1633

FILE

Ancient Monuments Laboratory
Report 70/87

HULLBRIDGE SURVEY, ESSEX: PALAEOLOGICAL AND PALAEOECONOMIC RESULTS FROM THE 1986 SURVEY SEASON.

Peter Murphy BSc MPhil

Ancient Monuments Laboratory Report 70/87

HULLBRIDGE SURVEY, ESSEX: PALAEOLOGICAL AND PALAEOECONOMIC RESULTS FROM THE 1986 SURVEY SEASON.

Peter Murphy BSc MPhil

Summary

Results from intertidal sites in the estuaries of the Rivers Thames, Roach and Blackwater are presented. Shelly midden-type deposits of Roman and medieval date on Canvey Island produced mollusca, crustaceans, mammal, bird and fish-bones, avian eggshell, diatoms and carbonised plant remains. At Purfleet a palaeosol containing a woodland mollusc fauna and neolithic axes, overlain by wood peat, was sampled. A preliminary study of the biostratigraphy of the Roach is described. In the Blackwater Estuary a settlement site, later prehistoric wooden structures and associated sediments produced seeds, cereals and wood.

Contributions from A K G Jones, Steve Juggins and Dr Rosemary Luff.

Author's address :-

Centre of East Anglian Studies
University of East Anglia
Norwich
Norfolk NR4 7TJ

Introduction

During 1986 new sites in the estuaries of the Rivers Thames and Roach were examined and further work was completed on Sites 18 and 28 in the Blackwater Estuary. The two main Thames sites, at Canvey Island and Purfleet (Sites 1 and 2), have great potential for palaeoecological and palaeoeconomic studies. Both sites have produced very rich assemblages of plant and animal macrofossils from comparatively small samples, and at Site 2 there is also considerable scope for soil, pollen and diatom studies. Detailed preliminary assessments of these sites were clearly required to determine the scale and type of investigations necessary to realise their full potential. Survey of the Roach estuary was less productive, though limited stratigraphic and palaeoecological studies have been undertaken to provide information of general relevance to palaeogeographic reconstruction on the Essex coast. In the Blackwater Estuary the progressive erosion of wooden structures at Site 18 was monitored and samples were collected for wood identification, but the main focus of interest was Site 28. Here the sediments overlying the palaeosol with neolithic occupation were recorded and samples from them were studied, C14 samples were collected from the complex of wooden structures and samples were examined from two newly-detected charcoal spreads on the palaeosol. Within the area of neolithic settlement excavated 100 samples were collected from the palaeosol with additional samples from features for the retrieval of carbonised cereals and other plant remains. Before starting work on these samples it was necessary to determine the most effective and least destructive processing method. Results from experimental processing of replicate samples are given below.

The Thames Estuary

Canvey Island (Site 1)

1) Stratigraphy and general description of deposits

The following section was exposed at the edge of the salt-marsh (top of section at c.2.44m. OD):

0-40cm. (2) Greyish-brown clay; well-developed blocky structure; rare small stones; rare fragments of briquetage and shell; few fine roots near top; merging boundary.

40-62cm. (3) Greyish-brown clay; structureless; abundant charcoal and marine mollusc shells; rare pottery and bone; distinct boundary.

62-77cm. (4) Greyish-brown clay; moderately well-developed blocky structure; yellow coatings on ped faces; rare charcoal; (bone common at this level elsewhere in section); merging boundary.

77-89cm. (4) Variable yellowish-brown and greyish-brown clay; weakly developed blocky structure; rare shells; (bone and flint pebbles common at this level elsewhere in section); moderately distinct boundary.

89-106cm. (5) Greyish-brown friable clay; mollusc shells and briquetage fragments common; charcoal flecks; merging boundary.

106-120cm. Yellowish-brown clay patches in greyish-brown clay matrix; rare briquetage, shell and charcoal.

Samples were collected at 5cm. intervals for diatom analysis, and three bulk samples were taken from each of layers 3, 4 and 5 in order to establish in general terms the composition of these deposits, to see how variable they are in composition and to retrieve assemblages of macrofossils (molluscs, crustaceans, bone of fish, mammals and other small vertebrates, charcoal, carbonised seeds and cereals). Thereby it was hoped to determine how the deposits were formed, to learn something of local coastal economies and to assess whether the biota present are of sufficient interest to justify further sampling.

The bulk samples were dried and then disaggregated by soaking in a solution of Calgon. Carbonised plant material (together with some small shell fragments and light bones) was then separated by repeated washover, using a 0.5mm. collecting mesh. The heavier residue was then washed out over a 0.5mm. mesh. After drying, the fraction >6mm. was separated by sieving and sorted into categories (stones and clay concretions, briquetage, pottery, mollusc shell, mammal bone etc, fishbone and charcoal). These categories of material were weighed and the weights calculated as percentages of the total fraction >6mm. The results, summarised in Table I , give a crude impression of sample composition though obviously small and light components (eg. fish-bones) are under-represented and other components, notably carbonised cereals, are not represented in this coarse fraction. The sieved fractions smaller than 6mm. were sorted under a binocular microscope at low power and identifiable macrofossils were extracted.

In addition to the macrofossils extracted from the samples mammal and large fishbones were collected from the exposed section faces by hand.

2) Macrofossils from the deposits

a) Mollusca and other shelly macrofossils

Layer 3

This layer appears to be very uniform, both in terms of the proportion of shell in the coarse fraction (74-85% by weight) and the species composition

Layer number	3	3	3	4	4	4	5	5	5
Sub-sample	a	b	c	a	b	c	a	b	c
Sub-sample weight (g)	2000g	3000g	3400g	4000g	3700g	4000g	3500g	3200g	3500g
Weight of fraction >6mm(g)	393g	572g	294g	352g	187g	155g	274g	547g	206g
Stones, clay concretions (g)/%	22g/5.6%	46g/8.0%	50g/17.0%	243g/69.0%	89g/47.6%	97g/62.6%	126g/46.0%	194g/35.5%	5g/2.4%
Briquetage (g)/%	4g/1.0%	5g/0.9%	6g/2.0%	36g/10.2%	15g/8.0%	21g/13.5%	38g/13.9%	119g/21.8%	60g/29.1%
Pottery (g)/%	12g/3.1%	8g/1.4%	1g/0.3%	4g/1.1%	1g/0.5%	1g/0.6%	6g/2.2%	8g/1.5%	21g/10.2%
Mollusc shell (g)/%	330g/84.0%	489g/85.5%	218g/74.1%	-	-	-	92g/33.6%	216g/39.5%	117g/56.8%
Mammal bone etc.(g)/%	21g/5.3%	14g/2.4%	12g/4.1%	67g/19.0%	82g/43.9%	34g/21.9%	11g/4.0%	9g/1.6%	2g/1.0%
Fish-bone (g)/%	2g/0.5%	5g/0.9%	3g/1.0%	1g/0.3%	-	1g/0.6%	-	-	-
Charcoal (g)/%	2g/0.5%	5g/0.9%	4g/1.4%	1g/0.3%	-	1g/0.6%	1g/0.4%	1g/0.2%	1g/0.5%

Table I : Composition of the fraction >6mm. in samples of Layers 3, 4 and 5.

Weights were determined to the nearest gram. The percentage figures refer to the percentage by weight of the fraction >6mm. made up by each category of artefacts, macrofossils and stones.

Layer number	3	3	3	4	4	4	5	5	5
Sample	a	b	c	a	b	c	a	b	c
Littorina rudis (Olivi)	-	-	-	-	-	-	+	+	-
Littorina littorea (Linné)	++	-	+	-	-	-	-	+	-
Littorina sp	-	-	-	+	-	-	+	-	+
Hydrobia ulvae (Pennant)	-	+	-	-	-	-	-	++	-
Buccinum undatum Linné	-	-	-	-	-	-	-	+	-
Mytilus edulis Linné	+++	+++	++	+	+	-	+	+	+
Ostrea edulis Linné	++	++	++	+	-	-	++	++	++
Chlamys sp	-	-	-	-	-	-	+	-	-
Cerastoderma sp	+	+	+	-	+	+	+	+++	-
Macoma balthica (Linné)	-	-	-	-	-	-	-	+++	-
Scrobicularia plana (da Costa)	+++	+++	+	-	-	-	+	++++	-
Pholadidae indet (abraded frags)	-	-	-	-	-	-	-	++	-
Indeterminate abraded bivalve frags	-	-	-	-	-	-	+	++	-
Vallonia sp	-	-	-	-	-	-	-	+	-
Limacidae indet	-	-	-	-	-	-	-	+	-
Barnacle frags	+++	++	++	-	-	-	++	++	++
Carcinus maenas L (cheliped frag)	-	-	-	-	-	-	+	-	-
Avian eggshell	-	++	++	-	-	-	-	++	++

Table 2 : Mollusca and other shelly macrofossils from layers 3, 4 and 5

+ - rare; ++ - fairly common; +++ - common; ++++ - abundant.

of its shell assemblage. The samples consist predominantly of mature but fragmentary valves of Mytilus edulis and Scrobicularia plana, with smaller numbers of mature and juvenile valves of Ostrea edulis. Shells of Littorina littorea are present in two samples, a shell of Hydrobia ulvae in one and scraps of Cerastoderma valves occur in all three. The fragments of Cerastoderma sp. and the H. ulvae shell are heavily weathered and abraded, the Littorina shells are fairly abraded and the Scrobicularia and Ostrea valves are comparatively unweathered. The Mytilus valves are variably preserved: some have lost their pigmented surfaces and are disintegrating into fibrous crystalline bundles but others have well-preserved surfaces.

The Ostrea shells show a fairly rich epifauna on their external surfaces, mostly of bryozoans and barnacles, with borings of the worm Polydora. A few oyster valves have an internal encrustation of bryozoans. The Mytilus shells are generally free of encrusting organisms, apart from small external patches of bryozoans. The remaining mollusc shells are either devoid of epifaunal organisms or are too abraded for traces of these organisms to survive. One Scrobicularia fragment from 3b is partly burnt. Fragments of barnacles are common and two of the samples produced unabraded fragments of avian eggshell.

Layer 4

Samples from this layer produced extremely small quantities of weathered shell fragments, all under 6mm. in size, of Mytilus, Ostrea, Cerastoderma and Littorina.

Layer 5

The samples from this layer fall into two distinct categories. Samples a and c consist mainly of large Ostrea valves with external encrustations of barnacles, bryozoans and Polydora borings. They also contain abraded shells and fragments of Mytilus, Cerastoderma, Scrobicularia, Chlamys, and Littorina. Sample a produced a cheliped fragment of the shore crab Carcinus maenas, and c contains unweathered avian eggshell fragments. Barnacle fragments occurred in both samples, and in c several of these were partly burnt.

Sample 5b is quite different. Although large Ostrea shells are present most of the mollusca are represented by small, very abraded fragments of Mytilus, Cerastoderma, Scrobicularia, Macoma, Pholadidae, Littorina spp,

Hydrobia ulvae and unidentified abraded scraps of other bivalves. There are a few small unabraded but burnt fragments of Buccinum shell, avian eggshell fragments and rare shells of terrestrial molluscs (Limacidae, Vallonia sp).

Conclusions

It is apparent from this preliminary study that these deposits are by no means simply shell middens, although they certainly include a proportion of shell representing human food waste, and in some samples relatively unabraded shells of mature mussels and oysters are common (eg. 3a,b and c, 5a and c). In sample 5b, however, small abraded fragments of common intertidal molluscs representing assemblages formed by natural processes predominate and all the samples from layers 3 and 5 contain at least some abraded fragments of this type.

The processes by which natural inshore shell deposits (cheniers) form have been described by Greensmith and Tucker (1969). In essence offshore shell bodies representing death assemblages from the local fauna provide a source of shell which is transported shore-wards and deposited on the marsh-edge during storms. Some of the abraded shell in these deposits no doubt arrived directly by this means. However within layer 5 there are discrete pockets of chenier-type material of very limited extent (over 50cm. or less) which appeared to have been emplaced artificially (eg. 5b). It seems possible that material dug from natural cheniers in the vicinity was transported to this site and dumped, together with food waste and clay in order to raise the level of the marsh surface. The taphonomic processes thought to have contributed to the formation of these shell assemblages are summarised diagrammatically in Fig 1.

Separating the natural from the cultural component of these assemblages is thus difficult. However it seems reasonable to suppose that unabraded mature shells of edible species do represent human food and on these grounds the oyster (Ostrea edulis) seems to have been the main species eaten whilst layer 5 accumulated, but the mussel (Mytilus edulis) is more important in layer 3. In layer 3, however, there are also many unabraded mature shells of Scrobicularia plana, a species which is not normally eaten. The absence of juvenile or abraded shells does imply deliberate collection for some purpose, conceivably as human food or as bait for line-fishing.

Because of these problems of interpretation it seems unlikely that further work on the molluscs would add significantly more information.

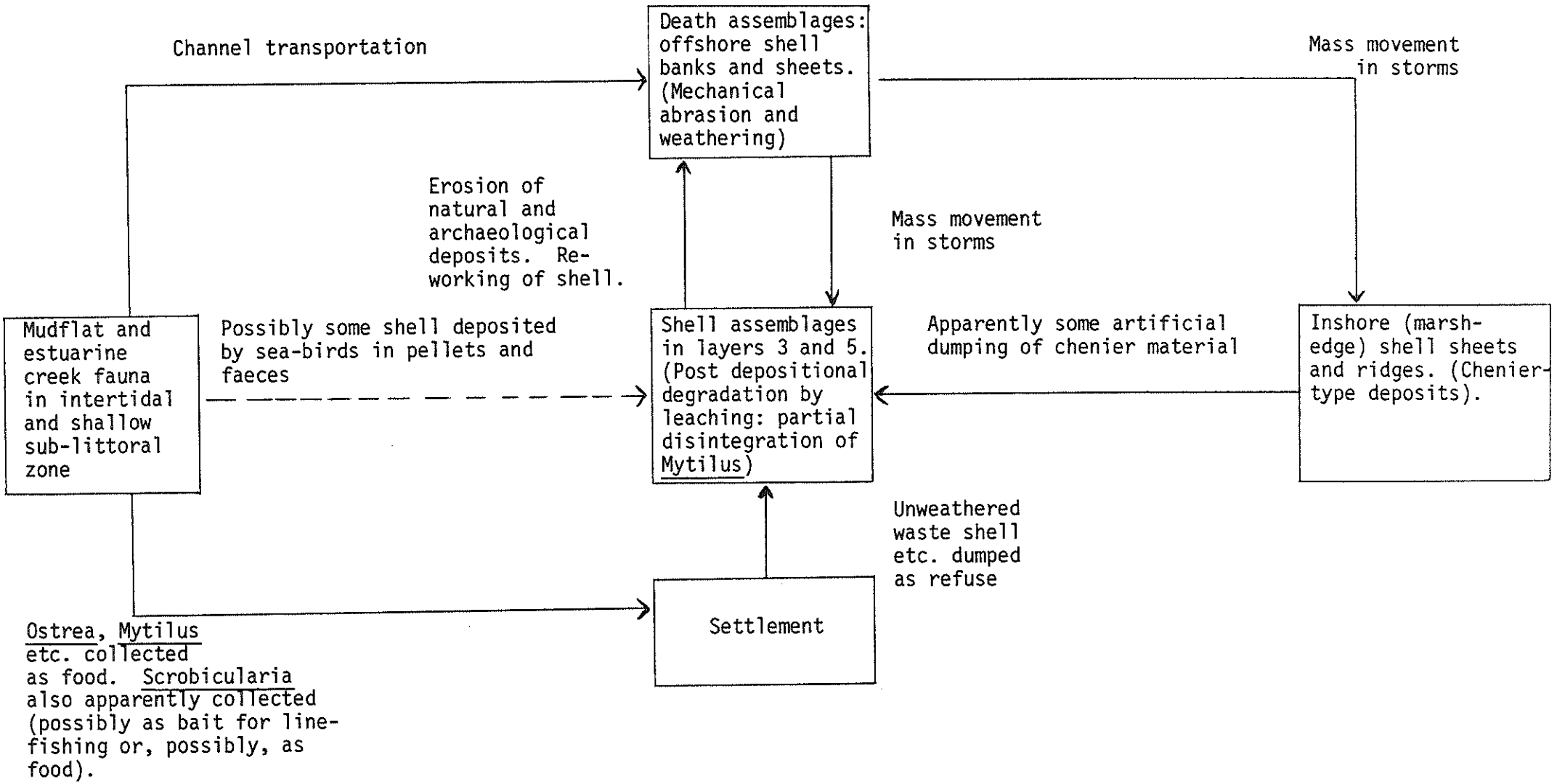

Fig 1: Suggested taphonomy of the shell assemblages from layers 3 and 5

b) Fish remains by Andrew Jones.

Coastal sites giving large assemblages of fish bones are not common in southern Britain, but at this site erosion has exposed sections through Roman and medieval deposits which contain abundant fish remains and molluscan shell. The bones are particularly well preserved and fragments of otoliths (ear stones used extensively in fisheries management) are present. Samples were collected to examine the composition of the deposits in detail and to assess if more intensive sampling would be necessary and informative.

Table 3 summarises the finds of fish remains from the samples.

Taxon	3a	3b	3c	4a	4b	4c	5a	5b	5c
Thornback ray	-	+	+	-	-	-	-	-	-
?Shad	+	+	-	-	-	-	-	-	-
Herring/sprat	+	+	+	+	+	-	+	+	-
Eel	-	-	-	-	+	-	-	-	+
Conger eel	+	-	-	-	-	-	-	-	-
Whiting	+	+	-	-	-	+	-	-	-
Cod	-	+	-	-	-	-	-	-	-
Haddock	-	+	+	-	-	-	-	-	-
Horse mackerel	+	+	-	+	-	+	-	-	-
Stickleback	-	-	-	-	-	-	+	-	+
Flatfish	+	+	-	+	-	+	+	+	+

Table 3 : Fish remains from layers 3, 4 and 5 (summary).

Layer 3

This layer gave the largest number of remains and the most diverse assemblage of fishes. A few bones were collected by hand from the exposure. This hand-collected assemblage contained vertebrae of large cod (Gadus morhua), haddock (Melanogrammus aeglefinus), whiting (Merlangius merlangus), horse mackerel (Trachurus trachurus) and flatfish (Pleuronectidae). The sieved samples contained denticles of a ray, possibly thornback ray (Raja clavata), herring bones, possibly shad (Alosa sp), a conger eel vomer (Conger conger), medium sized cod, in addition to remains of the species recovered by hand. Fish remains were particularly rich in the deposits with one 2kg. sub-sample giving in excess of 20 identifiable remains.

Layer 4

Samples from this layer yielded bones of small clupeids, herring (Clupea harengus), eel (Anguilla anguilla), whiting, horse mackerel and flatfish vertebrae. 15 identifiable bones from 11.7kg. deposit.

Layer 5

This layer produced rather small numbers of bones of young fish of the herring family, a single eel vertebra, a stickleback (Gasterosteidae) spine and some flatfish vertebrae. A small number of minute vertebrae remain to be identified. 11 identifiable bones from 10.2kg. sediment.

Discussion

The remains from layer 5 are enigmatic. It is possible that they simply represent remains of fishes which lived in the areaand whose bones have become incorporated into the deposits by natural processes. Alternatively, some or all may be the remains of fishes exploited by the Romano-British population of the area. Small fishes were often caught and imported into towns, possibly for the manufacture of fish sauces. Sites at both York and London have produced deposits of young fish of the herring family from Roman and Dark Age layers (Jones 1985, Bateman and Locker 1982). More work, comparing the Roman horizon with similar sediment devoid of archaeological traces, will indicate if the small bones were part of an assemblage deposited by man.

The material from layer 4 appears to contain a mixture of species, some similar to layer 5 and some similar to layer 3. Further work should establish if this is simply a result of re-working or if the assemblage represents a true transitional zone.

There can be little doubt that the remains recovered from layer 3,dominated by medium to large food fish, represent the remains of a fishery exploiting the Thames estuary. It is most important that larger samples of this material are excavated in order to determine the nature of the fishery and investigate whether the site is a fish processing area. (The kinds of skeletal elements present in assemblages of fish at consumption sites are usually different from fish processing sites.)

There is considerable variation between the subsamples, particularly within Layer 3. One 3kg. subsample was dominated by whiting and pleuronectid

remains, a 2kg. subsample was dominated by herring bones while the third (3.4kg.) subsample was dominated by gadid and pleuronectid remains. From the data available it is not possible to determine which species is dominant, although whiting and pleuronectid bones occurred in many of the samples.

Work on fishbone assemblages from sites in London has often hinted at the importance of the Thames estuary as a fishery for the City (eg. Jones 1976, 1978). At Canvey there is the distinct possibility that a fish processing site has been located (at least for the medieval period). Coastal erosion means that the material is gradually being lost and it is important that the site be investigated in greater detail.

These assemblages are of considerable interest for they almost certainly represent the traces of past fishing activity within the Thames estuary. It is clear that the upper layer contains very large numbers of fish-bones and it seems reasonable to compare these deposits with the well known fish and shell middens of Scotland. I know of no coastal sites in southern Britain which produce a sequence of fish remain-bearing deposits dating from the Roman to medieval period. The potential for examining changes in fish exploitation through time are self-evident.

Suggested further work

It is suggested that on-site sieving equipment be installed at the site and that a modest-sized open area excavation take place. All the excavated soil should be processed through fine meshed sieves (1mm. at least) and bones examined in more detail in a post-excavation phase. Further small samples should be collected for detailed laboratory analysis of very small bones and other remains as necessary.

In addition substantial quantities of sediment devoid of obvious archaeological material from or near the site should also be processed in order to establish the kinds of fish, molluscan and other biological materials naturally present in the deposits.

c) Mammal, bird and amphibian bones by Dr Rosemary Luff

Bones collected by hand from the section and retrieved by sieving soil samples were received for examination. The distribution of taxa within the three layers sampled is summarised in Table 4.

	3	4	5
Sheep/goat	+	+	+
Small ungulate (?sheep/goat)	+	+	+
Cattle	+	+	-
Large ungulate (?cattle)	-	+	-
Pig	-	+	-
Common shrew	-	+	+
Field vole	-	+	+
Water vole	-	+	-
Wood mouse	-	-	+
Domestic chicken	+	+	-
Dunlin	+	-	-
Frog/toad	-	+	-

Table 4 : Bones of mammals, birds and amphibians from layers 3, 4 and 5 (summary)

Layer 3

The bone consists mainly of sheep/goat and small ungulate fragments (70 bones and 8 teeth), together with two domestic chicken bones, a dunlin bone and an upper cow molar. A horn-core was positively identified as sheep. Most of the bones of the skeleton are represented and some illustrate butchery marks (knife-cuts on a small ungulate rib and long-bone fragment). Eighteen fragments are unidentifiable and one had been burnt black.

The dunlin, Calidris alpina, is the most numerous of the small sandpipers. It nests on moors and marshes, and outside the breeding season is found in flocks along seashores and on mudflats of fresh or salt water.

Layer 4

Sheep/goat bones predominate in this layer (328 bones and 7 teeth), followed by cow and large ungulate (15 bones and 3 teeth), domestic chicken (1 bone) and young pig (1 deciduous incisor). One hundred and twelve fragments could

not be identified. Skull and horn-core fragments suggest that the sheep/goat remains are mainly sheep.

Five animals are represented by the sheep/goat remains which exhibit butchery marks and had been partially consumed by dogs. Most of the animals were circa two years old, having been slaughtered at the time of prime meat consumption although an unfused (proximal and distal) metacarpal revealed a foetal individual. A possible genetic defect was shown by a sheep mandible which had the third premolar rotated through a right angle and a congenital loss of the second premolar. A few small unidentifiable fragments had been burnt black.

Layer 5

This layer produced very little bone (48 bones and 2 teeth). Eight bone fragments and two teeth were assigned to small ungulate, while twenty-eight fragments could not be identified. One fragment was burnt a greyish-blue colour.

Discussion

The assemblages from these layers consist mainly of food refuse. Sheep/goat bones predominate, especially in layer 4. [Comment by P.M.: It is known that by the 11th century A.D. the Essex marshes were used extensively as sheep pasture. The predominance of sheep/goat bones in these Roman and medieval layers could suggest that this type of land-use had its origins in the Roman period, if not before, but clearly it will be necessary to obtain larger bone assemblages from the site before this can be established with any confidence.]

There is also a natural component, as shown by the following partial skeletons of small mammals and amphibians:

Layer 5 (sample a) Wood mouse (Apodemus sylvaticus)
Common shrew (Sorex araneus)
Field vole (Microtus agrestis)

Layer 4 (sample b) Common shrew (Sorex araneus)
Field vole (Microtus agrestis)
Water vole (Arvicola terrestris)
Frog/toad

All these small mammals are distributed fairly widely throughout Britain. The voles and shrews are extremely territorial and this, taken with the fact

that the common shrew spends about three quarters of its life underground, may suggest that the remains have accumulated as the prey of owls. A more detailed study will be necessary to determine this.

d) Diatom analysis by Steve Juggins

Samples for diatom analysis were obtained from the base of layer 5 and, by augering, from the underlying deposits. There was no diatom preservation at 100cm depth. Samples from 120 and 155cm produced sparse poorly-preserved diatoms. Hantzschia amphioxys and Navicula mutica, both common aerophilous or soil diatoms, predominated. These species were probably living in situ, indicating an environment not subject to continued inundation. A number of estuarine species (eg. Nitzschia navicularis and Melosira westii), present as single specimens, may have been deposited during periodic inundation by very high tides or transported and dumped together with the shells. No diatoms were preserved in the sample from 175cm.

(continued).

e) Carbonised cereals, seeds and other plant macrofossils (Table 5).

Layer 3. Samples from this layer produced from this layer produced charcoal, but very few carbonised seeds and no remains of cereals.

Layer 4. Occasional spikelet fragments of Triticum spelta, cereal culm fragments and poorly preserved grains probably of Avena sp. are associated in these samples with carbonised seeds and fruits of Atriplex sp(p), Malva sp, Plantago maritima, Scirpus cf. maritimus, Bromus mollis/secalinus, indeterminate Gramineae and unidentified stem fragments of monocotyledonous plants. Uncarbonised seeds of Sambucus nigra are also present and given the location of the site these are most unlikely to be contaminants.

Layer 5. Remains of cereals are much more common in samples from layer 5, particularly in sample 5c. Spikelet fragments of Triticum spelta predominate, Triticum dicoccum, Hordeum sp. and Avena sp. are also represented, but at much lower frequencies. Cereal grains are rare. Associated fruits and seeds of weeds and halophytes include Atriplex sp(p), Suaeda maritima, Rumex sp, Armeria/Limonium, Plantago maritima, Triglochin maritima, Bromus mollis/ secalinus and Gramineae. Monocotyledonous stem fragments and uncarbonised seeds of Sambucus nigra are again present.

Conclusions

The assemblages of carbonised plant remains from layers 4 and 5 are broadly similar in composition: in both layers there are mixed assemblages of cereal remains, mostly spelt spikelet fragments, with some arable weeds and seeds of halophytes. Interpreting these rather limited results is problematical. It is possible that these assemblages represent plants which were originally growing together, a situation which could have arisen only if some areas of the upper salt marsh were under cultivation. There is evidence from Holland and Germany that unprotected salt-marsh was cultivated by farmers inhabiting terp and wurt settlements (Körber-Grohne 1967; Van Zeist 1974; Behre 1976) but the crops grown in these areas were summer crops (Vicia faba, Hordeum vulgare, Avena sativa and Linum usitatissimum). Cultivation of autumn-sown crops in such marginal areas would have been hazardous because of the greater frequency of storms and associated salt-water flooding during winter (Van Zeist, ibid). In the samples from Canvey Island spelt is the main crop, and this cereal is generally assumed to have been autumn-sown. Moreover, no assemblages of straw-waste, which would definitely have established local cultivation, were recovered. Consequently it seems that these assemblages are unlikely to indicate that cereals were grown on the salt-marsh. They

Layer No.			3	3	4	4	4	5	5	5
Sample			b	c	a	b	c	a	b	c
Cereal indet	(caryopses)		-	-	3	-	-	1	-	23
	(caryopsis frags)		-	-	-	-	-	+	+	+
	('sprouts')		-	-	-	-	-	-	-	+
	(rachis fragments)	(a)	-	-	-	-	-	-	-	+
	(culm fragments)		-	-	+	-	-	-	-	-
Triticum spp	(caryopses)		-	-	-	-	-	3	1	27
	(spikelet forks/bases)	(b)	-	-	1	-	1	2	2	122
	(glume bases)	(b)	-	-	2	1	1	19	7	1338
	(rachis internodes)	(b)	-	-	-	-	1	4	1	179
	(rachis nodes)	(c)	-	-	-	-	-	-	-	4
	(awn fragments)		-	-	-	-	-	-	-	+
Hordeum sp	(caryopses)		-	-	-	-	-	-	1	2
	(rachis internodes)		-	-	-	-	-	1	-	9
	(awn fragments)		-	-	-	-	-	-	-	?
Avena sp	(caryopses)		-	-	-	7cf	-	-	-	-
	(awn fragments)		-	-	-	-	-	+	-	+
Avena/Bromus	(poorly preserved caryopses)		-	-	-	-	-	-	-	1
Bromus mollis/secalinus	(caryopses)		-	-	1fr	-	-	1	2	12
Gramineae indet	(caryopses)		1	1	-	2	3	2	1(k)	8
Atriplex sp(p)			-	-	1	33	-	-	-	2
Suaeda maritima (L) Dumort		(d)	-	-	-	-	-	-	-	1
Chenopodiaceae indet		(e)	-	-	-	6	-	-	-	1
Malva sp			-	-	1	7	-	-	-	-
cf. Polygonum aviculare agg			-	-	-	-	-	-	-	1
Rumex sp			-	-	1	-	-	-	-	12
Armeria/Limonium			-	-	-	-	-	3(i)	1(l)	3(l)

Plantago maritima L	(f)	-	-	-	1	-	5	7(j)	7
	(g)	-	-	-	1	-	9	3	12
Sambucus nigra L	(h)	-	-	1	5	4	1	-	-
Triglochin maritima L		-	-	-	-	-	-	-	5
Scirpus cf. maritimus L		-	-	-	1	-	-	-	-
Monot. stem fragments		-	-	-	+	-	+	+	+
Indeterminate stem fragments		-	-	-	-	-	-	+	-
Indeterminate (seeds etc)	(m)	-	1	6	-	1	22	20	38

Table 5 : Carbonised cereals, seeds etc. from layers 3, 4 and 5

Unless otherwise indicated taxa are represented by fruits or seeds.

Notes. a) In sample 5c these include a short section of immature rachis comprising 3 nodes and also a very abraded basal internode. (b) In all samples Triticum spelta is the predominant or only species present; in 5c there are a very few glume bases and spikelet forks of Triticum dicoccum. (c) These are poorly preserved. (d) Not definitely carbonised; possibly intrusive. (e) Testas missing or obscured. (f) Capsule lids, with or without seeds. (g) Seeds. (h) Non-carbonised seeds. (i) Seeds. (j) Including an intact capsule with part of perianth. (k) Very well-preserved caryopsis, c.1.7mm. long with a small basal median oval hilum and rows of rectangular cells on perianth. Puccinellia distans-type. (l) Seeds with traces of ribbed calyx adhering. (m) These are mostly elongate elliptical seeds or fruits, deformed and with surface detail poorly defined. Poorly carbonised seeds of Plantago maritima, Plumbaginaceae and Gramineae are probably represented.

are more plausibly interpreted as a mixture of crop-cleaning waste derived ultimately from agricultural settlements on slightly higher ground with remains of salt-marsh vegetation growing locally. This mixing could have occurred fortuitously in refuse fires or intentionally if crop-processing waste and salt marsh hay were mixed as animal fodder.

3) General conclusions

It is quite clear that these deposits are very heterogeneous in character and the taphonomy of the macrofossil assemblages which they contain is correspondingly complex. Although probably including some naturally-deposited sediment in situ the deposits appear to have largely been emplaced artificially to raise the marsh level. They incorporate food refuse and also some macrofossils re-deposited from natural assemblages. There also appears to have been some re-working of deposits. For example the coarse fractions of samples from layer 5 include up to 29% by weight of unabraded briquetage fragments, but in layers 4 and 3 the weight of briquetage decreases, and in layer 3 only a few small weathered fragments are present. This implies that briquetage fragments eroded out of layer 5 were subsequently re-incorporated into layers 3 and 4. No doubt bone and shell fragments from layer 5 were also weathered out and redeposited.

In view of the complexity of the site further work on the mollusca is not thought to be worthwhile. The fish and mammal remains, from layer 3 in particular, do require further attention and larger-scale bulk-sieving will be undertaken in 1987. The plant remains so far recovered are not of particular interest but further samples will be examined, in outline at least, to see whether any evidence for upper salt-marsh cultivation can be obtained.

Purfleet (Thames Site 2)

1) Stratigraphy

The sections and horizontal foreshore exposures visible below the sea-wall at this site show a sequence of predominantly mineral sediments, partly bedded, overlain by wood peats. A sample of wood from the base of the peat has been submitted for radiocarbon dating, but provisionally these deposits are thought probably to be related to the Thames II transgression, c.6500-5500bp. and the succeeding Tilbury III regression, c.5500-4000bp., spanning much of the Neolithic (Devoy 1977, 712-15). The stratigraphy and palaeoecology of these phases have been extensively studied by Devoy, in the Thames Estuary, and by Scaife (in Wilkinson, forthcoming) in the valley of the Mar Dyke. During the present preliminary investigation at Purfleet, therefore, palaeoecological studies have been largely confined to an assessment of some features associated with the ThII/TIII contact which have not been noted by earlier workers or were not present at their sites: in particular to a dry-land palaeosol developed on the presumed ThII sediments and covered by peats. Wood samples from the peat and underlying estuarine sediments and samples from a coarse detritus or drift mud (the 'leaf bed') have been examined, and samples for diatom analysis were also collected.

The deposits

Section 1

Immediately below the sea-wall there is a vertical section through a sequence of wood peats. The top of these peats is concealed beneath the sea-wall, but their base, where they overlie mineral sediments, is visible at the bottom of the section.

	Top surface at 0.00m. OD.
0-46cm.	Dark brown wood peat with some monocotyledonous plant remains; moderately distinct boundary.
46-77cm.	Brown, less woody peat; lower organic content than above; some monocot. plant remains; moderately distinct boundary.
77cm.+	Moderately firm grey silty clay; stoneless; in situ tree root systems penetrating from above.

The top surface shows in situ root systems and fallen trunks, with very rare heat-shattered flints (only 1 or 2 noted).

Section 2

On the lower shore, exposed as a near-horizontal surface, there is a thin reddened horizon containing mollusca, overlying clays and sandy silts. This is interpreted as an immature soil profile dating from the early stages of

the Tilbury III regression which formed on emergent tidal flats deposited in the Thames II transgression. Tree roots penetrating this surface show that it was originally overlain by the peats observed in section 1, though these have now been eroded away at this point.

	Top surface at -1.94m. OD.
0-2cm.	Reddened slightly firm clay; woody roots; almost stoneless but very rare small chalk pebbles; mollusc shells locally common (Cepaea, Clausilia, Discus, Zonitidae noted); narrow boundary.
2-13cm.	Grey clay with some woody roots; rare mollusc shells; narrow boundary, undulating over 2cm.
14-30cm.	Grey silty fine sand; some woody roots.

2) Mollusca and other macrofossils from section 2

A short column sample was collected from the top 28cm. of this section and mollusc shells were extracted from subsamples of this column using the methods described by Evans (1972, 44). Shells extracted are listed in Table 6.

Ecological information in the following discussion comes from Evans (1972) and Kerney and Cameron (1979). Apart from a few burrowing amphipods, juvenile barnacles and an abraded fragment of bivalve shell (probably Cerastoderma) from the top 2cm. of the section there is no evidence for contamination resulting from burrowing by modern intertidal organisms: annelids, elsewhere common in unsealed deposits exposed in the intertidal zone, were absent. It appears that these exposures are eroding rapidly, allowing little opportunity for extensive burrowing to occur.

The mollusc assemblages present establish several points about the palaeo-ecology of the site:

a) There is a strong positive gradient of shells within the top part of this palaeosol, ranging from about 156 shells/kg. in the top 2cm, through about 82 shells/kg. at 2-7cm. to under 5 shells/kg. at 7-23cm, though at 23-28cm. the shell concentration increases to about 26 shells/kg. However, there is no very marked change in the composition of the assemblages with depth: woodland snails predominate throughout. The most abundant taxa are Carychium tridentatum, Discus rotundatus and the Zonitidae (Vitrea crystallina, Vitrea contracta, Nesovitrea hammonis, Aegopinella pura, Aegopinella cf. nitidula and Oxychilus sp(p)). Other taxa characteristic of shaded conditions in these samples include Lauria cylindracea, Acanthinula aculeata, Clausilia bidentata, Cochlodina laminata

Depth (cm)		0-2	2-7	7-13	13-18	18-23	23-28
Bithynia sp	(a)	2	-	-	-	-	-
Lymnaea truncatula (Müller)		-	2	-	-	-	-
Succinea/Oxyloma sp	(b)	1	-	-	-	-	-
Carychium tridentatum (Risso)		34	11	-	-	-	-
Carychium sp	(b)	25	3	-	-	-	-
Cochlicopa spp		18	18	-	-	2	4
Lauria cylindracea (da Costa)		2	-	-	-	-	-
Acanthinula aculeata (Müller)		11	7	-	-	-	-
Punctum pygmaeum (Draparnaud)		4	2	-	-	-	-
Discus rotundatus (Müller)		62	17	1	1	1	11
Vitrea spp	(c)	52	19	-	1	-	1
Nesovitrea hammonis (Ström)		1	1	-	-	-	-
Aegopinella spp	(d)	17	3	-	-	-	-
Oxychilus spp		22	3	-	-	-	-
Zonitidae indet	(b)	36	12	1	1	2	9
Limacidae indet		5	7	-	-	-	-
Cochlodina laminata (Montagu)		1	-	-	-	-	-
Clausilia bidentata (Ström)		-	1	-	-	-	-
Clausiliidae indet	(b)	2	1	-	-	-	-
Trichia sp(p)	(b)	11	4	-	-	-	1cf
Cepaea/Arianta		6	3	-	-	-	-
Sample wt (kg)		2	1.4	1.4	1.4	1.1	1.0

Table 6 : Mollusca from section 2

Notes. (a) Opercula. (b) Abraded and/or very small apical fragments. (c) Including V.crystallina and V.contracta. (d) Including A.pura and A. cf. nitidula.

All samples included woody roots penetrating from the peat originally overlying the palaeosol and there were occasional fruitstones of Rubus fruticosus and nutlets of Carex sp. The sample from the top 2cm. included a few burrowing amphipods, juvenile barnacles and an abraded fragment of ?Cerastoderma shell.

and Punctum pygmaeum. In total, woodland taxa account for 86% and 70% of the assemblages at 0-2 and 2-7cm. respectively, the remainder of the assemblages consisting mostly of the catholic terrestrial taxa Cochlicopa spp, Arianta/Cepaea spp, Trichia sp. and Limacidae: catholic taxa are slightly more common at 2-7cm. than at 0-2cm.

The absence of mollusca associated with the herbaceous and scrub vegetation which presumably colonised the emergent tidal flats of the Thames II transgression prior to woodland development is thought to indicate that conditions were then not suitable for shell preservation. It may be suggested that during the early stages of the regression former intertidal sediments would have been subject to intensive leaching by rainwater. Any shells present would probably have been destroyed, and a non-calcareous base-poor immature soil would ultimately have developed. With the growth of forest, deeply-penetrating roots would have absorbed nutrients leached down, and these would ultimately have been re-deposited on the soil surface as litter (Curtis et al 1976, 25-6) thus increasing the base content of surface levels and permitting shell preservation. The absence, however, of certain thin-shelled taxa in these samples (Cecilioides acicula, Vitrina pellucida) may imply that there has been partial destruction of shell.

b) Almost all the molluscs from this section are of terrestrial taxa, though there are a few shells of the marsh and 'freshwater slum' taxa Lymnaea truncatula and Succinea/Oxyloma and two small opercula of a freshwater mollusc, Bithynia sp. These appear to indicate that these low-lying woods on the former valley slopes might have been subject to very occasional freshwater flooding, but were for the most part relatively dry.

c) Despite the presence of neolithic axes and flints found loose in the vicinity or stratified in this profile and equivalent deposits there is no evidence at all for woodland clearance. No charcoal fragments were seen on the exposed surface or in the samples. Mollusc species commonly associated with woodland clearance phases (eg. Pomatias elegans) were not observed in the samples examined, and species characteristic of open habitats are completely absent.

* Insert.

4) The 'leaf-bed'

This deposit, exposed on the lower shore, is a coarse detritus mud or drift mud consisting of a grey clay matrix with abundant twigs, leaves and other plant material. Its upper surviving surface is at -1.65m. OD but its

* Insert.

3) Diatoms from section 2 by Steve Juggins

Samples were collected at 2, 5, 15 and 30cms from the top of the surviving surface. Preservation was poor and diatoms were sparse, hence detailed counts have not been made.

2cm	No diatom preservation.
5cm	An assemblage dominated by the robust subtidal taxon Paralia sulcata which is clearly allochthonous, together with a number of estuarine epiphytic taxa (eg. Achnanthes hauckiana, Grammatophora oceanica and Achnanthes brevipes). The dominance of these taxa, together with estuarine sediment - inhabiting species demonstrates that these are undoubtedly brackish water deposits. The absence of fresh or fresh-brackish water forms suggests a relatively high salinity.
15cm	No diatom preservation.
30cm	A very badly preserved assemblage dominated by robust marine and brackish water forms (eg. Paralia sulcata and Nitzschia navicularis).

Plant macrofossils

Twigs, bark fragments
Buds/budscales
Catkins/catkin bracts
Leaves and leaf fragments (Corylus, Quercus)
Monocotyledonous stem fragments
Fruits, seeds etc. of Ranunculus acris/repens/bulbosus, Caltha palustris L, Tilia sp, Alnus glutinosa (L) Gaertner (common), Corylus avellana L, Lycopus europaeus L, Carex sp.
Mosses, including large wefts of Anomodon viticulosus (Hedw) Hook and Tayl. (a)

Animal macrofossils

Mollusca, including juvenile Sphaeriacea (common), Valvata cf. piscinalis (Müller), Bithynia sp (operculum), Lymnaea truncatula (Müller) (common), Carychium tridentatum (Risso), Succineidae, Vertigo pusilla (Müller), Discus rotundatus (Müller), Aegopinella pura (Alder), Clausiliidae and Trichia sp.
Ostracods
Insects
Fragment of fish-scale
Proximal femur of wild ox, Bos primigenius. Butchery is evinced by knife marks on the proximal, anterior and posterior surfaces. The head is stained green by algae (b).

Table 7 : Some macrofossils from the 'leaf-bed'

Notes. (a) Kindly identified by Dr Allan Hall, who comments (in litt): "These are the largest fossil specimens I've seen of Anomodon viticulosus. Smith (1978) says A.viticulosus can reach 12cm. He describes it as growing on "tree bases and trunks" and states that it is 'generally distributed, common and sometimes locally abundant in basic habitats at low altitudes'. Watson (1968) is emphatic about its calcicole habitat preferences".
(b) Identified by Dr Rosemary Luff.

stratigraphic relationship to the palaeosol of section 2 is obscured by deep deposits of recent intertidal mud. Macrofossils collected by hand and noted during a superficial examination of a 1kg. sample are listed in Table 7.

From this outline study it appears that this deposit accumulated in a tranquil sedimentary environment, within a wooded catchment. Plant material from wet valley floor woods (including abundant alder fruits) and also probably from drier woodland on higher ground (including macrofossils of hazel, oak and lime) is represented. Large masses of the calcicole moss Anomodon viticulosus suggest that plant material from the adjacent chalk anticline was incorporated into the deposit. In the sample examined no macrofossils of estuarine taxa were identified: the mollusca, for example, are all terrestrial (mainly woodland) and freshwater species. This implies deposition in a freshwater environment, perhaps a backswamp of the Mar Dyke relating to the Tilbury III regression. The deposit could, therefore, be penecontemporaneous with the palaeosol.

5) Wood

Samples were collected from drifted trunks in the presumed estuarine sediments exposed on the lower shore and from fallen trunks, more or less in situ, on the exposed upper surface of the peat in section 1, in order to establish the general types of woodland represented. The taxa identified are listed in Table 8.

	Estuarine sediments	Peat
Taxus sp	-	3+1cf
Ilex sp	-	1
Ulmus sp	3	3
Alnus sp	2	5
Corylus sp	3	-
Alnus/Corylus sp	1	-
Populus sp	1cf	-
Fraxinus sp	1	6
Total	11	19

Table 8 : Wood identifications from site 2.

The samples from the upper surface of the peat are predominantly of ash (Fraxinus sp) and alder (Alnus sp) with some yew (Taxus sp), elm (Ulmus sp) and holly (Ilex sp). The range of trees present is extremely similar to that in the lower peat bed at Crossness, recorded by Spurrell (1889, 219),

in which ash and alder predominated, with some yew. Yew, though not nowadays found as a natural component of fen woods, has commonly been reported from wood peats (Godwin 1975, 175) though it appears that this species does not flourish in very poorly-drained soils. Ash is characteristic of the later stages of woodland succession following calcareous fen (Godwin, ibid, 310). The abundance of ash and yew and the presence of elm and holly, taxa generally not found on wet soils, implies that the remains of trees from the top of the peat represent comparatively dry fen woods.

The remains of trees from the estuarine sediments include elm, alder, hazel (Corylus sp), ash and possibly poplar (Populus sp). These are all drifted trunks, some with root systems still attached, and are probably derived from several types of woodland.

6) General conclusions

The preliminary studies so far undertaken provide a basis for the following reconstruction of events:

a) There was an initial phase of mineral sedimentation probably in an estuarine environment and perhaps related to the Thames II transgression of c.6500-5500bp. Drifted tree trunks from woodland further upstream accumulated at the site.

b) During a regression phase, perhaps the Tilbury III regression of c.5500-4000bp., former tidal flats were exposed to subaerial weathering and leaching. A soil formed on these sediments and ultimately woodland developed. Initially soil conditions were well-drained. Neolithic artefacts indicate some activity in this woodland but there was no woodland clearance at this site. Freshwater drift muds accumulating within a wooded catchment may have formed in a backswamp of the Mar Dyke. These appear to be penecontemporaneous with the dry woodland.

c) Conditions subsequently became wetter and at least 77cm. of wood peat formed above the soil and freshwater sediments. In the later phases of valley woodland development ash, alder and yew were the dominant trees.

Further and more detailed work on diatoms, soil studies and palynology is clearly required at this site.

The Roach Estuary

The lower Roach estuary is almost completely embanked and consequently inaccessible for survey. Sections at the edge of the salt-marsh on both banks of the river upstream from Paglesham were examined but most of these sections are less than about 1m. deep. Only in the vicinity of Bartonhall Creek are there deeper sections showing a complete sequence of Holocene sediments overlying the pre-transgression land surface, which here was formed on a firm fine sandy silt 'head'. The deepest section, context 2, close to the head of Bartonhall Creek was recorded in detail.

1) Stratigraphy

The sequence in context 2 is as follows:

0-20cm	Moderately firm pinkish-grey clay; abundant roots; merging boundary.
20-45cm	Moderately firm grey clay; abundant large red and reddish-brown mottles; roots; merging boundary.
45-60cm	Soft grey clay; small distinct black mottles.
(60-c.90cm)	Section undercut by erosion and obscured by slumping.
c.90-100cm	Brown clayey humified peat; fine fibrous plant material; some recent annelid borings; sharp boundary.
100-120cm	Moderately firm grey clay; weakly developed blocky structure; small black mottles; fine black rootlets; merging boundary.
120-160cm	Moderately firm grey clay; small black and large yellowish-brown mottles.
(160-c.210cm)	Section obscured by slumping.
c.210-220cm	Greyish-brown organic clay; fine fibrous plant material and some monocot. leaf fragments; fairly sharp boundary.
220-225cm	Moderately firm grey clay; small black mottles; fine rootlets; sharp boundary.
225cm+	Very firm light grey fine sandy silt; reddish-yellow mottles.

Gravel observed at depth of 280cm.

Above each of the biogenic layers the overlying sediments have been eroded heavily, exposing the biogenic deposits as a horizontal bench, subject to burrowing. These surfaces have been partly buried by slumped material. It was not possible to cut the section back far enough to see complete undisturbed sections.

2) Dating

Samples were collected from the biogenic deposits at 90-100cm. and 210-220cm. for radiocarbon dating. Samples entirely free from recent burrows could not be obtained, but it is not thought that recent contamination will have a significant effect on the results.

3) % dry weight and % loss on ignition

Determinations were made on samples from the two biogenic deposits and underlying clays. The following results were obtained.

Depth (cm)	% dry weight	% loss on ignition
90	33.0	30.6
95	43.5	22.5
100	55.0	11.0
105	66.5	4.1
110	66.4	5.0
120	66.5	5.1
210	46.0	14.2
215	52.1	13.1
220	65.7	4.9
225	77.3	2.4
230	85.2	1.6

4) Plant macrofossils

Four 0.5kg. samples from 90-95, 95-100, 210-215 and 215-220cm. were examined in outline to establish the general characteristics of plant macrofossil assemblages from the two biogenic layers. Since these deposits were not well sealed in the exposures available there is a possibility that some recent plant material from adjacent salt-marsh vegetation might have been introduced by burrowing organisms, and for this reason full quantitative analysis was not undertaken.

The samples from between 210 and 220cm. produced abundant seeds of Salicornia sp, some fruits and seeds of other halophytes (Triglochin maritima, Suaeda maritima) and occasional macrofossils of terrestrial and freshwater aquatic plants including Ranunculus acris/repens/bulbosus, Chenopodium sp, Rubus fruticosus, Urtica dioica, Mentha sp, Sambucus nigra and Cirsium/Carduus sp. Seeds of Juncus spp. were also common, and both samples included woody twigs and stem fragments of monocotyledonous plants. A small charcoal fragment came from the upper sample. Foraminifera were very common and occasional insect remains were noted. This lower biogenic deposit appears to be an estuarine sediment incorporating some terrigenous plant material.

The assemblages of plant macrofossils from the samples at 90-100cm. are much sparser, and many of the fruits and seeds present are very poorly preserved: most cannot be closely identified. Taxa present include Ranunculus subg. Batrachium, indeterminate Chenopodiaceae (cf. Atriplex), Salicornia sp, Mentha arvensis/aquatica, Plantago major, Sambucus nigra, Alismataceae, Eleocharis sp. and Juncus sp. No foraminifera were observed but insect and cladoceran remains are present. Salicornia is represented by only a very few seeds, and the limited assemblages recovered are dominated by terrestrial and freshwater taxa. It may be suggested, very tentatively, that a phase of freshwater sedimentation is represented. The poor preservation of the macrofossils could perhaps indicate a phase of drying and subsequent humification.

(continued)

5) Diatom analysis by Steve Juggins

Diatoms were relatively sparse and often poorly preserved. Full counts have not been made, but a subjective 'zoning' of the samples was undertaken.

20,40,50 and 60cm.	The assemblages are dominated by Scoliopleura tumida, Caloneis westii and Diploneis spp, indicating an intertidal mudflat environment.
90,95 and 100cm.	The main taxon is Navicula pusilla with Hantzschia amphioxys, Pinnularia sp and Navicula peregrina. N. pusilla is a fresh-brackish water taxon but is also common in aerophilous or terrestrial habitats. The assemblage seems to indicate slightly brackish shallow water conditions - possibly only temporarily inundated. (If these sediments were accumulating in fresh/slightly brackish backswamps, as in the Crouch 'Upper Peat' one would expect a wider range of taxa to be present).
105,110,140cm.	No diatom preservation.
210,215 and 220cm.	Assemblages dominated by Caloneis westii and Diploneis spp, intertidal mudflat species. The increased percentage of Diploneis interrupta at 220 and 215cm could possibly reflect the higher organic content of the sediments and deposition in backswamps transitional to intertidal flats at 210cm. Interpretation of these assemblages is difficult but the sediments were definitely not formed in freshwater.
225cm.	No diatom preservation.

6) Preliminary conclusions

The sedimentary sequence in this part of the Roach estuary resembles that of the Crouch Estuary: the two clayey biogenic deposits at 90-100cm and 210-220cm seem stratigraphically equivalent to the Upper and Lower freshwater peats recorded at sites 4,8 and 9 in the Crouch. However these sediments in the Roach differ from the Crouch peats both lithologically and in terms of their biota. The maximum % loss on ignition for the upper deposit is only 30.6% and for the lower deposit 14.2%. Although in field descriptions these deposits have been loosely described as 'peats' they are more strictly speaking detritus muds formed apparently in fairly shallow water. Plant

macrofossils and diatoms indicate that the lower deposit is an estuarine sediment, whilst the upper deposit seems to have formed fresh/slightly brackish water conditions possibly subject to periodic drying. Whether these two biogenic deposits are contemporary with the two Crouch freshwater peats will be determined by the radiocarbon dates, but, if so, it appears that the Lower Peat 'regression' of the Crouch was not of sufficient magnitude for freshwater conditions to be established in the Roach.

The Blackwater Estuary

Site 18

Wooden structures exposed in plan on the foreshore were re-examined.

Context 86

This brushwood structure was planned in 1985 and a radiocarbon date of 2790 ± 80bp, or 840bc. (HAR-7055) was obtained subsequently. Over the winter of 1985/6 there had obviously been considerable erosion for when re-examined in 1986 the structure had lost its peripheral elements and the main mass of brushwood stood isolated on a low pedestal of grey estuarine clay. Wood samples were collected for identification and recording before the structure was completely destroyed by erosion.

Systematic sampling of this rather haphazard structure, composed in part of small twiggy brushwood, was difficult. However samples were taken from stems with coppice heels (86a and b) and transversely cut ends (86c,d and e) from the few underlying lateral stems and from a representative selection of other stems.

Immediately to the north of 86 a second similar mass of brushwood has been partly exposed by erosion since 1985. This will require re-examination in 1987.

Context 89

This complex of structures collectively numbered 89 comprises an apparent wattle fence, several vertical posts and a possible hurdle structure, none of which is very well exposed at present. The structures have not yet been recorded in detail. However some elements of the hurdle structure, including one cut end and two coppice heel bases (89 a,b,c) were removed for recording and identification since they were unlikely to survive erosion over another winter.

Some difficulties were experienced in identifying these wood samples since the woody tissue itself was rather soft and the stems had hard coatings of iron compounds which also filled cracks and some of the vessels. It was therefore difficult to obtain clear sections. Prolonged storage in methanol frequently hardens wood samples and for this reason the samples from 86 and 89 will be left, for the time being, in methanol in the hope of making them more suitable for identification.

Site 28

a) Stratigraphy

The wooden structures at site 28 are exposed in plan, their sedimentary cover having been removed by erosion, apparently of quite recent date. Establishing their stratigraphic context in relation to the sedimentary column and to extinct creek channels incised into the post-transgression sediments is therefore difficult. However at at least two locations some sediments adjacent to structures do survive. These have been recorded and investigated primarily in an attempt to relate phases of human activity to the sedimentary sequence.

Section 1

This was recorded from a small residual patch of eroded salt-marsh adjacent to context 98. This has been colonised by Spartina, with roots and rhizomes penetrating deeply. However by cutting back its edge a clean section was obtained, showing almost 80cm. of clays sealing the clayey biogenic deposit described in earlier reports as the 'Lower Peat'. Samples were collected for analysis of diatoms and macrofossils, partly to check that these sediments formed in similar conditions to those at sites 3 and 18 (described in the 1985 interim report) but more importantly in the hope of detecting any signs of human activity. The section is as follows:

Surviving surface at +0.82m. OD.

0-9cm	Soft reddish clay with abundant Spartina rhizomes; sharp boundary.
9-48cm	Soft grey clay; some Spartina roots + rhizomes; small black mottles; merging boundary.
48-76cm	Similar but with larger, more prominent black mottles; merging boundary.
76-83cm	Similar but with fragments of eroded peaty clay; matrix slightly lighter grey clay, moderately sharp boundary.
83-105cm	Soft brown peaty clay; sharp boundary.
105cm+	Pale grey slightly firm silty clay loam; rare flint pebbles ("head").

Plant macrofossils

Results of macrofossil analysis on samples below 71cm. are given in Table 9.

The assemblages from these samples are all dominated by seeds of halophytes. Below 93cm. Juncus seeds, mainly of Juncus gerardii, are extremely abundant

Depth (cm)	71-76	76-83	83-93	93-98	98-105
Ranunculus sceleratus L	-	-	-	1	-
Spergularia sp(p) (a)	1cf	1cf	-	-	-
Suaeda maritima (L) Dumort	41+fr	6+fr	2	5	-
Salicornia sp	168	411	52	4	-
Chenopodiaceae indet. (b)	3	1	1	-	-
Armeria/Limonium (c)	1	-	3	-	-
Glaux maritima L	-	-	1	-	-
Mentha arvensis/aquatica	-	-	-	1	-
Plantago maritima L (d)	-	1	1cf	-	-
Sambucus nigra L	1fr	-	-	-	1fr
Aster tripolium L	2	-	-	1	-
Sonchus asper (L) Hill	-	1	-	-	-
Triglochin maritima L	2	12	35	11	-
Juncus spp (e)	(50)	(80)	(640)	(3490)	(3100)
Carex sp	-	-	1	-	-
Puccinellia cf. distans (Jacq) Parl	-	-	1	-	-
Gramineae indet	1	-	1	1	-
Indeterminate seeds etc	1	-	3	1	-
Woody rootlets	+	+	+	+	-
Monocot. stem fragments	+	+	+	+	+
Charcoal fragments	+	-	+	-	++
Iron-replaced rootlets	-	+	+	+	++
Foraminifera	+	+	+	+	+
Insects	+	+	+	+	+
Sample wt (kg)	0.4	0.5	0.5	0.5	0.5

Table 9 : Macrofossils from the lowest 34cm of sediment in section 1, Site 28

Unless otherwise indicated plant taxa are represented by fruits or seeds. Figures in brackets are estimates of seed counts per 0.5kg of sediment based on counts from sub-samples (50g sub-samples apart from 98-105cm, where a 125g sample was sorted).

Notes: (a) V. poorly preserved.
(b) Seeds without testas, or immature seeds.
(c) Badly degraded calyces.
(d) Capsule lids.
(e) All samples included a high proportion of poorly-preserved Juncus seeds in which the cell pattern of the testa is either totally or partly destroyed. Amongst the better-preserved seeds Juncus gerardii-type seeds predominate (see Körber-Grohne 1964 for details). Some of the J.gerardii-type seeds fall in the size range of J.compressus but it is unclear whether preservation conditions and treatment methods have effects on seed size. J.gerardii s.s. is certainly present and apparently predominant.

but seeds of other taxa are rare. In the sample from 83-93cm. Juncus seeds are less common but seeds and fruits of Salicornia sp, Triglochin maritima and other halophytes (Suaeda maritima, Armeria/Limonium, Glaux maritima, Puccinellia cf. distans) increase in frequency. Above 83cm, Salicornia sp. is by far the commonest taxon, though seeds of Suaeda maritima are fairly frequent in the topmost sample at 71-76cm. Salt-marsh taxa present in samples from nearer the base of the sequence persist, though Juncus seeds are rare in the samples from above 83cm. Fruits and seeds of terrestrial and wetland taxa occur sporadically: these include Ranunculus sceleratus, Mentha arvensis/aquatica, Sambucus nigra, Sonchus asper and Carex sp.

The assemblages fall into three main categories, which appear to represent vegetational changes associated with the transgression:

1) 93-105cm. The predominance of Juncus gerardii, a species of rush characteristic of salt-marshes at levels upwards from just below high water of spring tides (Clapham, Tutin and Warburg 1962) suggests that the lowest sediments at this site were formed in a high marsh environment. Seeds of taxa other than Juncus are either virtually absent (98-105cm) or rare and poorly preserved (93-98cm). This suggests that periodic drying resulted in the destruction of most plant macrofossils, apart from durable seeds such as Juncus spp.
2) 83-93cm. The sample from this level produced a more diverse assemblage of halophytes including species with habitat ranges extending from upper to lower salt marsh.
3) 71-83cm. The assemblages from the grey clay at this level are dominated by Salicornia sp, a characteristic plant of low salt marsh and intertidal mud flats.

In summary the macrofossils indicate a transition from higher salt marsh vegetation, through mixed salt-marsh communities to intertidal mud flats with Salicornia. The lowest sediments at site 3 in the Blackwater Estuary, although again representing a transgressive sequence, did not produce macrofossil assemblages characteristic of the highest zone of salt marsh (Wilkinson and Murphy 1985, 44-59): Salicornia is common from the very base of the sequence at this site. One possible explanation for this difference is that there were variations in the rate of the transgression. It could be suggested that at site 3 lower salt-marsh and mud-flat habitats were established quite rapidly, whereas site 28 lay at the estuary margin for a long enough period for high salt-marsh vegetation to become established. Variations in the levels of the two sites could also be relevant: the 'head' surface at site 3 is at about -1.12m. OD, but at site 28 it is at about

-0.23m. OD. It is possible that there was penecontemporaneous deposition of low and high salt marsh sediments at the two sites.

Whatever the reasons for this difference between sites in the Blackwater Estuary it does seem that the lowest sediments at site 28 were formed on the highest zone of salt-marsh, a semi-terrestrial habitat lying roughly between MHWS and storm-flood level, and inundated comparatively rarely. The abundance of small rootlets replaced by iron compounds in these lowest sediments indicates that there was some translocation and reprecipitation of iron in the partly-dried sediments. This comparatively dry marsh surface would have been suitable for human use and the charcoal fragments from the sample at 98-105cm. certainly imply some nearby human activity. The absence of dateable material makes it difficult to correlate this phase with any of the structures at the site.

Section 2

The wooden structure 96 was recorded in some detail in 1985, but its stratigraphic position had not been established. By means of a transect of auger probes it was established that this structure lies within an infilled creek roughly at its deepest point, where the creek muds would have been at their most unconsolidated . An auger hole directly adjacent to 96 (Section 2) showed the following sequence:

0-40cm. Very soft grey clay with black mottles (top 20cm. too unconsolidated to be retained in the chamber); merging boundary.

40-50cm. Very soft pale greyish-brown clay.

Soft sediments continued to a depth of 90cm. Samples for diatom analysis were collected from between 20 and 50cm. depth.

* insert.

b) Charcoal scatters

A 1.6kg. sample from 125, a dense charcoal spread at the western end of the site and a 3kg. sample from 142, a more diffuse scatter on the head surface near the excavated area, were examined. The aim was to establish whether these deposits are of sufficient interest to justify more detailed and extensive sampling. 125 produced large quantities of oak (Quercus sp) charcoal with one 10mm. twig probably of gorse or broom (Ulex/Sarothamnus). Several poorly preserved carbonised seeds including seeds of Sambucus nigra and Solanum nigrum were also recovered. 142 contained only small, unidentified charcoal fragments. The results from these two small samples do not suggest that it will be possible to interpret these deposits in terms of activities and further work is probably not worthwhile.

* insert.

Diatom analysis by Steve Juggins

Samples collected from sections 1 and 2 were examined.

Section 1

30cm.	No diatom preservation.
60,80,90 and 95cm.	Assemblages dominated by Caloneis westii with Scoliopleura tumida and Diploneis spp. indicate deposition on an intertidal mudflat.
100cm.	In this sample the predominant species are Diploneis interrupta and Navicula peregrina with reduced numbers of Caloneis westii. A brackish water backswamp or salt-marsh environment is indicated.

The sequence of backswamp/salt-marsh to intertidal mudflat deposits recorded here appears to be analogous to that recorded at Blackwater Site 3.

Section 2

25cm.	No diatom preservation.
50cm.	The assemblage is dominated by Nitzschia navicularis and Paralia sulcata. The numerical dominance of these two robust forms over a large number of more fragile, but nevertheless well preserved, sediment-inhabiting species suggests that most of the assemblage is allochthonous, though clearly deposited in an estuarine environment.

c) Samples from the excavated area

During the 1986 season excavation of an area 10x5m. within the spread of neolithic occupation debris at site 28 provided the first opportunity in this project for extensive sampling at a settlement site. Since this was originally a dry land site there is no preservation of organic materials by waterlogging, and soil pH is low enough to destroy unburnt bone, molluscs and other calcareous macrofossils: only charcoal, carbonised cereals and seeds and burnt bone fragments are preserved. Nevertheless the site has not been subject to prolonged subaerial weathering or to human disturbance and thus gives a chance to examine the distribution of carbonised plant macrofossils within the neolithic soil and underlying features, in a situation where the possibility of contamination by more recent carbonised plant remains can be entirely discounted. However, sampling an intertidal site of this type on a large scale and dealing with the samples collected present some new technical difficulties. In this section these technical aspects will be considered and an assessment will be made of the best method of processing the samples.

The site was excavated by successively removing thin spits of soil by trowelling. Samples were collected from each metre square at two levels (once recent unconsolidated mud had been removed) giving a total of 100 samples from the neolithic soil with additional samples from post-holes and other features. It would have been simplest to process these samples on site but experimental wet-sieving in an adjacent creek was unsuccessful due to difficulties of disaggregating the waterlogged heavy clay loam matrix of the samples. This meant that most samples had to be carried from the site across an extensive intertidal mudflat, though a boat was used to transport some of them. In these circumstances collection of very large samples was out of the question: bags of soil containing 5-7kg. of wet soil were taken.

Having transported the samples to the store assessment of the best processing technique was necessary. A technique which effectively disaggregated the matrix without excessively damaging the carbonised plant remains was required. To determine the best method six replicate samples were collected from grid square 101 (Samples A-F) and each was processed by a different method, as follows:

101A. 5kg. sample (wet weight). Sample processed wet. Vigorous manual disaggregation in cold water. Washover and wet-sieving using 0.5mm. meshes throughout. Processing time 20 mins.

101B. 5kg. sample (wet weight). Sample processed wet. Disaggregation attempted by soaking in hot water. After 24 hours still not

completely disaggregated. Broken down completely by manual disaggregation. Wash-over and wet-sieving. Processing time 10 mins.

101C. 5kg. sample (wet weight). Sample processed wet. Disaggregation attempted by soaking in hot solution of Calgon. Incompletely disaggregated after 19 hours; broken down completely by manual disaggregation. Wash-over and wet-sieving. Processing time 10 mins.

101D. 5kg. sample (wet weight). Sample air-dried (dry weight 3.8kg). Sample broken up into c.5cm. lumps, disaggregated by soaking in cold water. Time for disaggregation 45 mins. Wash-over and wet-sieving. Processing time 6 mins.

101E. 5kg. sample (wet weight). Sample air-dried (dry weight not recorded). Sample broken up into c.5cm. lumps, disaggregated by soaking in hot water. Time for disaggregation 1 hour. Wash-over and wet-sieving. Processing time 6 mins.

101F. 5kg. sample (wet weight). Sample air-dried (dry weight not recorded). Sample broken into c.5cm. lumps, disaggregated by soaking in hot solution of Calgon. Time for disaggregation c.50 mins. Wash-over and wet-sieving. Processing time 6 mins.

Carbonised plant remains recovered from the six samples using these techniques are listed in Table . The results are remarkably consistent and there is no reason to think that any of the methods used is markedly more destructive than the others. This is surprising since it had been anticipated that manual disaggregation in particular would have crushed a large proportion of the seeds and charcoal fragments. Selecting a suitable technique for processing the remaining samples from the site can therefore be based on criteria of convenience and rapidity. On these grounds the methods used for samples 101D and 101E seem best: air-drying, soaking in hot or cold water (without Calgon, which does not seem to accelerate disaggregation) followed by washover and wet-sieving with 0.5mm. meshes.

The results from these six samples are very encouraging: from 30kg. of soil 55 cereal grains and 7 cereal spikelet fragments besides some culm fragments, hazel nutshells and a Vicia/Lathyrus cotyledon were recovered. The only cereal identified so far is emmer, Triticum dicoccum. In terms of neolithic sites generally this is a respectably sized assemblage. If the remaining samples produce comparable quantities of material an unusually large collection of neolithic cereals should be obtained, and there is a prospect of reconstructing the types of activity which resulted in their deposition. It is hoped that it will be possible to process all the samples collected and to make at least a preliminary assessment of the plant remains present before excavation continues in 1987.

		101A	101B	101C	101D	101E	101F
Cereal/grass	cb	-	-	-	-	4	-
Indeterminate cereal	ca.frags	+	+	+	+	+	+
	ca	3	3	6	4	4	5
Triticum dicoccum Schübl	ca	5	3	6	3	6	7
	gb	-	-	2	-	1	2
	spb	1	1	-	-	-	-
Vicia/Lathyrus sp	co	-	-	-	-	1	-
Corylus avellana L	ns.frags	+	-	+	+	+	+
Sambucus nigra L	s.uc	-	-	-	1	-	-
Indeterminate	s	-	-	1	1	-	-
Indeterminate	cat.frag	-	+	-	-	-	-
Charcoal fragments >2mm (g)		0.88	0.81	0.80	1.55	1.47	0.52
Sample wt (kg)		5	5	5	5	5	5

Table 10: Plant macrofossils from grid square 101

Abbreviations. ca - caryopses; cat - catkin; cb - culm base; co - cotyledon; frags - fragments; gb - glume base; ns - nut shell; s - seed; uc - uncarbonised.

References

Bateman, N. and Locker, A. (1982) The sauce of the Thames. London Archaeologist 4/8, 204-207.

Behre, K.E. (1976) Die Pflanzenreste aus der Frühgeschichtlichen Wurt Elizenhof. Bern/Frankfurt.

Clapham, A.R., Tutin, T.G. and Warburg, E.F. (1962) Flora of the British Isles (2nd edn). Cambridge University Press, London.

Curtis, L.F., Courtney, F.M. and Trudgill, S. (1976) Soils in the British Isles. Longman. London/New York.

Devoy, R.J.N. (1977) "Flandrian Sea-Level Changes in the Thames Estuary and the Implications for Land Subsidence in England and Wales" Nature 270 (1977), 712-715.

Evans, J.G. (1972) Land Snails in Archaeology. Seminar Press, London and New York.

Godwin, H. (1975) The History of the British Flora. Cambridge University Press, London.

Greensmith, J.T. and Tucker, E.V. (1969) "The origin of Holocene shell deposits in the chenier plain of Essex, England". Marine Geology 7, 403-25.

Jones, A.K.G. (1976) The fish remains. pp. 170-6. In Black, G., 'Excavations in the sub-vault of the Misericorde of Westminster Abbey'. Transactions of the London and Middlesex Archaeological Society 27, 135-78.

Jones, A.K.G. (1978) passim, pp. 171-2, 220, 414-8, 466-7, 601. In Bird, J., Graham, A.J., Sheldon, H. and Townend, P. (eds) 'Southwark excavations 1972-74. Parts I and II'. Southwark and Lambeth Archaeological Excavation Committee. Joint publication No. 1. London and Middlesex Archaeological Society and Surrey Archaeological Survey.

Jones, A.K.G. (1985) Fish bones from excavations in the cemetery of St. Mary Bishophill Junior, York. Ancient Monuments Laboratory Report No. 4601.

Kerney, M.P. and Cameron, R.A.D. (1979) A Field Guide to the Land Snails of Britain and North-West Europe. Collins, London.

Körber-Grohne, U. (1964) "Bestimmungsschlüssel für sub-fossile Juncus - Samen und Gramineen - Früchte" in Haarnagel, W. Probleme der Kustenforschung im Südlichen

Nordseegebiet 7, 32-47.

Korber-Grohne, U. (1967) Geobotanische Untersuchungen auf der Feddersen Wierde. Wiesbaden.

Scaife, R. in Wilkinson, T.J. (forthcoming) "Archaeology and Environment in South Essex: Rescue Archaeology along the Grays By-Pass 1979/1980". East Anglian Archaeology.

Spurrell, F.C.J. (1889) "On the estuary of the Thames and its alluvium". Proc.Geol.Soc. 11, 210-230.

Wilkinson, T.J. and Murphy, P. (1985) The Hullbridge Basin Survey 1985 Iterim Report No. 6. Essex County Council, Chelmsford.

Van Zeist, W. (1974) "Palaeobotanical Studies of settlement sites in the coastal area of the Netherlands". Palaeohistoria XVI.