromerian.

Heavy-mineral analysis has revealed differences between the unbedded deposit overlying the channel sediments at Sugworth and samples of typical Northern Drift from elsewhere in the Oxford area, despite the fact that all were mapped as 'Plateau Drift' by the Geological Survey. In fact, the unbedded deposit at Sugworth has a heavy-mineral content similar to the underlying channel sediments (Shotton *et al.,* 1980). The main difference is the paucity of garnet in the typical Northern Drift, despite the richness of this mineral in the Triassic of the West Midlands, the main source of Northern Drift pebbles. Garnet is relatively abundant in the channel sediments and overlying unbedded clayey gravel at Sugworth. This difference can probably be attributed to the weathering of garnet over a lengthy period. It therefore argues for the greater antiquity of the Northern Drift in general, and particularly those remnants at higher levels, in comparison with the channel sediments and overlying deposits of Northern Drift type at Sugworth. If this is the case, a pre-Anglian age for the higher-level Northern Drift is clearly indicated.

Shotton (1981) adopted a polygenetic interpretation of the Northern Drift. He argued that much of this material is probably the de-calcified upstream continuation of the various pre-Anglian gravels of the Middle Thames, but that the Triassic-derived clasts must have originally been carried into the area by glacial means, since the soft clays of the Lias would have always given rise to a north-east/south-west-trending strike valley separating the Cotswolds from the source of these rocks in the West Midlands (Shotton *et al.,* 1980; Shotton, 1981, 1986). This argument hinges on the effectiveness of geologically controlled strike valleys as barriers to through-drainage. However, it is only necessary to look as far as the Weald to observe rivers habitually crossing outcrops of nonresistant rock-types, such as the Weald Clay and the Gault Clay, that have given rise to strike valleys.

By comparing the relative proportions of their quartz and quartzite components, Hey (1986) demonstrated that Northern Drift remnants from different altitudes represent distinct fluvial aggradations. He sought to correlate these with the pre-Anglian gravels of the Middle Thames (see Chapter 1). According to Hey, the unbedded gravel capping the Sugworth Channel is a decalcified and degraded remnant of the fluvial deposit defined as his Freeland Member (here classed as a formation). It is apparent, therefore, that the Northern Drift represents a series of decalcified terrace deposits of various ages, the oldest, highest units presumably dating from the Early Pleistocene, whereas the youngest, the Freeland Formation, is post-Cromerian (*sensu* Sugworth). This interpretation explains the occurrence of Northern Drift material both in and above the Sugworth Channel Deposits and also explains the preservation within the deposits at Sugworth of an unusually large amount of semi-durable garnet. The Freeland Formation, as the lowest (and youngest) within the Northern Drift Group, would be expected to be the least weathered. This is not only confirmed by the relative abundance of garnet at Sugworth, but also by the presence of a few surviving limestone clasts (Shotton *et al.,* 1980).

The distribution of substantial Northern Drift remnants alongside the course of the River Evenlode suggests that this river had a much larger catchment in pre-Anglian times than at present. It is therefore possible to envisage the early Evenlode draining the source areas of the Northern Drift erratics directly, obviating the need to invoke glacial transport (Bridgland, 1986b, 1988c; Hey, 1986; (Figure 2.6)). This idea was, in fact, very popular amongst earlier workers, many of whom considered a 'Severn-Thames' river to have existed prior to the Middle Pleistocene (Ellis, 1882; Davis, 1895, 1899, 1909; Buckman, 1897, 1899a, 1899b, 1900; White, 1897).

Biostratigraphical implications of the Sugworth deposit

The most critical palaeontological evidence at Sugworth, and the strongest indication of a Cromerian age, comes from the vertebrate and molluscan remains. Large mammals from the site include *Dicerorhinus etruscus* (Falconer), restricted in Britain to the Cromerian and Pastonian Stages. Amongst the small mammals present is the water vole *Mimomys savini* (Hinton), which is unknown after the Cromerian. This species was replaced by *Arvicola cantiana* (Hinton), either during the latter part of the Cromerian Stage (*sensu* West Runton) or between it and an additional temperate episode that has been claimed, on the basis of this faunal change, to have occurred between the Cromerian and the Anglian Stage (Stuart, 1988; see Chapter 1). Teeth comparable with those of the extinct shrew *Sorex savini* (Hinton) from the type-Cromerian at West Runton were also present (Stuart, *in* Goudie and Hart, 1975; Stuart, 1980, 1982a).

The Mollusca included a number of species that first appear in the British record in the Cromerian Stage, namely *Valvata naticina* (Menke), *Bithynia inflata* (Hansen), *Marstonniopsis scholtzi* (Schmidt) and *Unio crassus* (Philipson). These occur with *Valvata goldfussiana,* which disappears from the record after the Cromerian, and *Tanousia runtoniana* (Reid) (=

Nematurella runtoniana auctt.), which is unique to that stage. The dominance of taxa indicative of fully temperate conditions, coupled with the consistent fall in species number from the base to the top of the channel-fill (which implies climatic deterioration), suggests correlation with biozone GrIII (late temperate) of the interglacial, somewhat after the climatic optimum (Gilbertson, in Goudie and Hart, 1975; Gilbertson, 1980). Additional molluscan species have recently been recognized by Preece (1989).

Other aspects of the fauna and flora are less conclusive. The ostracods include abundant *Scottia browniana* (Jones), which limits the age to Hoxnian or earlier, together with occasional species of early Middle Pleistocene or late Early Pleistocene affinities (Robinson, 1980). The beetle fauna from Sugworth indicates a temperate climate and the presence of deciduous woodland (Osborne, in Shotton *et al.,* 1980). However, very few sites of Cromerian age in Britain have yielded insect remains, so stratigraphical comparisons cannot yet be made on this basis. The palynological evidence from Sugworth is insufficiently detailed to distinguish between the Hoxnian and Cromerian stages, although biozone III of one or the other is indicated (Gibbard and Pettit, 1978; Pettit and Gibbard, in Shotton *et al.,* 1980). The consensus view of Shotton *et al.,* based on consideration of the various biostratigraphical evidence, was that the Sugworth Channel was infilled during biozone CrIII of the Cromerian Stage.

Wider significance and correlation

Recent attempts at correlation between high-level terraces in the Middle Thames and the various decalcified aggradations of the Northern Drift Group have led to a reconsideration of the stratigraphical position and age of the Sugworth deposits. Gibbard (1985) suggested a correlation between the late Anglian Black Park Gravel of the Middle Thames and the Freeland Terrace, on the basis of elevation and projected long-profile reconstructions. The same author correlated the Winter Hill Gravel of the Middle Thames, which he held to be contemporaneous with the Anglian Stage glaciation of the Vale of St Albans, with the Combe Terrace of Arkell (1947a, 1947b), the division of the Northern Drift immediately higher in the terrace sequence than the Freeland Formation (see (Figure 2.2); Chapter 1). These correlations were supported by Hey (1986). However, as both these authors recognized, there are inherent difficulties with this interpretation. According to Hey (1986), the channel-fill at Sugworth is, on the basis of standard terrace stratigraphy, intermediate in age between the Combe and Freeland aggradations. This would appear to imply that the Sugworth Channel Deposits are themselves of Anglian age, a correlation that is clearly untenable. Gibbard's interpretation differed from that of Hey in that he did not include the upper unbedded gravel at Sugworth in the Freeland Formation. On the basis of his terrace correlations, Gibbard (1985) considered the Sugworth deposits to be too low (at 85.5–92 m O.D.) to be related to either of the Anglian aggradations, the Combe and Freeland Formations (the latter he projected to *c.* 96 m O.D. in the Sugworth area). Instead, he placed them between the late Anglian Freeland Formation and the early Saalian Hanborough Gravel. Gibbard was therefore forced into the conclusion, in spite of the biostratigraphical evidence outlined above, that the Sugworth sediments were deposited during the late Hoxnian (biozone HoIII), thus explaining his earlier inclusion (Gibbard, 1983, p. 23) of the site in the Hoxnian Stage.

This conclusion has received little support. Preece (1989) reiterated the biostratigraphical case for assigning the site to the Cromerian. He pointed out, however, that the continental record indicates considerable stratigraphical complexity for the Lower Pleistocene to lower Middle Pleistocene period. In The Netherlands, in particular, a series of glacial–interglacial cycles is known from this period, giving rise to the term 'Cromerian Complex' (Zagwijn, 1986; de Jong, 1988; see Chapter 1). Preece therefore accepted that the Sugworth sediments might represent a different temperate episode within the Middle Pleistocene to the type-Cromerian at West Runton. Despite this, he was adamant that the deposits at Sugworth could not be post-Cromerian. A similar view has been adopted by Bridgland *et al.* (1990), in a three-way bio-stratigraphical comparison of the sites at Sugworth, Little Oakley (Essex) and the West Runton stratotype. All three sites were interpreted as 'broadly Cromerian', although it was recognized that difficulties existed in correlation with the complex Dutch sequence. It is therefore possible that different episodes within the 'Cromerian Complex' may be represented by the three British sites (see also Chapter 5, Little Oakley).

Further support for the correlation of the Sugworth Channel Deposits with the Cromerian Stage (*sensu lato*) has recently been provided by amino acid geochronology. Preece (1989) quoted similar D-alloisoleucine: L-isoleucine ratios from *Valvata piscinalis* (Müller) shells from Sugworth (mean 0.286 ± 0.016, n = 2) and West Runton (mean 0.283 ± 0.037, n = 5). These compare with significantly lower ratios from the same species from Hoxnian sites (from Hoxne, for example, a mean of 0.243 ± 0.023, n = 3). These ratios were measured in the INSTAAR laboratories of the University of Colorado. Rather different results were produced by Bowen *et al.* (1989), using the same technique. These authors obtained a comparable mean ratio from *Valvata goldfussiana* (Wiist) from Sugworth (0.296 ± 0.008, n = 4), but this is significantly lower than *V. piscinalis* ratios obtained by this laboratory from specimens from West Runton (0.348 ± 0.011, n = 5) and from Little Oakley (0.324 ± 0.004, n = 2 and 0.336 ± 0.027, n = 4) (Bridgland *et al.,* 1990; see Chapter 5, Little Oakley). The closest match for the Sugworth ratio amongst the Bowen *et al.* data for *Valvata* species is with Clacton (0.299 ± 0.002, n = 3) and Ingress Vale, Swanscombe (mean 0.297 ± 0.009, n = 5), both of which they ascribed to Oxygen Isotope Stage 11. Bowen *et al.* considered the Hoxnian (*sensu* Hoxne) to correlate with Oxygen Isotope Stage 9, so the above interpretation still holds that Sugworth is pre-Hoxnian. However, Bowen *et al.* (1986b) correlated the Anglian Stage with Oxygen Isotope Stage 12, which would therefore place Sugworth after the Anglian.

The above correlation, which implies the separation of the Anglian and Hoxnian by an extra interglacial–glacial cycle, provides some support for Gibbard's (1985) interpretation of the Sugworth Channel Deposits as Hoxnian. However, even if the Swanscombe deposits are attributed, on the basis of amino acid ratios, to a separate temperate episode, earlier than the Hoxnian (*sensu* Hoxne), the palaeontological evidence from the Swanscombe deposits strongly resembles that from other Hoxnian sites and provides little support for a correlation with Sugworth (see Chapter 4, Swanscombe). Moreover, the mammalian and molluscan assemblages from the two sites strongly indicate that Sugworth, with clear Cromerian affinities, is older than Swanscombe.

The revised scheme for terrace correlation between the Upper and Middle Thames, outlined in Chapter 1 (Figure 1.3), allows a more satisfactory interpretation of the Sugworth Channel Deposits and their relation to British Pleistocene chronostratigraphy. This revised scheme holds that the Freeland Formation is the upstream equivalent of both the Winter Hill and the Black Park Gravels of the Middle Thames, thus indicating a much lower elevation for the Upper Thames floodplain during the earlier part of the Anglian Stage than was envisaged by Gibbard (1985). No Anglian aggradation therefore occupies a higher terrace position than the sequence at Sugworth. This interpretation allows the biostratigraphical evidence for a Cromerian age for the channel deposits to be reconciled with the relative dating of the various terrace formations, derived from their stratigraphical relation to the glaciation of the Vale of St Albans.

One of the few other Cromerian sites in Britain outside the type area (the Cromer Forest Beds of north Norfolk), that at Little Oakley (north-east Essex), also occurs within the Thames system (see Chapter 5). The deposits at Little Oakley appear to fall within the Low-level Kesgrave Group (see Chapters 1 and 5). It was suggested in Chapter 1 that during the early Middle Pleistocene, phases of downcutting (rejuvenations) by the Thames had little effect in the valley upstream from Essex. This view is supported by the Upper Thames sequence, where the Sugworth deposits, believed on palaeontological grounds to be of similar age to those at Little Oakley (Bridgland *et al.,* 1988, 1990), appear to underlie the upstream equivalent of the (Anglian) Winter Hill and Black Park aggradations, implying that no rejuvenation took place in this area between the Cromerian and the end of the Anglian.

Summary

The Sugworth GCR site is of major importance to British Pleistocene stratigraphy. The oldest interglacial remnant within the Upper Thames sequence is found at this locality. Its interpretation has been the subject of some controversy, resulting largely from difficulties in correlating terrace deposits between the areas north and south of the Chilterns. There appears, however, to be overwhelming palaeontological evidence that it is of a broadly Cromerian age. Sugworth therefore represents one of only a handful of Cromerian localities in this country. Cromerian deposits that can be related to fluvial terrace sequences are extremely rare and Sugworth is the only such site in the valley of the modern Thames. It has important implications both for Thames terrace stratigraphy and for correlation with the neighbouring Midlands region.

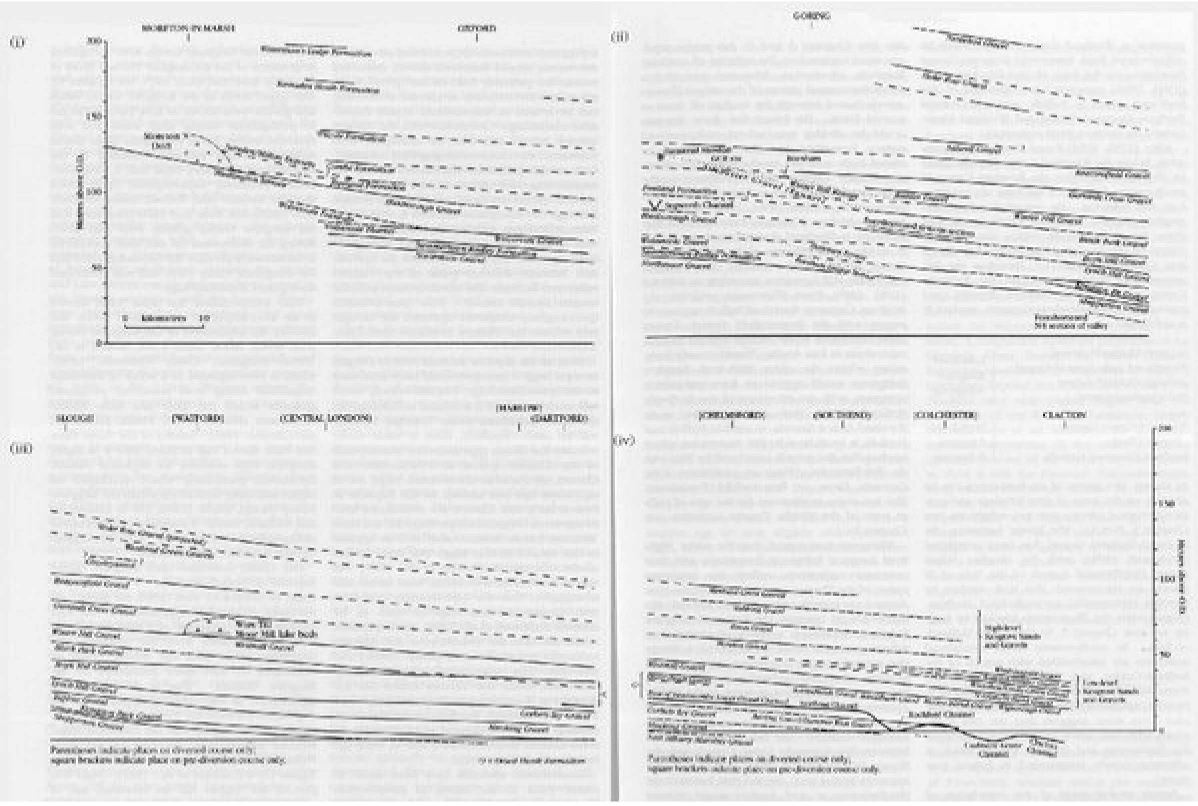
Satisfactory correlation of British Cromerian sites with the more complex Dutch sequence has yet to be achieved. This correlation would be an essential preliminary to matching the British terrestrial stratigraphy with the oceanic early Middle Pleistocene oxygen isotope record. Evidence from fossiliferous sites such as Sugworth will provide the basic data for such correlation. Early results from amino acid geochronology suggest that correlation with the oceanic record will be possible in the near future.

Conclusions

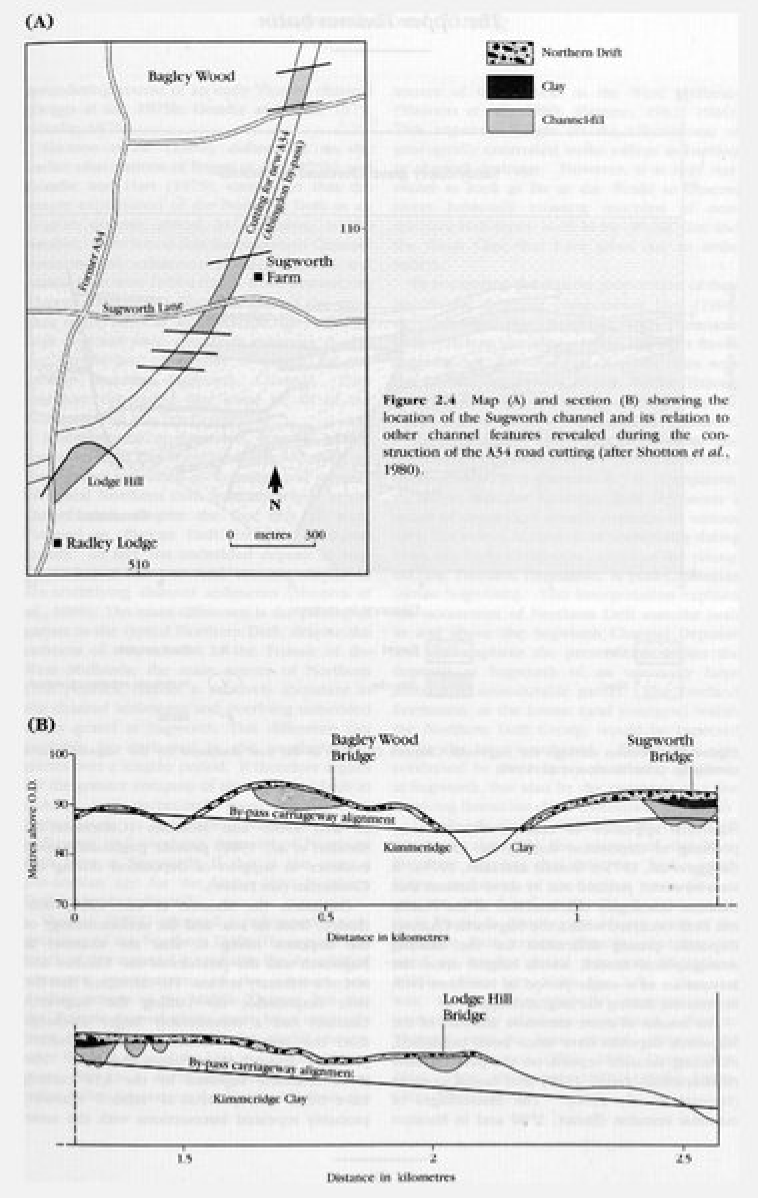
The richly fossiliferous channel-fill deposits at Sugworth (containing fossil molluscs, beetles, ostracods, vertebrates and plant remains, including pollen) are believed to have been deposited during an interglacial (one of the warmer, non-glacial phases of the Pleistocene 'Ice Age'), about half a million years ago.

These interglacial sediments, deposited by an ancestral Thames that was larger than the present river, are overlain by an enigmatic, clayey, gravelly deposit. This later deposit appears to form part of a river terrace that accumulated during a much colder climatic phase, about 450,000 years ago (the Anglian Stage), when ice sheets covered most of Britain. Prior to the discovery of the Sugworth interglacial channel, it was widely believed that such clayey and gravelly sediment, found covering high ground in the Upper Thames, was a true glacial till (boulder clay). This Northern Drift, as it was called (because it contains numerous pebbles of rocks derived from the area north of the Cotswolds, the present limit of the Thames catchment), is now considered to represent the remnants of a series of early river terraces, now weathered and degraded, dating from a period during the early Pleistocene when the Thames drained a far larger catchment than that of the modern river.

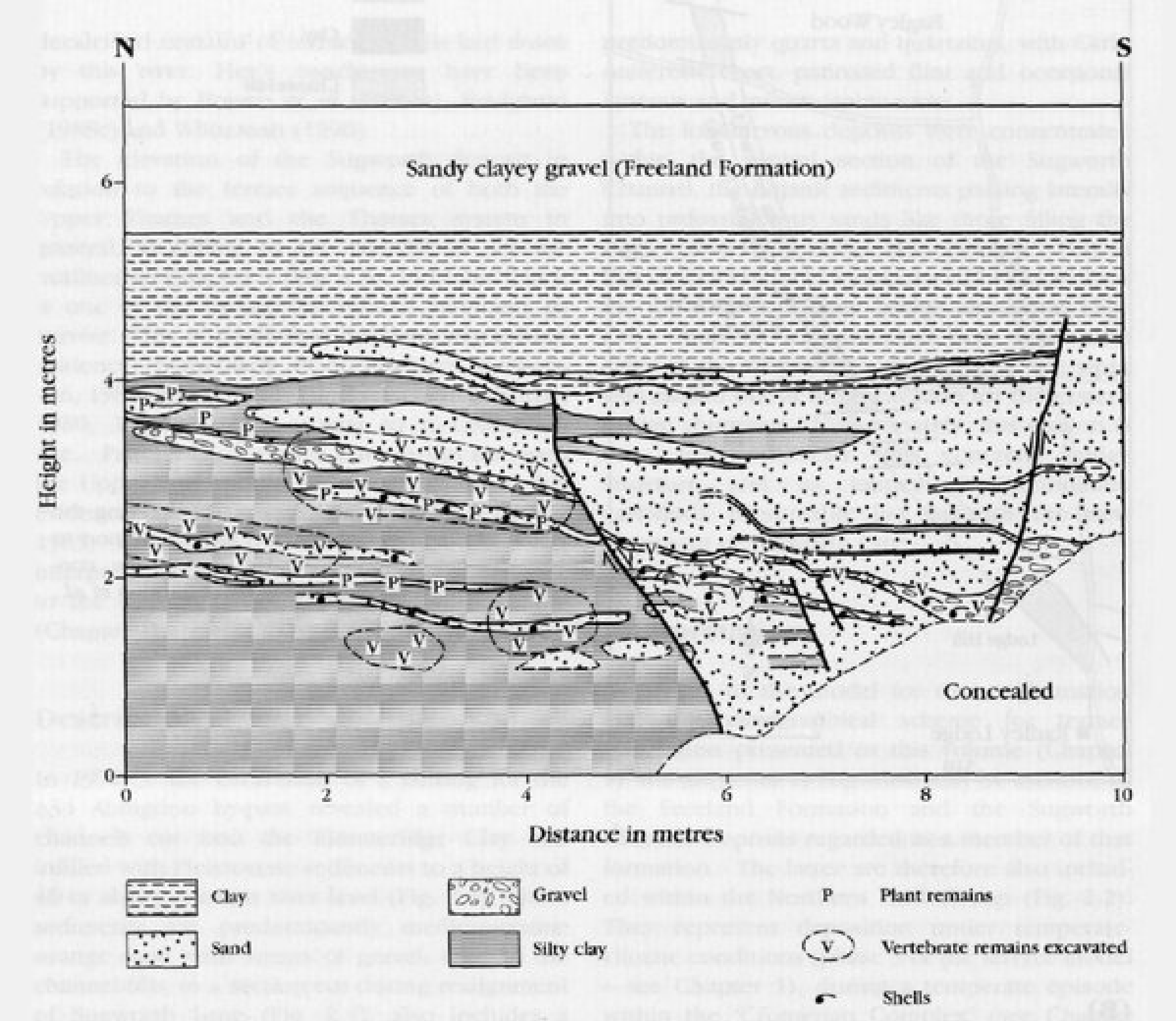
[References](#)



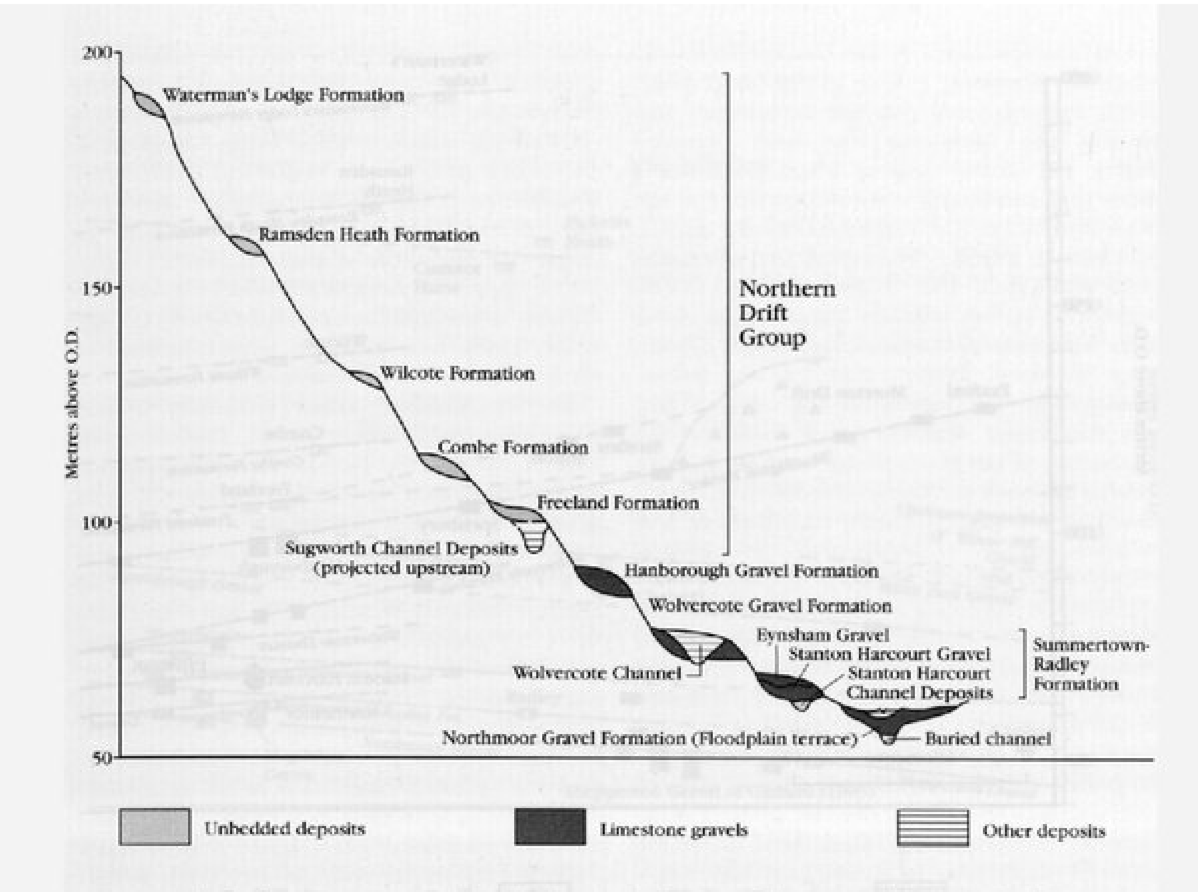
(Figure 1.3) Longitudinal profiles of Thames terrace surfaces throughout the area covered by the present volume. The main sources of information used in the compilation of this diagram are as follows: Arkell (1947a, 1947b), Briggs and Gilbertson (1973), Briggs et al. (1985), Evans (1971) and Sandford (1924, 1926) for the Upper Thames; Gibbard (1985) and Sealy and Sealy (1956) for the Middle Thames; Bridgland (1983a, 1988a) and Bridgland et al. (1993) for the Lower Thames and eastern Essex; Whiteman (1990) for central Essex.



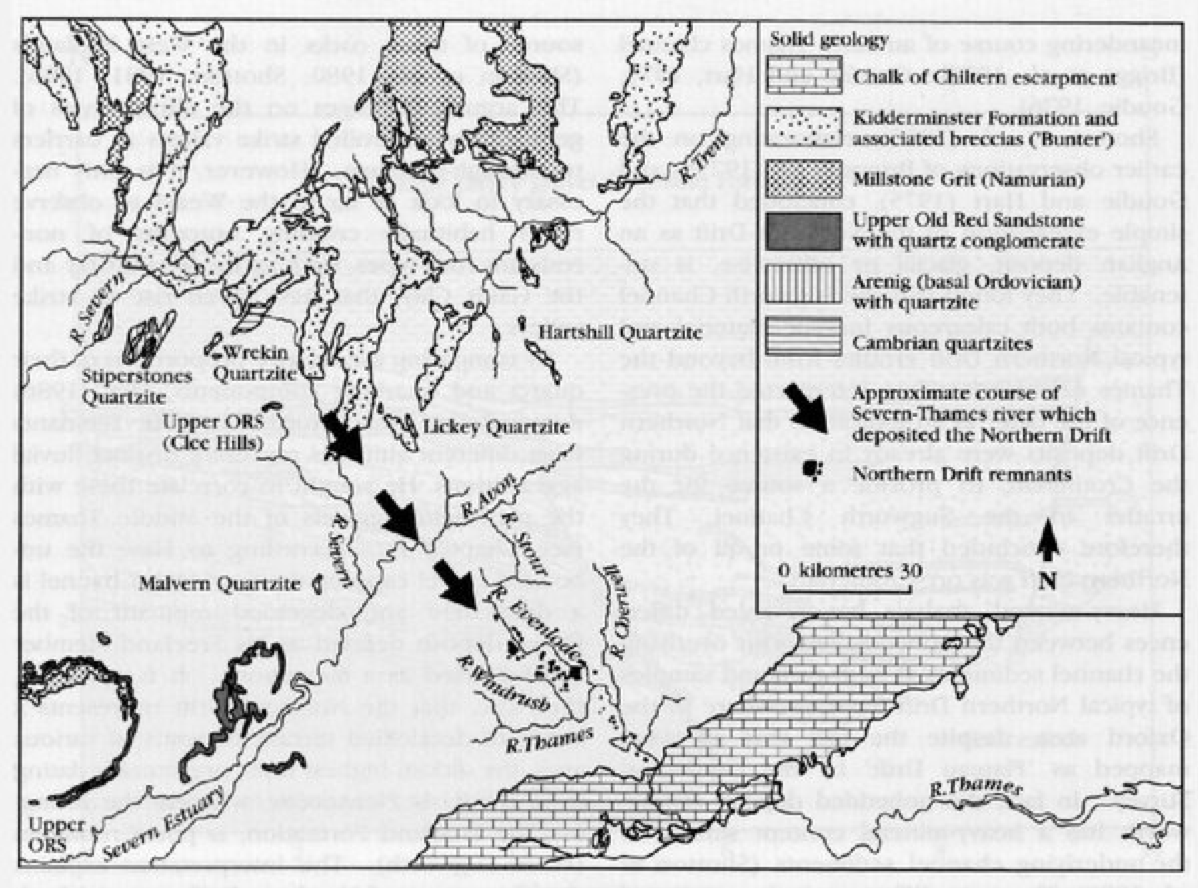
(Figure 2.4) Map (A) and section (B) showing the location of the Sugworth channel and its relation to other channel features revealed during the construction of the A34 road cutting (after Shotton et al., 1980).



(Figure 2.5) Section through the Sugworth Channel Deposits in the east abutment for the Sugworth Lane overbridge (after Shotton et al., 1980).



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



(Figure 2.6) Map showing the course of the hypothetical Severn—Thames river of the Early Pleistocene.