Great Totham (Lofts Farm Pit)

[TL 866 092]

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Highlights

A view, rare in the Thames catchment, of presumed Devensian fossiliferous sediments is here afforded by a section in a gravel terrace of the River Blackwater, a former tributary of the Thames. These deposits contain a typical cold-climate mammalian fauna, with reindeer, woolly mammoth, woolly rhinoceros and hyaena. They also contain pollen and the remains of insects and ostracods.

Introduction

A gravel pit in the 2nd Terrace of the Blackwater at Great Totham exploited what appear to be the most recent sediments included within the GCR Thames coverage. This site is located 2 km NNE of Maldon, on the northern side of the River Blackwater, at the upstream limit of its

present-day estuary (Figure 5.1). Organic sediments interbedded with the gravel near Lofts Farm have yielded a large collection of mammalian bones, as well as pollen, other plant remains, insects and ostracods. The deposits are believed to represent the Devensian Stage, on the bases both of their faunal contents and of regional terrace stratigraphy.

Devensian sediments are relatively common in the valley bottom (floodplain) gravels of the Thames upstream from London and in many of its tributaries (Coope and Angus, 1975; Sutcliffe and Kowalski, 1976; Gibbard *et al.,* 1982; Kerney *et al.,* 1982; Gibbard, 1985). In these situations, however, they invariably lie below the water table and are difficult to study except where accessible in active gravel pits or temporary exposures. Downstream from London, Holocene subsidence of the North Sea Basin, coupled with the low Devensian base level, ensures that sediments dating from the last glacial are well below floodplain level, within the buried channel. In Essex such sediments, like the Ipswichian deposits at East Mersea (see above), can therefore be studied only in the valleys of minor rivers such as the Blackwater, where steeper upstream gradients bring them more rapidly above floodplain level than is the case with the Thames (Bridgland, 1988a).

At present the Blackwater flows out to sea east of Maldon, but offshore bedrock surface contour mapping indicates that before the Holocene marine transgression it flowed into the now submerged valley of the Thames-Medway, *c.* 20 km to the south of Clacton (D'Olier, 1975; Bridgland and D'Olier, 1989; (Figure 5.5)F). The Blackwater may therefore be regarded as a tributary of the Thames-Medway system.

The Great Totham locality has not been described hitherto, so the present report is the first documentation of evidence collected at the site. An excavation was carried out at Lofts Farm Pit by the GCR Unit in the autumn of 1985, when the organic sediments were sampled in detail. Analyses of the samples collected on this occasion are still incomplete.

Description

The former gravel workings at Great Totham exposed deposits attributed by the Geological Survey (Sheet 241) to the 2nd Terrace of the Blackwater-Chelmer system, immediately downstream of the confluence between these two rivers (Figure 5.1). In a small area to the northwest of Lofts Farm [TL 866 092] the following section was recorded:

	Thickness
Surface stripped prior to quarrying (the original surface level was *c.* 9 m O.D.)	

3. Disturbed clayey gravel occurs within ice-wedge casts and involutions in (2)	*c.* 3 m
2. Organic clays and silts, oxidized near top	2.6 m
1. Gravel, horizontally bedded	*c.* 2 m
London Clay	

Involutions and ice-wedge pseudomorphs, which occur in the upper part of the sequence, indicate that permafrost conditions have prevailed at Great Totham at some time since the deposition of the fossiliferous sediments. Clast■lithological analysis of the gravel (bed 1) reveals a close similarity to other deposits attributed to deposition by the River Blackwater (Table 5.5).

The most spectacular discoveries at Great Totham were a collection of vertebrate bones (Figure 5.36) amassed by R. Wrayton, who visited the site frequently while it was in operation (1982–4) and discovered the organic sediments. The mammalian assemblage consists of *Canis lupus* (wolf), *Crocuta crocuta* (spotted hyaena), *Rangifer tarandus* L. (reindeer), *Megaloceros* sp. (giant deer), *Bison* and/or *Bos* (bovid), *Coelodonta antiquitatis* (woolly rhinoceros), *Equus ferus* (horse) and *Mammuthus primigenius* (woolly mammoth). Freshwater fish and Amphibia are also represented, namely *Perca fluviatilis* L. (perch), *Esox lucius* L. (pike), *Gasterosteus aculeatus* L. (three-spined stickleback), a cyprinid (carp family), frog (*Rana* sp.) and indeterminate newt (Figure 5.37). The bones are well preserved, although many show evidence of damage during transport by the river. The remains of small mammals have been discovered but have yet to be identified. During the 1985 excavation an ulna of woolly mammoth was discovered *in situ* in the organic silty clay, the only addition to the assemblage of large bones. The organic deposits also contain pollen and the remains of plants, insects and ostracods.

The majority of the insect remains recovered at Great Totham came from a bulk sample from bed 2, the organic clays and silts. These were supplemented by a similar but smaller assemblage from a sample collected in 1984, which has not been related to the stratigraphical sequence described above, but which can be assumed to come from bed 2. Altogether 45 taxa of Coleoptera were recorded, of which 37 could be identified to species or species group. Six are no longer living in Britain and are distinguished by an asterisk in the following list:

Carabidae	
Notiophilus aquaticus (L.)	23
**Diacheila polita* (Fald.)	3
Elaphrus cupreus Duft.	1
Loricera pilicornis (F.)	1
Clivina fossor (L.)	2
Dyschirius globosus (Hbst.)	2
Trechus secalis (Payk.)	1
Bembidion (*Metallina*) *properans* (Steph.)	3
Bembidion (*Princidium*) *bipunctatum* (L.)	6
Bembidion (*Notaphus*) *obliquum* Sturm	1
Bembidion (*Blepharoplataphus*) *virens* Gyll.	1
Bembidion (*Plataphodes*) sp.	1
**Bembidion* (*Plataphus*) *hasti* Sahib.	1
Bembidion (*Philochthus*) *aeneum* Germ.	4
Pterostichus strenuus (Panz.)	1
Pterostichus melanarius (Ill.)	1
Calathus melanocephalus (L.)	1
Agonum ericeti (Panz.)	1
**Amara munici palls* (Duft.)	5
**Amara torrida* (Panz.)	2
Dytiscidae	
Ilybius sp.	1

Gyrinidae	
Gyrinius aeratus Steph.	1
Hydraenidae	
Helophorus aquaticus (L.) type	1
Hydrophilidae	
Cercyon melanocephalus (L.)	2
Cercyon tristis (Ill.)	1
Cercyon analis (Payk.)	2
Cryptopleurum minutum (F.)	1
Hydrobius fuscipes (L.)	1
Silphidae	
Thanatophilus dispar (Hbst.)	1
Liodidae	
Agathidium marginatum Sturm	1
Staphylinidae	
Stenus sp.	1
Xantholinus sp.	1
Tachyporus sp.	1
Tathinus sp.	1
Scarabaeidae	
Aegialia sabuleti (Panz.)	3
Aphodius fimetarius (L.)	5
Aphodius sp.	27
Chrysomelidae	
**Phaedon segnis* Weise	1
Curculionidae	
Apion sp.	2
Otiorhynchus fusci pes (Ol.)	7
Otiorhynchus arcticus (F.)	3
Otiorhynchus ligneus (Ol.)	3
Otiorhynchus rugifrons (Gyll.)	5
Notaris aethiops (F.)	3
Alophus triguttatus (F.)	12

In this faunal list the nomenclature follows that of Lucht (1987). The number opposite each taxon indicates the minimum number of individuals present in the sample.

During the period when R. Wrayton was collecting fossil bones from the Great Totham site, he also sieved a large amount of the biogenic sediment of bed 2 and found it to contain a rich fossil fauna and flora. At this time a number of broken valves of the bivalve *Pisidium* sp. and an apex of the gastropod *Bithynia tentaculata* were recovered. These remain the only Mollusca recorded from the site. Also collected at this time (1984) was the preliminary sample from bed 2 that produced significant numbers of beetles and ostracods; it was the assessment of this preliminary sample that prompted the more detailed investigation of the site that was undertaken by the GCR Unit the following year.

A study has been made of the cladoceran and ostracod remains from five serial bulk samples that were taken from the lower 0.9 m of bed 2 during the 1985 GCR excavation. The uppermost of these samples was barren, but the other four, from the lowest 0.70 m of bed 2, all contained small crustacea (Table 5.7). Between 0.15 and 0.50 m from the base of the unit, cladoceran ephippia and ostracod valves were present in profusion, particularly in the 0.15–0.30 m sample. As a similar assemblage of small crustacea was present in all four fossiliferous samples, the 0.15–0.30 m sample can be regarded as representative of the bed 2 fauna at its optimum. In this sample, cladoceran ephippia, the saddle-shaped coverings of 'winter' or 'resting' eggs, were common. Both the elongate ephippia of the *Daphnia magna* group and more triangulate ephippia belonging to the *D. pulex* or *D. longispina* groups were present in equal quantities. Ten species of ostracods were recorded from this sample (Table 5.7). The most abundant species was *Candona neglecta,* which was represented by many adult male and female valves and large numbers of instars. Valves of *Ilyocypris gibba,* often strongly tuberculate, were also very common (Table 5.7). Four other species were found in significant numbers: *Candona candida, Cyclocypris serena, Cypria ophthalmica* and *Ilyocypris bradyi.* Adult valves and instars of the remaining species (Table 5.7) were present only in small numbers. Single valves of *Candona protzi* Hartwig and *Candona weltneri* Hartwig were found in the 1984 preliminary sample, but no examples of these species were encountered in the material collected from the 1985 GCR excavation.

(Table 5.7) Ostracods from Great Totham (identifications by T. Allen).

		Height (cm) above base of organic clays and silts				
Species	**Group**	**0–15**	**15–30**	**30–50**	**50–70**	**70–90**
Cyclocypris-serena (Koch)	1	—	Common	Very rare	—	—
Candona candida (Müller)	2	Very rare	Common	Common	Very rare	—
Candona neglecta Sars	2	Very rare	Abundant	Abundant	Very rare	—
Ilyocypris bradyi Sars	2	—	Common	Common	—	—
Cypria opbthalmica (Jurine)	3	—	Common	Very rare	—	—
Ilyocypris gibba (Ramdohr)	4	Very rare	Very common	Common	—	—
Eucypris zenkeri (Chyzer)	4	—	Rare	—	—	—
Limnocythere inopinata (Baird)	4	—	Rare	Very rare	—	—
Herpetocypris sp.	?	—	Rare	Very rare	—	—
Potamocypris sp.	?	—	-- Very rare	Very rare	—	—
Overall frequency		**Very rare**	**Very common**	**Common**	**Very rare**	**Absent**

Only a preliminary assessment of the palaeobotany of the organic deposits can be given here. Three samples from bed 2 have been analysed, from 2 m, 2.5 m and 3 m (approximately) above the London Clay. The second of these was from a particularly fossiliferous level, rich in macroscopic plant remains and ostracods (although collected from an earlier exposure, this was probably broadly equivalent to the richest ostracod-bearing levels sampled in 1985 — see above). All three samples yielded a similar pollen assemblage, dominated by herbs, grasses and sedges (Figure 5.38). The plant macrofossil counts from the three levels are also closely comparable (Table 5.8).

Interpretation

The organic sediments (bed 2) at Great Totham have provided considerable palaeontological evidence, but this is predominantly of value to environmental reconstruction rather than stratigraphy. Although further assessment of the flora and fauna is in progress, the fossil assemblage recognized thus far is not stratigraphically diagnostic. It is necessary to look to the terrace record of the River Blackwater, and to the position of the deposits at Great Totham within that sequence, to gain an indication of their relative age.

(Table 5.8) Plant macrofossils from Lofts Farm Pit, Great Totham (identifications by M. Pettit).

Height above London Clay

	2m	**2.5m**	**3m**
Ranunculus subgenus *Ranunculus*	la	—	1a
Ranunculus subgenus *Batrachium*	8.5a	9.5a	5a
Potentilla anserina	1a	—	—
Potentilla sp.	2a	2a	5a
Wok sp.	—	is	—
Silerze vulgaris cf. subspecies (*maritima*)	1s	is	—
Carex sp.	7n	6n	3n
Scirpus lacustris	1n	—	—
Eleocharis palustris	2n	—	—
Potamegeton sp.	20fst	20fst	20fst
Zannichellia palustris	16a	22a	3a
Hippuris vulgaris	—	4a	—
Linum perennes subspecies (*anglicum*)	—	1s	1s
Moss fragment	—	+	—
a: achene; n: nut; fst: fruitstone; s: seed.			

The mammalian assemblage from Great Totham comprises species that are all well known from the Devensian Stage in Britain. All have been obtained from Devensian sediments that have been dated using the radiocarbon technique (see Stuart, 1982a, 1991). A similar mammalian assemblage occurs, for example, in the Cave Earth of Kent's Cavern, which is regarded as Devensian in age (Sutcliffe, 1974). However, all the species present at Great Totham have been recorded from earlier Middle and Late Pleistocene deposits, so their occurrence together at Great Totham does not necessarily indicate a Devensian age. For this reason a horse metatarsal has been submitted to the Godwin Laboratory at Cambridge for radiocarbon dating. Although some of the species in this assemblage also occur in interglacials (giant deer, mammoth and horse, for example), the assemblage as a whole is suggestive of a cold episode. It fully conforms with the environ mental indications from the palaeobotany, from which a treeless, open habitat can be envisaged.

The insect assemblage provides a considerable insight into conditions prevailing at the time when the organic deposits were laid down. Viewed as a whole, the assemblage is characteristic of open ground, sparsely or patchily vegetated, on a substrate that must have included both clay and gravel. *Notiophilus aquaticus,* for example, prefers rather open dry ground with short heaths and grasses, sometimes living in apparently sterile places. *Bembidion bipunctatum* is often found in the company of *B. vixens* and *B. hasti* on sterile stony banks. *Amara municipalis* also lives in sandy or gravelly habitats with sparse vegetation. *Diacheila polita* is today one of the characteristic species of the tundra, where it is usually found on dry peaty soil. *Agonum ericeti,* a surface dweller that likes sunlight, is a stenotopic species requiring acid soils. Clay substrates are required by *Bembidion aeneum,* which is believed to prefer somewhat saline soils. *Clivina fossor* burrows in clayrich soils, avoiding pure sand (Lindroth, 1985).

There are very few Coleoptera present that require fully aquatic habitats. Single specimens of *Ilybius* and *Gyrinus* indicate that some open water must have been available, while *Hydrobius fuscipes* occurs in stagnant water. The remainder of the Hydrophilidae in the assemblage are mainly species of damp, decomposing vegetation, or are dung-dwellers. The relatively high numbers of the scarabaeid *Aphodius* also suggests the presence of large quantities of dung, although some members of this genus can live in well-rotted vegetable material. *Thanatophilus dispar is* a carcass beetle often found under rotting fish in northern Europe (Strand, 1946).

The beetle assemblage provides little information about the specific composition of the flora at the time of deposition. All the species of *Otiorhynhus* are polyphagous herbaceous plant eaters. Their abundance in the assemblage indicates that such plants were readily available. *Notaris aethiops* is usually said to prefer *Sparganium,* but its ubiquity in arctic Eurasia suggests that it can feed on a variety of different Cyperacaea.

The beetle assemblage is strongly indicative of a climate substantially colder than that of today. With the exception of *Phaedon segenis,* which lives at the present time in the mountains of eastern Europe, all the species occur today in the far north of Europe. *Diacheila polita* is especially significant in this respect. Its nearest modem habitat to Britain is on the Kola peninsula, in northern Russia, from where it ranges across the tundra of Eurasia as far as northwestern Alaska. Only occasionally is it found below the tree line. *Bembidion hasti* is an exclusively north-palaeoarctic species that lives today in the mountains of Fennoscandia, extending eastwards into western Siberia.

An interesting feature of the Great Totham insect assemblage is that it lacks the important group of exclusively Asiatic species that characterizes faunas from Devensian interstadial sites (Coope, 1968, 1987). The implication of this particular faunal difference is that the Great Totham deposits were laid down under climatic conditions that were less continental than those prevailing during the major part of the Upton Warren Interstadial Complex.

One species in this insect assemblage, *Pbaedon segnis,* has up to now been found only in Devensian interstadial contexts in Britain. This was found (incorrectly recorded under the name *P. pyritosus*) at Upton Warren (Coope *et al.,* 1961) and at Marlow (Coope, in Gibbard, 1985), in deposits that have been attributed to the Middle Devensian. The absence at Great Totham of the group of exclusively eastern Asiatic species makes correlation with the major part of the Upton Warren Interstadial Complex unlikely. The Devensian interstadial fauna from Isleworth (Coope and Angus, 1975) also lacks far-eastern species, but in that case the insect assemblage is indicative of temperate conditions, quite different to those inferred at Great Totham. The Great Totham assemblage may thus represent a hitherto unrecognized episode within the Devensian.

The ostracod assemblage provides further information about the palaeoclimate at the time of the deposition of bed 2. The species present can be divided into four groups based on differences in their capacity to tolerate the annual cycle of seasonal changes in water temperature (Table 5.7), as follows:

Group 1: *Cyclocypris serena*

This species has been classed as a cold stenothermal (confined to low-temperature environments) form by Diebel and Wolfschlager (1975). The two species encountered only in the 1984 sample, *Candona protzi* and *C. weltneri* (see above, Description), have also been listed as cold stenothermal forms (Hiller, 1972) and therefore belong within this group, although not featuring in (Table 5.7).

Group 2: *Candona candida, Candona neglecta* and *Ilyocypris bradyi*

These three species thrive in cool water and can survive quite cold aquatic temperatures, but they may decline in numbers or become absent as water temperatures reach their peak in mid- and late summer. ' *Candona candida* is found only rarely when water temperatures exceed 18°C (Hiller, 1972).

Group 3: *Cypria ophthalmica*

Cypria ophthalmica, the only species in this group, is tolerant of a wide range of water temperatures, living not only in cold and cool water, but also thriving in the warmer water of summer.

Group 4: *Ilyocypris gibba, Eucypris zenkeri* and *Limnocythere inopinata*

These species flourish in the warm aquatic conditions of the summer months and, while able to tolerate the cooler water temperatures of spring and autumn, they would be absent during the coldest winter months.

Overall the ostracod assemblage contains a preponderance of species adapted to cool water conditions. As aquatic temperatures started to rise in late spring to early summer, the cold stenothermal forms (Group 1) would have become scarce and then failed, leaving the cool water ostracods (Group 2) to dominate the assemblage. A subsidiary fauna of summer species (Group 4) would have begun to appear at this time, becoming increasingly important as temperatures increased during the early summer. By mid- to late summer the Group 4 species would have formed a substantial part of the ostracod fauna, perhaps even achieving a short period of dominance if water temperature peaked at above 18–2O.D.g;C. As aquatic temperature decreased with the onset of autumn, the summer species would have declined, leaving the cool-water species again predominant. *Cypria ophthalmica,* the single Group 3 species, would have been a constant member of the fauna throughout the year.

This ostracod assemblage lived in a permanent body of fresh or oligohaline (slightly brackish) moving water with at least moderate summer weed growth. *Eucypris zenkeri,* in particular, is characteristic of slowly moving, shallow, plant-rich waters (Klie, 1938). The assemblage is similar to faunas described from the Devensian interstadial sites at Fladbury, Isleworth and Upton Warren (Siddiqui, 1971). The presence of numerous Daphniidae ephippia, such as are found in the silts and clays at Great Totham, may be an indication of seasonality, as these egg covers are produced to enable the survival of periods of inhospitable conditions; however, the climatic significance of these is limited, as ephippia are produced by the Daphniidae at the present time over a wide range of latitudes, from arctic to subtropical (Shotton and Osborne, 1965).

The preliminary pollen analysis of the organic sediments (Figure 5.38) indicates that vegetation was sparse at the time of deposition. Tree and shrub pollen are so rare as to preclude the growth of such plants locally, the small quantities present probably resulting from either long-distance transport or reworking. Amongst the herb pollen, several distinct plant communities are indicated. It is clear that the channel and adjacent wet ground supported communities of the aquatics *Thalictrum, Myriophylum spicatum* L., *Sparganium* and *Butomus.* The abundance of grass pollen, together with a range of dry-ground herbs, points to the occurrence of grassland further away from the depositional site. The pollen of Compositae (Liguliflorae), *Artemisia, Plantago majorimedia,* Umbelliferae, Caryophyllaceae, *Helianthenmum, Centaurea nigra, Vicia/Lathyrus* and *Matricaria* type were all probably derived from this habitat. Damp grassland and meadow environments also occurred in the vicinity, to judge by the abundance of pollen from Cyperaceae, *Sanguisorba officinalis* L. and *Caltha* type.

Of particular interest is the repeated occurrence of the pollen of halophytic plants such as *Plantago maritima* L. and *Armeria.* These records, reinforced by the finds of *Silene vulgaris maritima* (Withering) (A. and D. Love) in the plant macrofossil assemblage (see below), are indicative of high soil salinity. This phenomenon has been frequently attributed to high evaporation rates under cold-climate conditions (West, 1988).

The limited plant macrofossil assemblage (Table 5.8) compares closely with that of the pollen. It is dominated by the remains of aquatics such as *Potamogeton* spp., *Hippuris vulgaris* (L.), *Ranunculus* (*Batrachium*)*, Myriophyllum* cf. *spicatum* and *Zannichelia palustris* (L.). Marsh plants (*Eleocharis palustris* (L.) Roemer and Schultes, *Potentilla* sp.) and dry grassland taxa (*Linum perenne anglicum* Ockendon, *Viola* sp. and *Ranunculus* (*Ranunculus*)) occur in all three samples (Table 5.8), confirming that similar conditions prevailed throughout the period of the deposition of the organic clays and silts. The palaeobotanical evidence is typical of cold episodes during the Middle and Late Pleistocene, intervals that are often termed 'full-glacial'. Such floras recur repeatedly and are not therefore characteristic of any particular period.

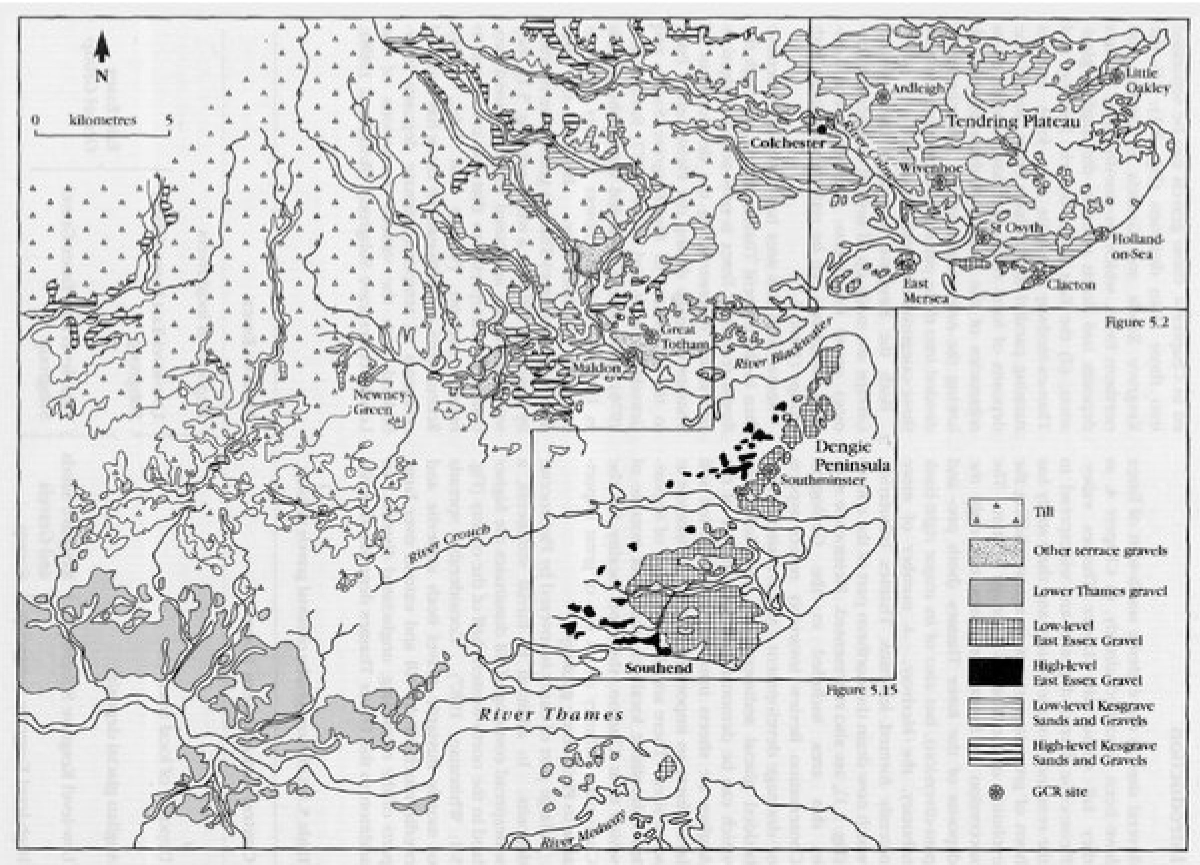
As indicated above, the terrace record of the Blackwater provides some stratigraphical indication of the likely age of the Great Totham deposits. The long-profiles of the terraces in both branches of the Blackwater system, the Blackwater itself and the River Chelmer, have been illustrated by Bristow (1985). In the Maldon area and further downstream, Bristow recognized no well-marked formations above the 2nd Terrace. A minor spread, mapped as 3rd Terrace, to the north of Chigborough Farm (around [TL 878 091]) appears to be poorly differentiated from the 2nd Terrace (Bristow, 1985, figure 21). In the present volume the deposits on the northern side of the Blackwater estuary, which were mapped as 'Glacial Sand and Gravel', are recognized as higher, older terraces of the Blackwater system (see above, Maldon and East Mersea). (Figure 5.32) shows projections of the long-profiles of the terrace gravels of the Blackwater system downstream from Maldon. The downstream gradient of the 2nd Terrace indicates that it falls below ordnance datum between Tollesbury and Mersea Island. As has been noted previously, this places the 2nd Terrace lower in the Blackwater terrace sequence than the fossiliferous deposits at the East Mersea Restaurant and Hippopotamus sites (Figure 5.32). Since the latter have been attributed to the Ipswichian Stage, this would appear to provide important confirmatory evidence for the Devensian age of the 2nd Terrace and, therefore, the deposits at Great Totham.

In terms of the scheme for Thames terrace stratigraphy promoted in this volume, however, the occurrence of Ipswichian and Devensian deposits in different terraces of the Blackwater system is somewhat surprising. In the London area Ipswichian sediments and deposits dating from the mid-Devensian Upton Warren Interstadial both occur within the Kempton Park Formation of the Thames (see Chapter 3, Fern House Pit). No terrace rejuvenation appears to separate the Ipswichian and the Middle Devensian in this area, the downcutting to the Shepperton Gravel level occurring in the Late Devensian (Gibbard, 1985). It is possible that a rejuvenation occurred in the early Devensian in the Upper Thames, however; recent indications from a site in the Northmoor Formation at Cassington (see Chapter 2, Stanton Harcourt and Magdalen Grove) suggest that sediments of Chelford Interstadial or Upton Warren Interstadial age occur there (D. Maddy, pers. comm.), which would require there to have been a downcutting event soon after the deposition of the Ipswichian Eynsham Gravel at the Summertown-Radley Terrace level.

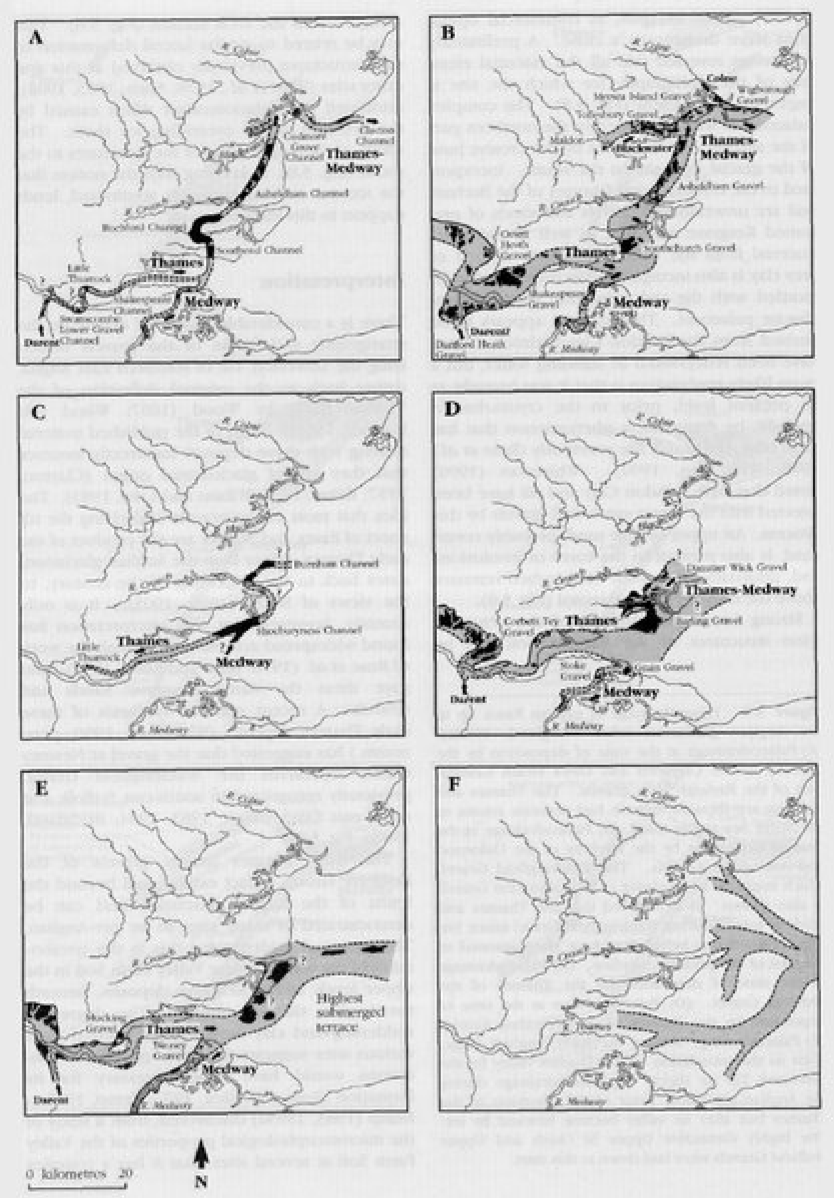
Conclusions

The Great Totham site provides a rare opportunity for the study of last-glacial fossiliferous sediments in the lower reaches of the Thames system, in this case situated in the valley of the River Blackwater (a former Thames tributary). Organic sediments here have yielded an impressive assemblage of large mammal remains, as well as smaller vertebrates, pollen, other plant remains, insects and ostracods. The mammal fauna has many of the elements regarded as typical of cold climatic episodes: wolf, giant deer, reindeer, woolly rhinoceros and mammoth are all represented. A rich assemblage of fossil beetles has been collected from the organic sediments. It too points to conditions much colder than today, with several species present that now live in the far north of Europe and/or Eurasia. The last glacial (Devensian) age cannot be ascertained with certainty from the palaeontology, however. It is necessary to compare the height of the Great Totham sediments within the sequence of Blackwater terraces with that of the last interglacial site at East Mersea, which appears to be in a higher (and therefore older) terrace, implying that the Great Totham terrace post-dates the last interglacial.

References

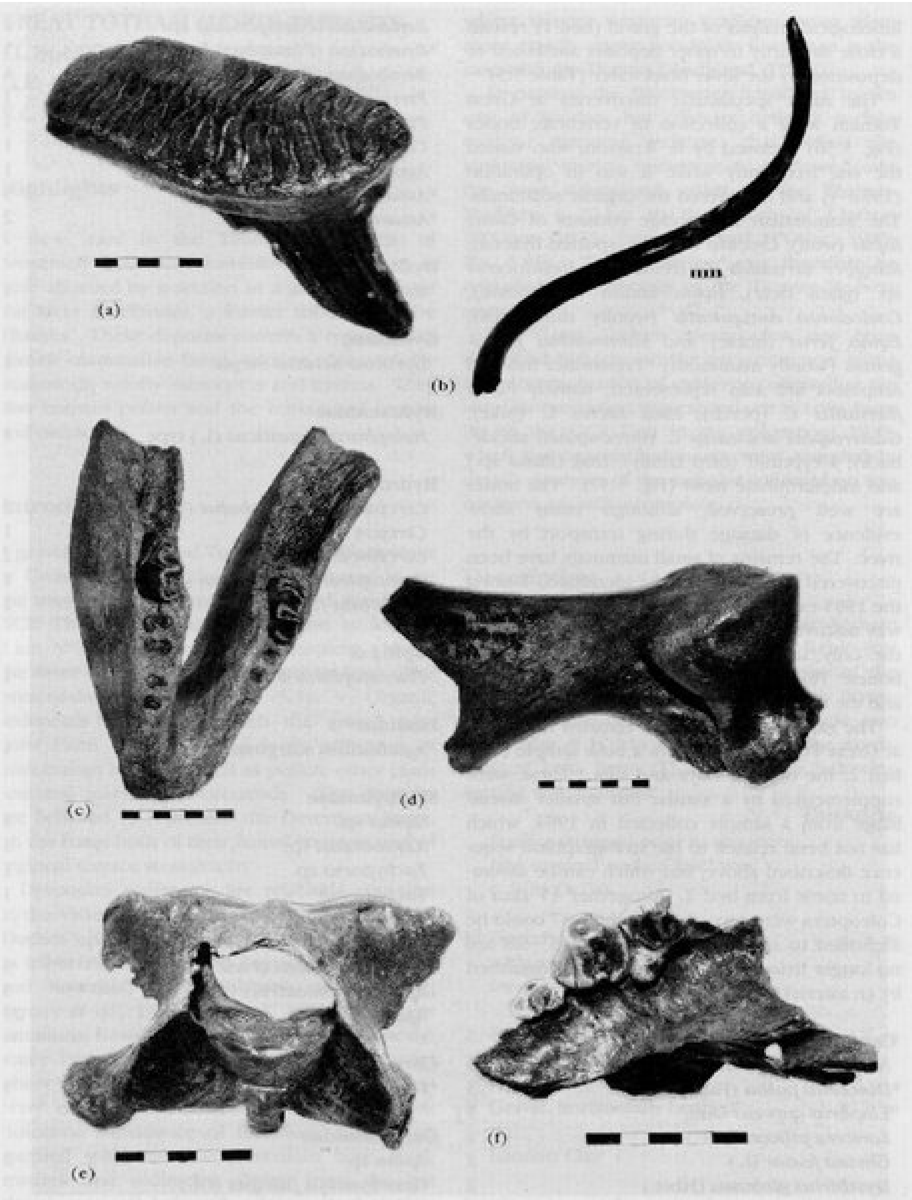


(Figure 5.1) Pleistocene geology of Essex, showing the various types of gravel described in this chapter, the extent of the Anglian till sheet and the relation of these to the existing drainage systems (modified from Bridgland, 1988a).



(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).

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

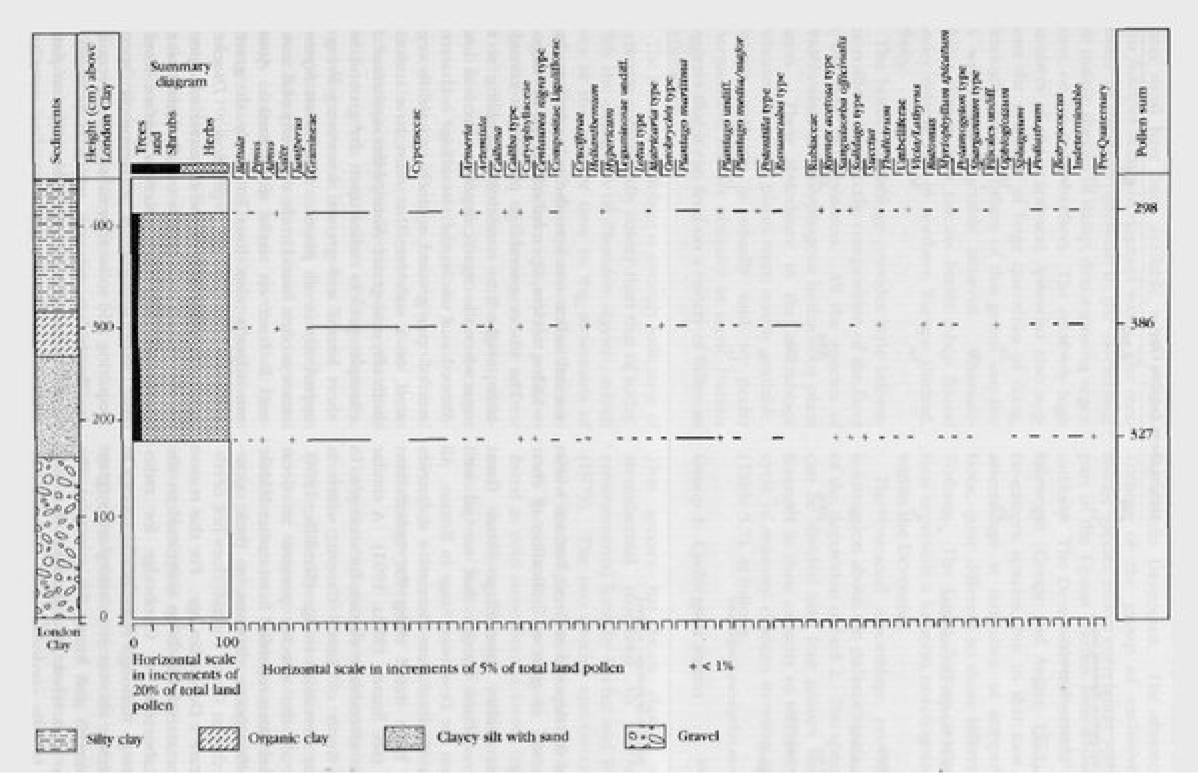


(Figure 5.36) Mammalian bones from Great Totham (R. Wrayton collection). (A) Molar tooth of mammoth (Mammuthus primigenius). (B) Tusk of mammoth (Mammuthus primigenius). (C) Lower jaw of woolly rhinoceros (Coelodonta antiquitatis). (D) Humerus of woolly rhinoceros (Coelodonta antiquitatis). (E) Vertebra of horse (Equus ferus). (F) Fragment of jaw of spotted hyaena (Crocuta crocuta). Scale bars are graduated in cm. (Photos: R. Wrayton).

(Figure 5.37) Small vertebrate remains from Great Totham. The identifiable species represented are pike (Esox lucius), perch (Perca fluviatilis), stickleback (Gasterosteus aculeatus) and frog (Rana sp.; probably R. temporaria, common frog). Remains of a cyprinid fish (carp family) and indeterminate newt are also present. Identifications by B. Clarke (Amphibia) and A. Wheeler (fish) of the Natural History Museum. Scale bar is graduated in mm, numbered in cm. (Photo: Paul Douthwaite.)

		Height (cm) above base of organic clays and silts				
Species	**Group**	**0 - 15**	**15 - 30**	**30 - 50**	**50 - 70**	**70 - 90**
Cyclocypris serena (Koch)	1	-	Common	Very rare	-	-
Candona candida (Müller)	2	Very rare	Common	Common	Very rare	-
Candona neglecta Sars	2	Very rare	Abundant	Abundant	Very rare	-
Ilyocypris bradyi Sars	2	-	Common	Common	-	-
Cypria ophthalmica (Jurine)	3	-	Common	Very rare	-	-
Ilyocypris gibba (Ramdohr)	4	Very rare	Very common	Common		-
Eucypris zenkeri (Chyzer)	4	-	Rare	-	-	-
Limnocythere inopinata (Baird)	4	-	Rare	Very rare	-	-
Herpetocypris sp.	?	-	Rare	Very rare	-	-
Potamocypris sp.	?	-	Very rare	Very rare	-	-
Overall frequency		**Very rare**	**Very common**	**Common**	**Very rare**	**Absent**

(Table 5.7) Ostracods from Great Totham (identifications by T. Allen).

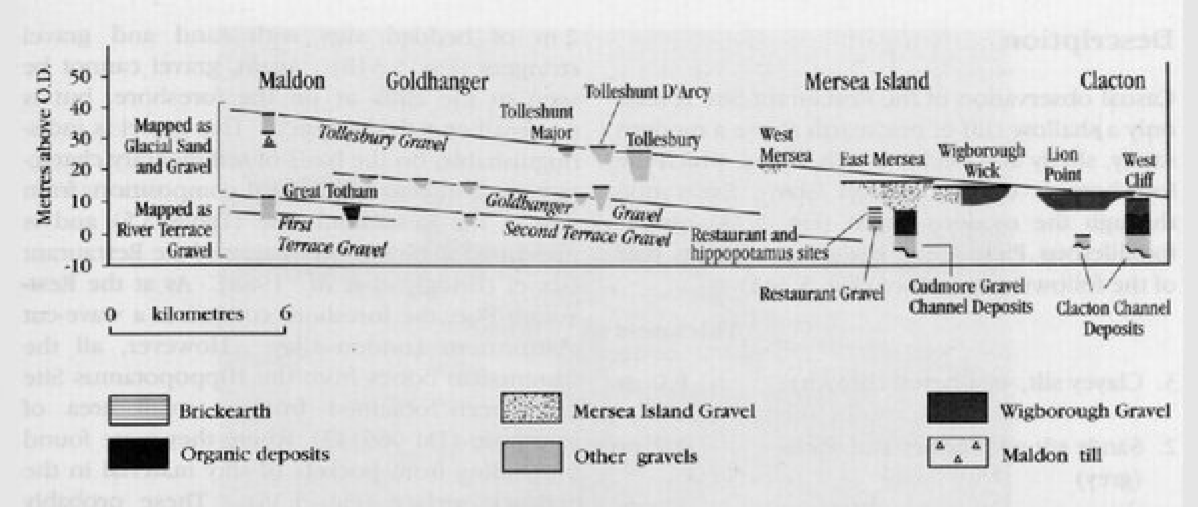


(Figure 5.38) Pollen from the organic deposits at Great Totham.

	Height above London Clay		
	2m	**2.5m**	**3m**
Ranunculus subgenus *Ranunculus*	1a	-	1a
Ranunculus subgenus *Batrachium*	8.5a	9.5a	5a
Potentilla anserina	1a	-	-
Potentilla sp.	2a	2a	5a
Viola sp.	-	1s	-
Silene vulgaris cf. subspecies (*maritima*)	1s	1s	-
Carex sp.	7n	6n	3n
Scirpus lacustris	1n	-	-
Eleocharis palustris	2n	-	-
Potamogeton sp.	20fst	20fst	20fst
Zannichellia palustris	16a	22a	3a
Hippuris vulgaris	-	4a	-
Linum perennes subspecies (*anglicum*)	-	1s	1s
Moss fragment	-	+	-

a: achene; n: nut; fst: fruitstone; s: seed.

(Table 5.8) Plant macrofossils from Lofts Farm Pit, Great Totham (identifications by M. Pettit).



(Figure 5.32) Longitudinal profiles of Blackwater terrace gravels.