Maldon Railway Cutting

[TL 842 067]

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Highlights

This is the type locality of the Maldon Till, deposited here during the Anglian Stage at a position close to the maximum extent of Lowestoft glaciation. The till at Maldon has previously been interpreted as stratigraphically earlier than the main Lowestoft Till, separated from the latter by an intermediate glacial gravel. Gravels overlying the till at Maldon were hitherto regarded as part of this intermediate deposit, but are now interpreted as fluvial terrace sediments. These are taken to be the product of the Blackwater–Chelmer river system, which came into being, following the Anglian glaciation, as the new drainage of the area once occupied by the Thames.

Introduction

Maldon Railway Cutting is of importance to Pleistocene studies as the type locality of the Maldon Till, which has been claimed to represent an early ice advance into southern East Anglia. It was formerly held that this represented the second of three separate glacial advances into the Chelmsford area (Clayton, 1957, 1960).

However, following the recognition that glaciation occurred in Essex only during the Anglian Stage (Turner, 1970; Baker, 1971; Bristow and Cox, 1973; Perrin *et al.,* 1973), the Maldon Till was later attributed to the earlier of two advances of the Lowestoft Till ice into the region (Baker, 1971, 1983; Ambrose, 1973; Baker and Jones, 1980; Bristow, 1985). These various interpretations of the evidence at Maldon were based largely on the original description of the railway cutting sections by Whitaker (1889), the exposures having been obscured since that date. However, till was mapped at the locality in the late 1960s by the Geological Survey (Ambrose, 1973; Sheet 241).

A recent re-excavation of the site, soon to be part of the Maldon by-pass road scheme (the railway closed many years ago), confirmed the presence of till beneath coarse gravel. However, analysis of the clast composition of the gravel (Table 5.5) and the discovery of a hand-axe, apparently from the deposit, suggest that it is not glacial outwash, as was previously assumed. This reappraisal has undermined previous interpretations of Anglian glacial stratigraphy, which held the Maldon Till to be earlier than the main Anglian ice advance into the region. The till at Maldon has subsequently been interpreted as an isolated outlier of the widespread sheet of Lowestoft Till that covers much of central and north-western Essex (Whiteman, 1987; in Allen *et al.,* 1991). The Maldon outlier, in fact, falls marginally outside most published reconstructions of the Anglian ice limit (see, for example, Rose, 1983b; Bowen *et aL,* 1986a). It is one of several small till remnants along the line of the Danbury–Tiptree Ridge, regarded by many authors as the maximum south-eastward extent of the Lowestoft Till (see Geological Survey, New Series Sheet 241; Bristow, 1985).

Description

Whitaker (1889) described sections created in August 1887 at Maldon, during the construction of the railway to Wickford. Whitaker recorded detailed variations that he observed at various points along the cutting. He also listed the following generalized succession (Whitaker, 1889, p. 317):

(e) 'Gravel. ?At one place becoming a gravelly loam. Overlying, or ?locally replaced by

(d) Brown bedded loam and sand, with gravelly layers, beneath which there occurs, also locally

(c) Bedded gravel and loam.

(b) Grey boulder clay, or stony loam, with, at the base,

(a) Irregular gravelly bed.'

London Clay was exposed beneath the glacial deposits and also occurred as a lenticular mass up to 2.5 m thick within the Pleistocene sequence. Whitaker regarded the latter as a 'boulder', although emplacement as a result of diapirism or glaciotectonic deformation may also be envisaged.

In March 1984 two small sections were reopened (as part of the Geological Conservation Review) in the side of the disused cutting by P. Allen, C.A. Whiteman and the author, located in the steep face of an old landslip-scar. The sections broadly confirmed Whitaker's observations, revealing the following sequence (see (Figure 5.30)):

	'Thickness
4. Sand and silt, poorly exposed, to land surface (39 m O.D.)	4.0 m
3. Sandy silt, with gravel stringers and sand lenses	1.0 m
2. Gravel, silty and poorly bedded	2.3 m
1. Chalky till, sandy, fresh grey (weathered brown near top)	> 1.0 m
London Clay (seen lower on the cutting side)	

The basal gravel described by Whitaker (see above, a) was not seen; this does not necessarily indicate its absence, since the base of the till could not be exposed because of waterlogging. The till itself contains conspicuous Chalk clasts, ensuring that it is readily distinguished from the London Clay bedrock. The deposit appeared unusually well-bedded in the GCR section, but was otherwise of typical Lowestoft Till appearance (Whiteman, 1990).

The gravel (bed 2) was found to be similar, in terms of clast composition (Table 5.5), to the Kesgrave Group Thames deposits that cover much of central Essex (see Part 1 of this chapter and (Table 5.2)). Material of the type associated with Anglian glacial deposits, such as *Rhaxella* chert (Bridgland, 1986b), is only present in small quantities. The deposit comprises only durable clasts, indicating that it is not an ice-proximal outwash gravel. A hand-axe was discovered whilst removing talus from the section. This is a rolled and patinated specimen (Figure 5.31), which, judging from its condition and its location in pebbly talus, almost certainly came from the gravel.

The uppermost 4 m of the sequence (bed 4) was observed in a narrow trench cut in the sloping cutting-side above the face illustrated in (Figure 5.30). This sandy silty deposit, which has a reddish brown colour, may equate with Whit-aker's brown loam and sand (above, d), which he described as locally replacing the upper part of the gravel.

Interpretation

The interpretation of the till at Maldon as a 'lower boulder clay' dates back to the original description by Whitaker, who suggested that it correlated with similar deposits occurring beneath 'glacial gravel' in Suffolk and Norfolk (Whitaker, 1889, pp. 299 and 316). The site achieved the status of a type section three-quarters of a century later, as a result of the work of Clayton (1957, 1960, 1964), despite having been obscured by talus and vegetation throughout the intervening period. Clayton (1957) recognized three separate tills in central Essex, (1) an older, dissected 'Hanningfield Till', confined to high ground, (2) a lower till within a 'sandwich' of deposits filling valleys, his 'Maldon Till' and (3) a later 'Springfield Till', forming the upper leaf of the sequence in the valleys and separated from the Maldon Till by gravel. This last deposit, which he termed the 'Chelmsford Gravels', was interpreted as glacial outwash. Clayton (1957) suggested a correlation between the Hanningfield Till and the continental Elsterian (= Anglian) glaciation and between the later tripartite sequence (Maldon Till, Chelmsford Gravels and Springfield Till) and the Saalian Stage. Within a few years Clayton had modified his views, suggesting that the Hanningfield and Maldon Tills were both Anglian, with the Chelmsford Gravels representing the Hoxnian and the Springfield Till representing the Saalian (Clayton, 1960).

Later workers demonstrated that no distinction could be made between the till occurring on plateaux and that in valleys, leading to the conclusion that only a single glaciation has occurred in southern East Anglia (Turner, 1970; Baker, 1971; Bristow and Cox, 1973; Perrin *et al.,* 1973), during the Anglian Stage (Turner, 1973). The Maldon Till was therefore attributed to an early advance of the Anglian ice and the Chelmsford Gravels were, once again, regarded as outwash (Baker and Jones, 1980; Baker, 1983).

Bristow (1985) expressed doubt as to whether the till described at Maldon was an *in situ* glacial deposit, observing that other records of a lower till in the Chelmsford area could instead be interpreted as London Clay, glacial lake deposits or colluvium. A lower till was found during recent Geological Survey mapping, however, in the Witham area (Bristow, 1985). The name Maldon Till was applied to this deposit, despite reservations about the type locality, which had not been seen in section since the construction of the railway.

Wooldridge (1957) had suggested a correlation between the Maldon Till of Clayton and the till at Hornchurch, which he believed to represent the glaciation that diverted the Thames into its modern valley (see Chapter 4, Hornchurch). This correlation was later supported by Clayton (1960, 1964). A summary of the progression of views on the glacial history of southern Essex was provided by Baker and Jones (1980). They suggested that the Maldon Till could also be correlated with the Ware Till of the Vale of St Albans (see Chapter 3) and that the early Anglian glacial advance responsible for this deposit was also responsible for the diversion of the Thames from its valley across central Essex. They envisaged that a temporary route was used by the river, carrying it from the Vale of St Albans by way of the modern Lower Lea valley into its modern course downstream of London (see Chapter 3, Part 2), a hypothesis supported by Cheshire (1981) and Baker (1983). Baker and Jones (1980) cited evidence from proglacial lake deposits in the Newport area of north-west Essex for the duration of the interval between lower and upper Anglian tills. In that area they recognized a lower, Quendon Till, separated from the main Lowestoft Till sheet. They correlated this lower till with the Maldon Till of south-east Essex and the Ware Till of Hertfordshire. The counting of supposed annual varves in the above-mentioned lacustrine deposits suggested to Baker and Jones that the Quendon/Maldon Till ice advance and the readvance that resulted in the accumulation of the main Lowestoft Till were separated by an interval of 5400 years. During this interval the ice-front apparently stabilized just to the north of Newport.

The most recent re-evaluation of the till at Maldon is that by Whiteman (in Allen *et al.,* 1991), who, following the 1984 re-excavation, equated it with his Newney Green Member of the Lowestoft Till Formation. Although the Newney Green Member is the lower of two divisions of the Lowestoft Till recognized by Whiteman in central Essex, he considered it to be part of the single till sheet that covers southern East Anglia. Whiteman found no evidence in central Essex for the tripartite sequence (Maldon Till–Chelmsford Gravels–Springfield Till) proposed by Clayton. He pointed out that in many instances the deposits ascribed to the middle part of this sequence, the Chelmsford Gravels, are in fact occurrences of Kesgrave Sands and Gravels and therefore pre-date the glacial sequence altogether (Whiteman, in Allen *et al.,* 1991). Whiteman's work supports the correlation between the tills at Maldon and Hornchurch, since he also assigned the latter to his Newney Green Member. Cheshire (1986a) suggested that the till exposed in 1984 at Maldon might have been geliflucted, which could account for its stratified appearance.

The recent reinvestigation of the Maldon site shows that the interpretation of the till there as the lowest part of a tripartite sequence, underlying an outwash gravel, is unfounded. The gravel overlying the till at Maldon is not an outwash deposit; it contains none of the non-durable material that characterizes proximal outwash gravels (Bridgland, 1986b) and a distal outwash origin appears also to be precluded by the paucity of 'Anglian erratics' such as *Rhaxella* chert (Table 5.5). The gravel contains similar proportions of local and exotic material to the Kesgrave Sands and Gravels of central Essex, from which it is presumably largely derived. In this it resembles Blackwater terrace gravels at Tollesbury (Bridgland, 1983a) and Great Totham (see below). Thus it is likely that the gravel at Maldon is a terrace deposit within the Blackwater/Chelmer system. The occurrence of a hand-axe in this gravel at Maldon would appear to support this interpretation; although such palaeoliths are no longer regarded as indicative of a post-Anglian age (see Chapters 1 and 3), they are unknown from outwash gravels in this area.

The elevation of the gravel at Maldon, with a base level of 32 m and a maximum surface height of 39 m O.D. (the upper part is replaced by sands and silts in the section recorded here), suggests a correlation with the Tollesbury Gravel (type locality: TL 947 106) of Bridgland (1983a). The latter formation, aggraded to *c.* 26 m O.D. in its type area, was correlated by Bridgland with the Mersea Island Gravel, implying a further correlation with the earliest post-diversion formation of the Thames-Medway in eastern Essex and with the Boyn Hill Gravel of the Thames system (see Part 2 of this chapter). This aggradation is believed to have been initiated late in the Anglian Stage and to have been completed in the early Saalian

(Bridgland, 1988a; (Table 5.6)). If the gradient required to trace the Tollesbury Gravel downstream into the Mersea Island Gravel, *c.* 0.7 m per kilometre, is projected upstream to Maldon it would take the top of the formation to *c.* 35 m O.D. Allowing for a slight upstream increase in gradient, this strongly supports the correlation of the Maldon and Tollesbury aggradations ((Figure 5.5)B and 5.32). The Maldon deposit can therefore be regarded as an upstream outlier of the Tollesbury Gravel. Its geographical location suggests that it may have been deposited by the Chelmer, the southern branch of the Blackwater system (see (Figure 5.1)).

If the gravel overlying the till at Maldon is correctly interpreted as a terrace deposit laid down after the Anglian glaciation, there remains no stratigraphical basis for its interpretation as the 'lower till' within the tripartite sequence described by Clayton (1957). Even if a 'lower till' can be demonstrated elsewhere in the area (Bristow, 1985), the name Maldon Till would not be appropriate for it unless correlation with the till at Maldon can be established.

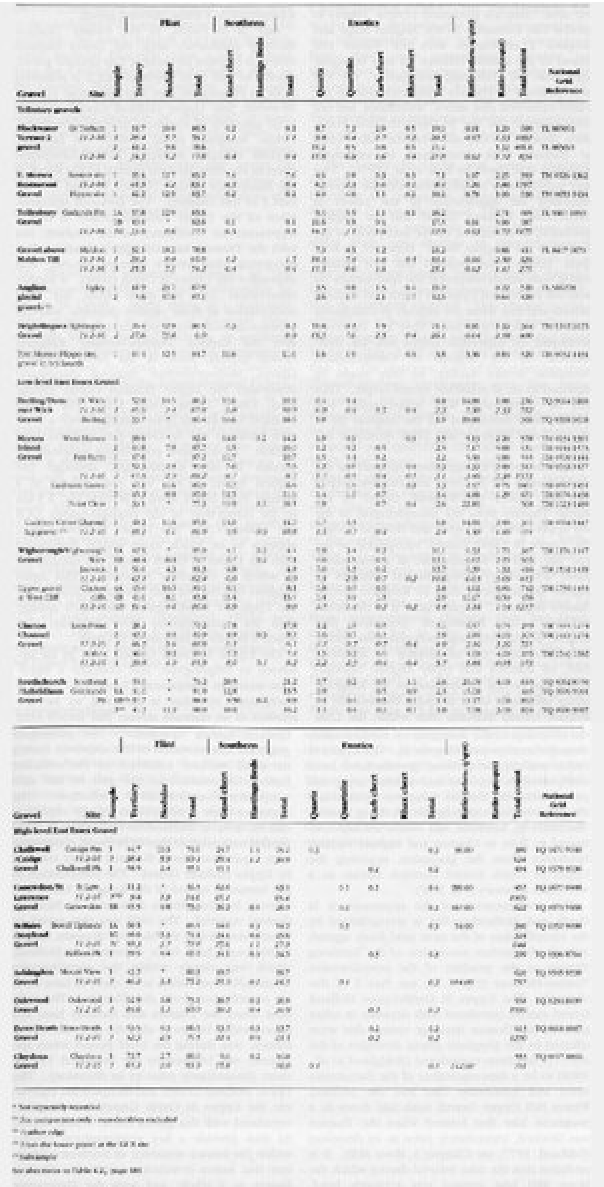
Summary

The railway cutting section at Maldon is significant in that it has provided a basis for a number of complex stratigraphical models that have been widely used to explain the glacial sequence in southern East Anglia. Doubts about the occurrence of *in situ* till at Maldon have been allayed by a recent reinvestigation, but this has itself raised doubts about the status of the deposit as an early 'lower till' within the glacial sequence. This status depends upon gravel overlying the till being a glacial outwash deposit, part of a tripartite sequence with a later 'upper till' (not present in the Maldon area). The discovery that the gravel at Maldon is probably a terrace deposit of the Blackwater/ Chelmer system means that the underlying till can no longer be placed at the base of the tripartite sequence of Clayton (1957) and may question the validity of that sequence.

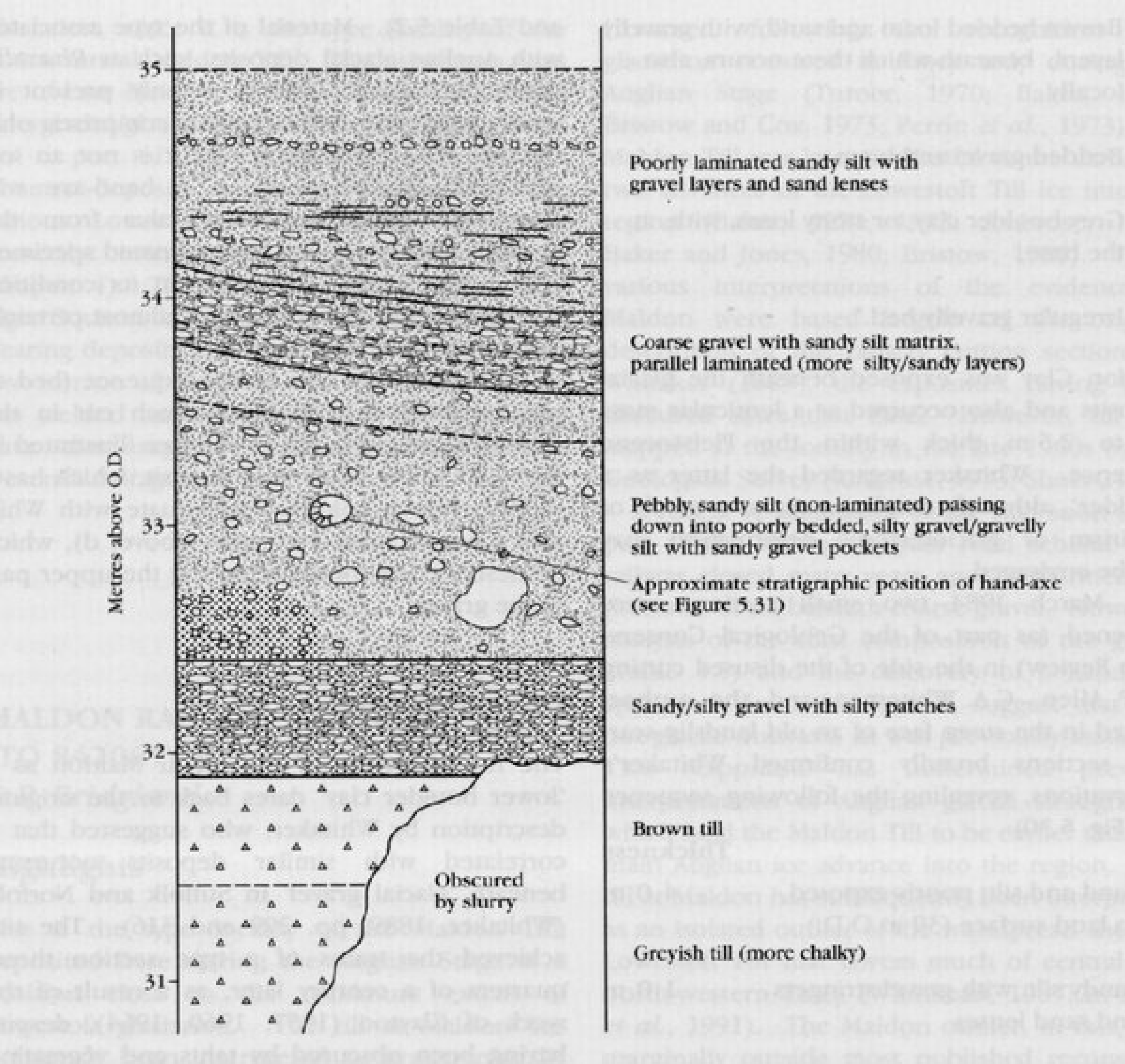
Conclusions

The historic section at Maldon, showing glacial sediments (Maldon Till) overlain by waterlain gravels, has previously been cited as evidence for of a complex regional story of alternating deposition by ice sheets and meltwater streams. The Maldon Till has been widely interpreted as the lower element in a three-part sequence of till, glacial gravel and till, the gravel at Maldon being regarded as the intermediate meltwater deposit. The recognition, presented here for the first time, that this gravel is the product of the Blackwater/Chelmer river system, casts doubt upon the validity of the three-part sequence. The Maldon section is now more simply interpreted as showing till, deposited by East Anglian ice around 450,000 years ago, overlain by river gravels deposited subsequent to the Anglian glaciation.

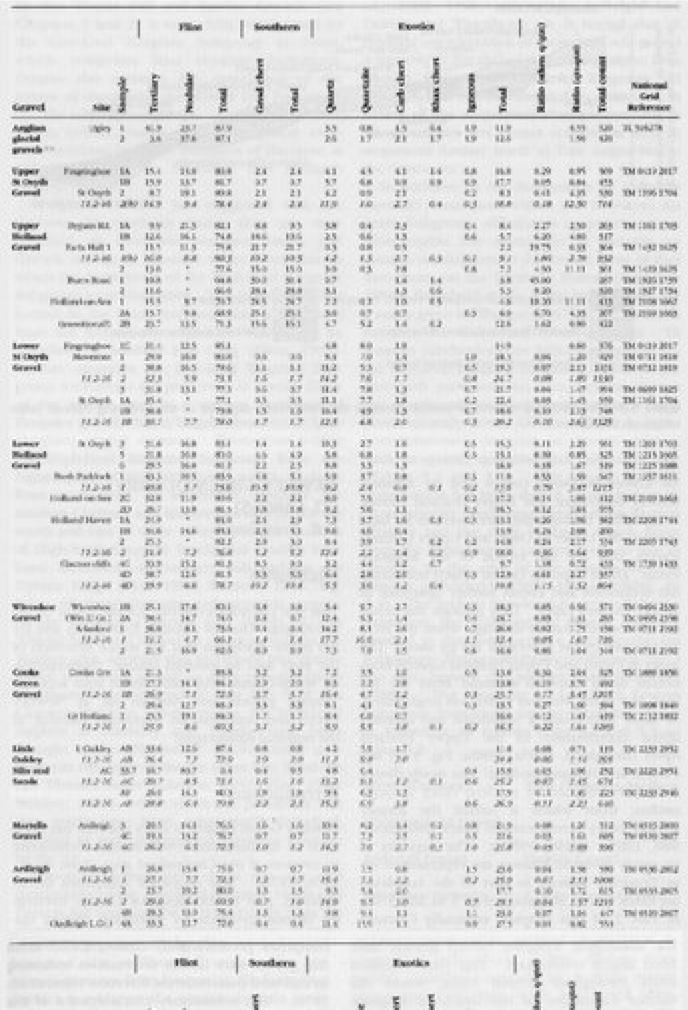
References



(Table 5.5) Clast-lithological composition of gravels described in Chapter 5, Parts 2 and 3.

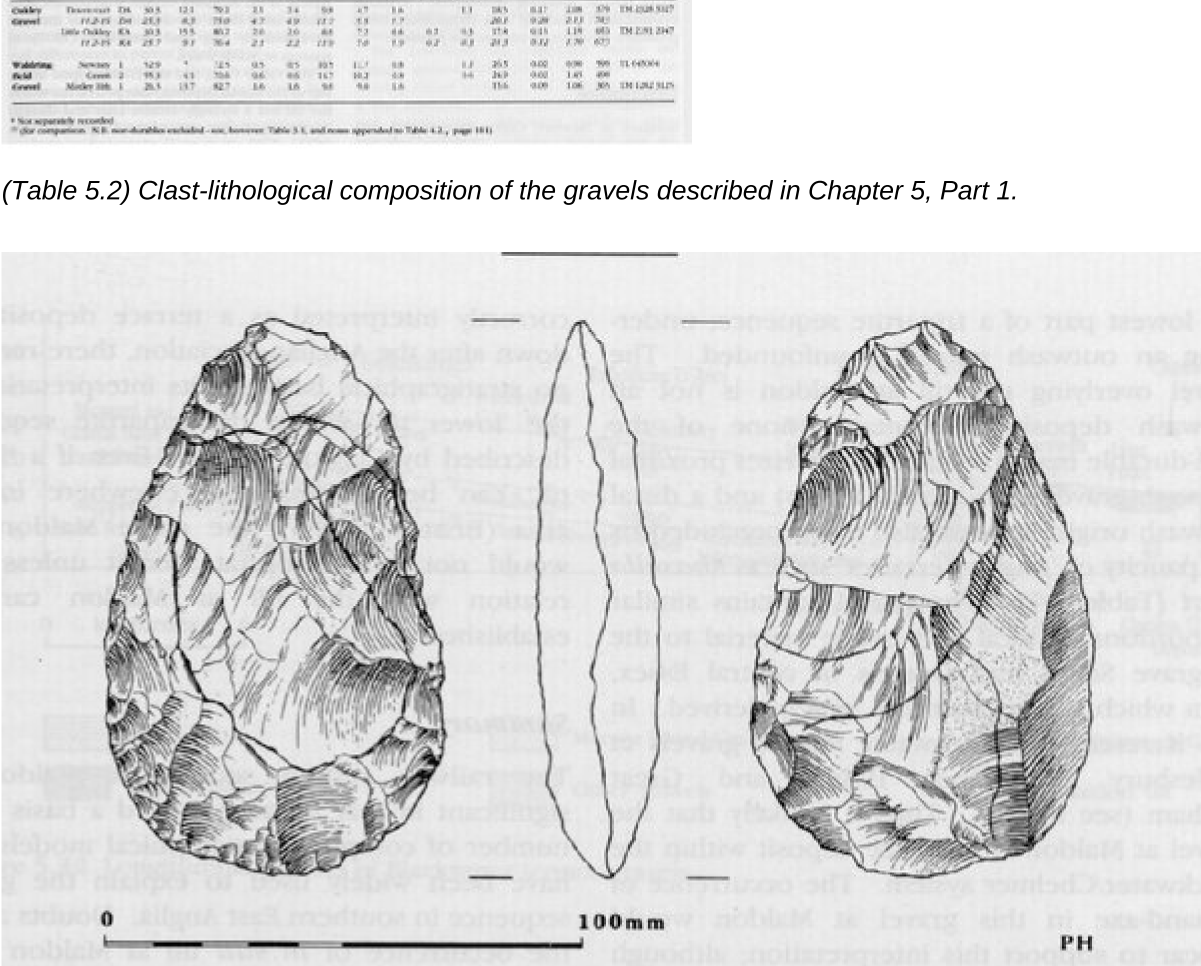


(Figure 5.30) Section excavated at the Maldon GCR site in March 1984. Beds 1–3 are illustrated (see Description).



Gravel	Site	Sample	Flint: Tertiary	Flint: Nodular	Flint: Total	Southern: Greensand chert	Southern: Total	Quartz	Exotics: Quartzite	Exotics: Carb chert	Exotics: Rhax chert	Exotics: Igneous	Exotics: Total	Ratio (others q/qtzt)	Ratio (q/qtzt)	Total count	National Grid Reference

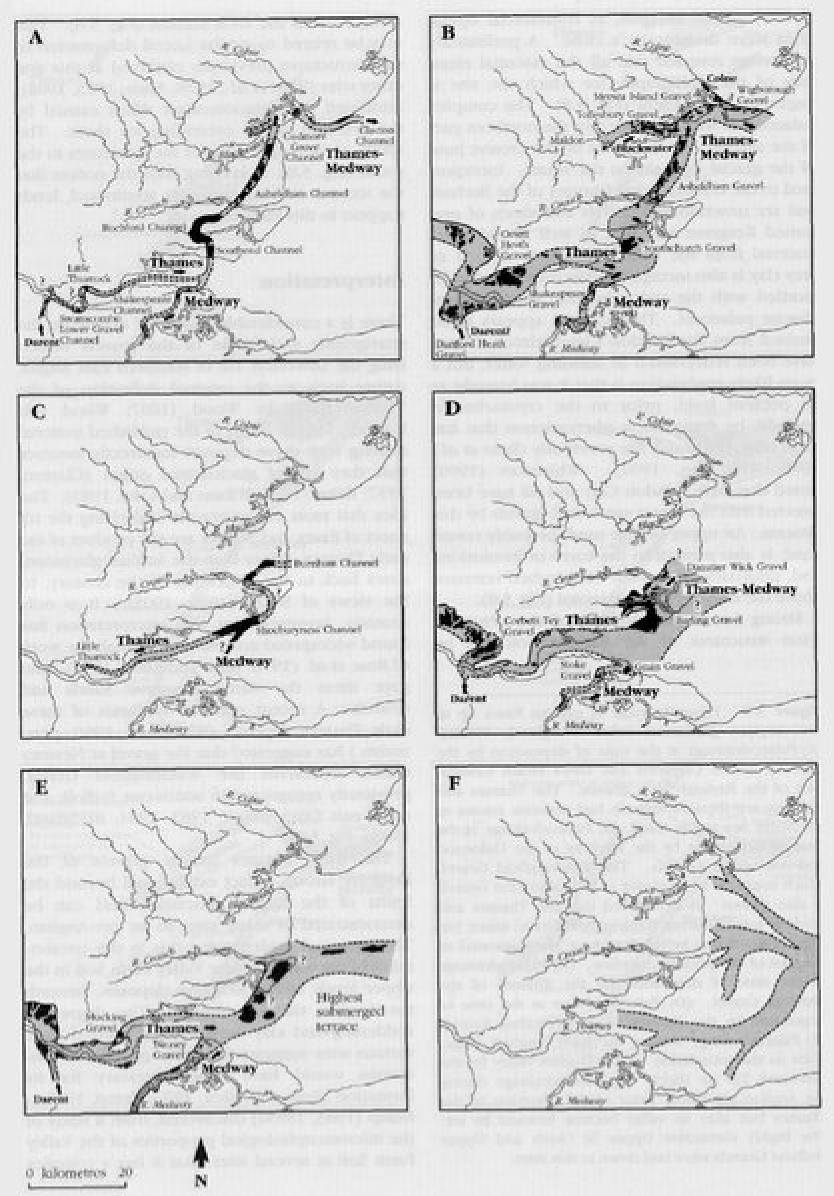
(Table 5.2) Clast-lithological composition of the gravels described in Chapter 5, Part 1.



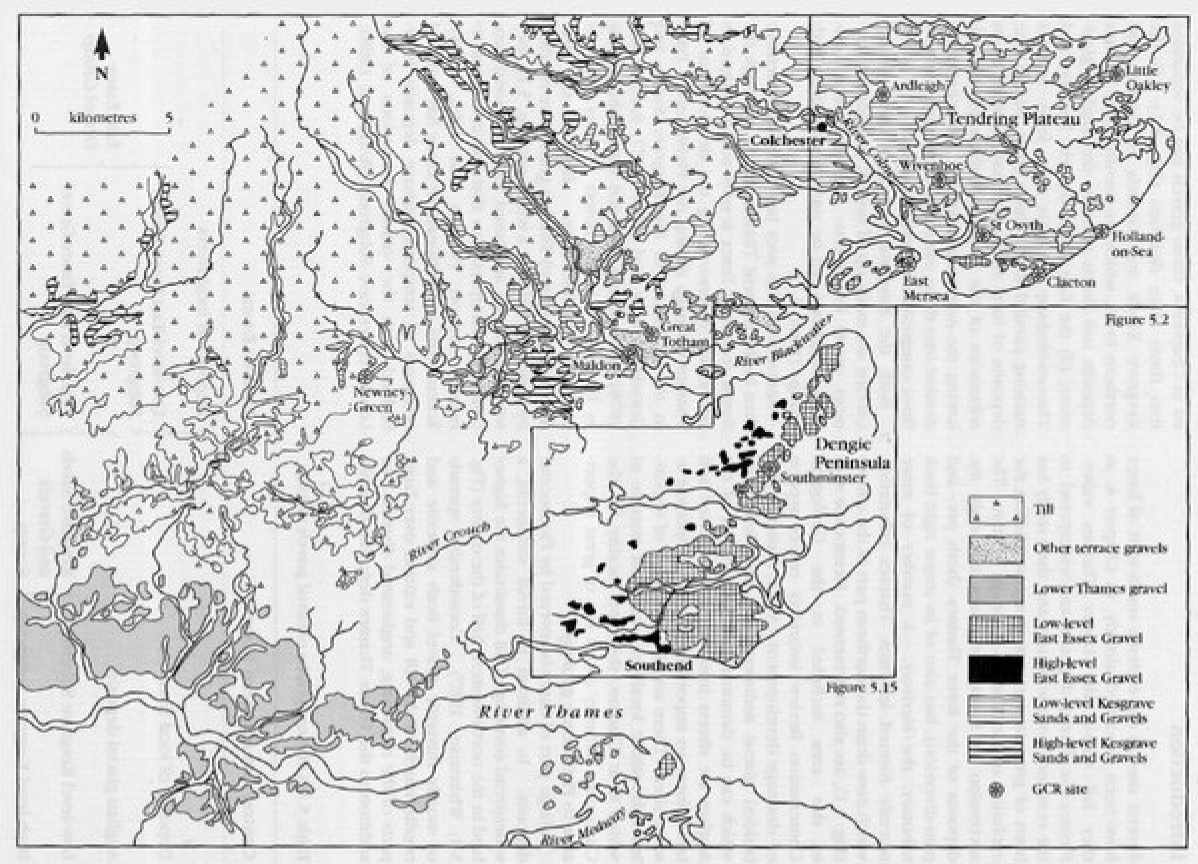
(Figure 5.31) Flint hand-axe from Maldon Railway Cutting, found during the GCR excavations. The artefact is a cordate hand-axe of Wymer's (1968) type J, having a symmetrical shape with a cutting edge around the entire circumference. The implement has a white surface patina and is slightly rolled, although with rather more severe damage of the edges. Both sides show a network of incipient thermal fractures. (Drawing and description by P. Harding).

Southend area	Dengie Peninsula	Tendring Plateau	Middle/Lower Thames equivalent	Stage	^{18}O
– – – – – – – – – Offshore – – – – – – – – – – – –			Kempton Park/East Tilbury Marshes	late Saalian - Devensian	6-4 or 2
– – – – – – – – – Below alluvium – – – – – – – – – –			Taplow/Mucking	late Saalian	8-6
Barling	Dammer Wick		Lynch Hill/Corbets Tey	mid-Saalian	10-8
Southchurch	Asheldham	Mersea Island/Wigborough	Boyn Hill (and Black Park)	Anglian - early Saalian	12-10
– – – – – – – – – – – – – – Thames diversion (stratigraphic marker) – – – – – – – – – – –				Anglian	12
Chalkwell	Caidge	St Osyth/Holland	Winter Hill	Anglian	12
Canewdon	St Lawrence	Wivenhoe/Cooks Green		early Anglian	12
Belfairs	Mayland	Ardleigh/Oakleigh	?Rassler	'Cromerian Complex'	21-13
Ashingdon		Waldringfield			
Oakwood			?Gerrards Cross		
Daws Heath			?Beaconsfield	Early Pleistocene	Pre-21
Claydons			?Satwell		

(Table 5.6) Gravel formations in eastern Essex.



(Figure 5.5) Palaeodrainage of Essex following the Anglian glaciation (modified from Bridgland, 1988a). (A) Palaeodrainage during the filling of the Southend/Asheldham/Clacton Channel. The Swanscombe Lower Gravel Channel and the Cudmore Grove Channel are both thought to be lateral equivalents. The Rochford Channel is now thought to represent an overdeepened section of the same feature (see text). This channel was excavated in the late Anglian by the newly diverted Thames and filled during the Hoxnian Stage (sensu Swanscombe). (B) Palaeodrainage during the deposition of the Southchurch/Asheldham Gravel.. This aggradational phase is believed to have culminated during the earliest part of the Saalian Stage, early in Oxygen Isotope Stage 10. (C) Palaeodrainage during the filling of the Shoeburyness Channel. The channel beneath the Corbets Tey Gravel of the Lower Thames is believed to be an upstream equivalent of this feature. It is thought that both the excavation and filling of the channel were intra-Saalian events, dating from Oxygen Isotope Stages 10 and 9 respectively. (D) Palaeodrainage during the deposition of the Barling Gravel. This is regarded as an intra-Saalian deposit, aggraded during Oxygen Isotope Stage 8. (E) Palaeodrainage during the deposition of the Mucking Gravel of the Lower Thames. The Thames-Medway equivalent of this formation is buried beneath the coastal alluvium east of Southend and can be traced offshore (Bridgland et ed., 1993). This aggradational phase occurred towards the end of the complex Saalian Stage, culminating early in Oxygen Isotope Stage 6. (F) Palaeodrainage during the last glacial. The submerged valley of the Thames-Medway has been recognized beneath Flandrian marine sediments in the area offshore from eastern Essex (after D'Olier, 1975).



(Figure 5.1) Pleistocene geology of Essex, showing the various types of gravel described in this chapter, the extent of the Anglian till sheet and the relation of these to the existing drainage systems (modified from Bridgland, 1988a).