ANCIENT MONUMENTS LABORATORY
REPORT

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TITLE Environmental Archaeology in East Anglia, 1977-1980

Captions to figures

Fig. 1 : Location of main sites mentioned in text.
B Barnham; BA Bergh Apton; BD Brandon; BH Broome Heath; BO Bowthorpe; BR Brancaster; C Caister; CH Chelmsford; CJ Chignall St James; CO Colchester; F Foulness; Fl Fingringhoe; GH Gallows Hill, Thetford; H Hunstanton; HM Hockham Mere; I Ipswich; IC Icklingham; KL King's Lynn; LC Little Cressingham; N Norwich; OB Old Buckenham Mere; R Risby; S Springfield; SH Spong Hill; SP Sea Palling; ST Stowmarket; T Thetford; W Witham; WE Weeting; WR West Row; WS West Stow; Y Yarmouth.

Fig. 2 : Some biological remains from the Hunstanton Iron Age settlement.
a. Upper part of cusp of shark tooth
b. *Chlamys* sp., *Cerastoderma* sp. (fragment)
c. *Truncatellina cylindrica*
d. *Hordeum* sp. (barley) rachis internode
e. *Triticum spelta* glume base
Scales: a,c,d,e 1mm b. 1 cm

Fig. 3 : Some Breckland mollusc assemblages (simplified histograms)
a. Barnham, Suffolk. Inner ditch, buried soil, 160-170 cm } Iron Age
b. Barnham, Suffolk. Outer ditch, buried soil, 155-165 cm }
c. Risby, Suffolk. Ditch, buried soil, 50-60 cm. } Bronze Age
d. Little Cressingham, Norfolk. Outer ditch, buried soil, 85-90 cm }
(on right) Shells of two common species: *Pupilla muscorum* and *Vallonia excentrica*, from Risby. 1mm scale.

Fig. 4 : Phytoliths from the Bowthorpe barrow (11431 CST)
a: 'Hats' b: Rectangular/Trapezoidal c: Elliptical d: Oblong e: Oblong, sinuous f: Wavey-edged costal rods g: Cross h: Simple and complex 'dumb-bells' i: Elongate, smooth j: Elongate, sinuous k: Elongate, spiny l: Elongate, concave end. m: Elongated, ornamented.

Fig. 5 : *Vicia faba* var. *minor* (horse-bean)
Frog Hall Farm, Fingringhoe, Essex
Scale graduated in mm.

Fig. 6 : West Row Fen, Mildenhall (MNL 137)
Frequencies of main categories of mollusca and stonewort oosporangia, with ecological interpretation.
Simplified histogram.

Fig. 7 : Some Bronze Age cereals from West Row (MNL 130)
a, b, *Triticum dicoccum*. Emmer
c. *Hordeum* sp. var *nudum* Naked barley (puffed at apex)
d. *Hordeum vulgare* Hulled barley
1 mm scale.

Fig. 8 : Some invertebrates and plant remains from urban sites.
a. *Ensis siliqua* Interior of right valve of razorshell. St George's Street Norwich (176N)
b. *Cancer pagurus* Edible crab, chela fragments. Bishopgate Norwich (154N) and Alms Lane (302N) Norwich
c. *Phoenix dactylifera* Intact date and diagramatic section of fractured specimen. 45-46 High Street Colchester
d. *Calendula officinalis*. Pot marigold, achene } Whitefriars,
e. *Vitis vinifera*, Grape 'pip' } Norwich (421N)
f. *Linum usitatissimum* Flax seed }

Scales a-c: 1 cm. d-f: 1 mm

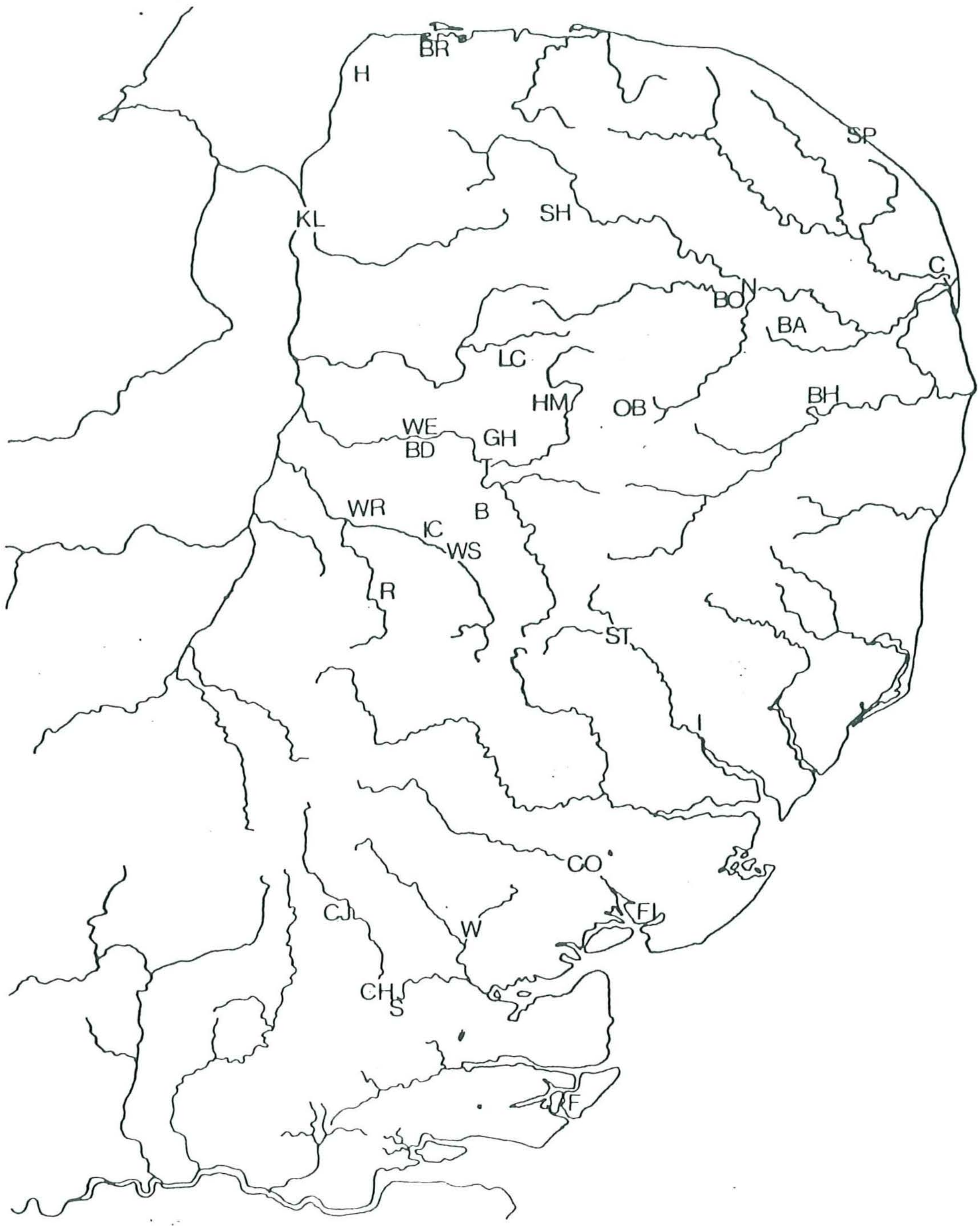
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Fig 1.

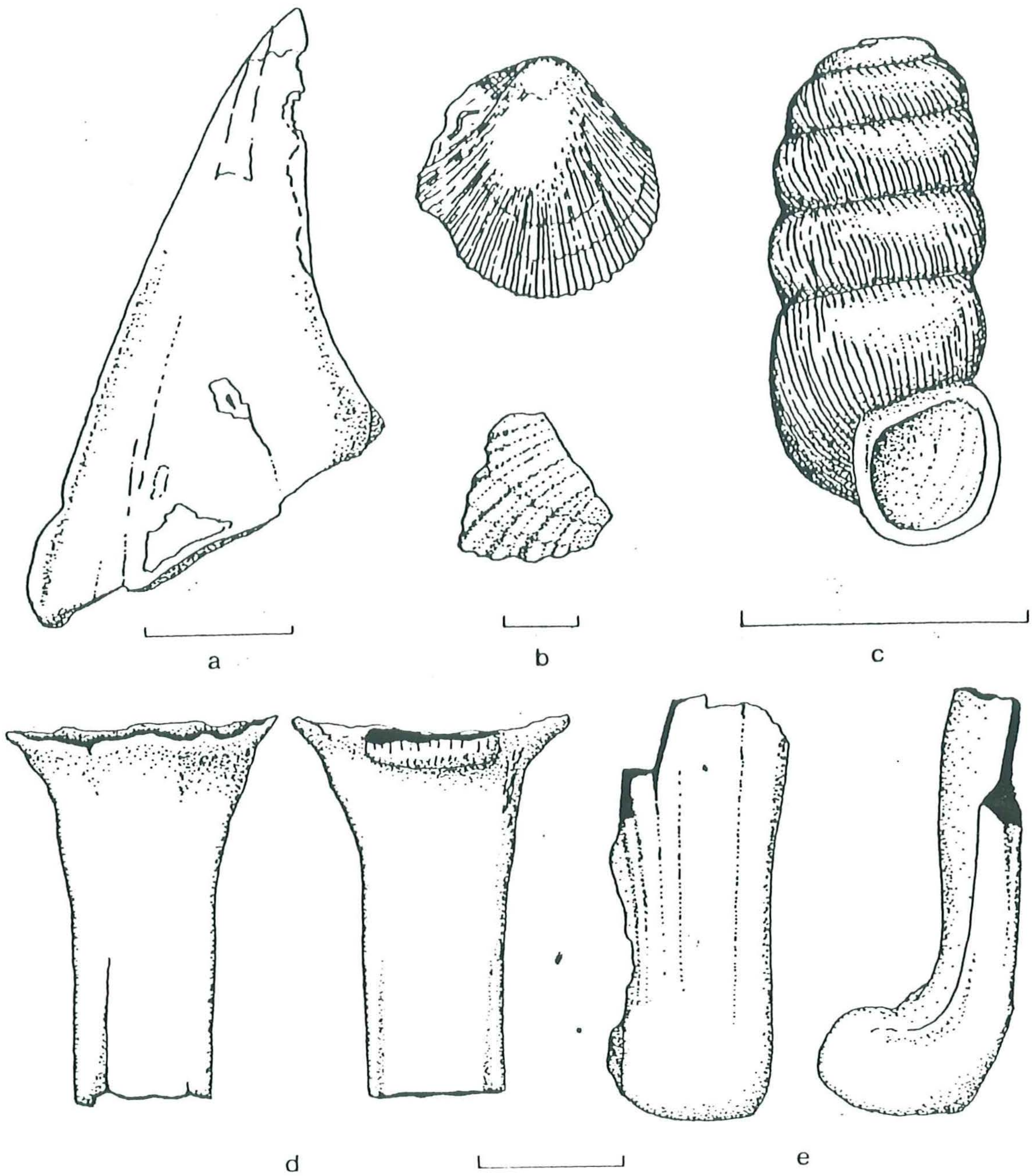

Fig 2.

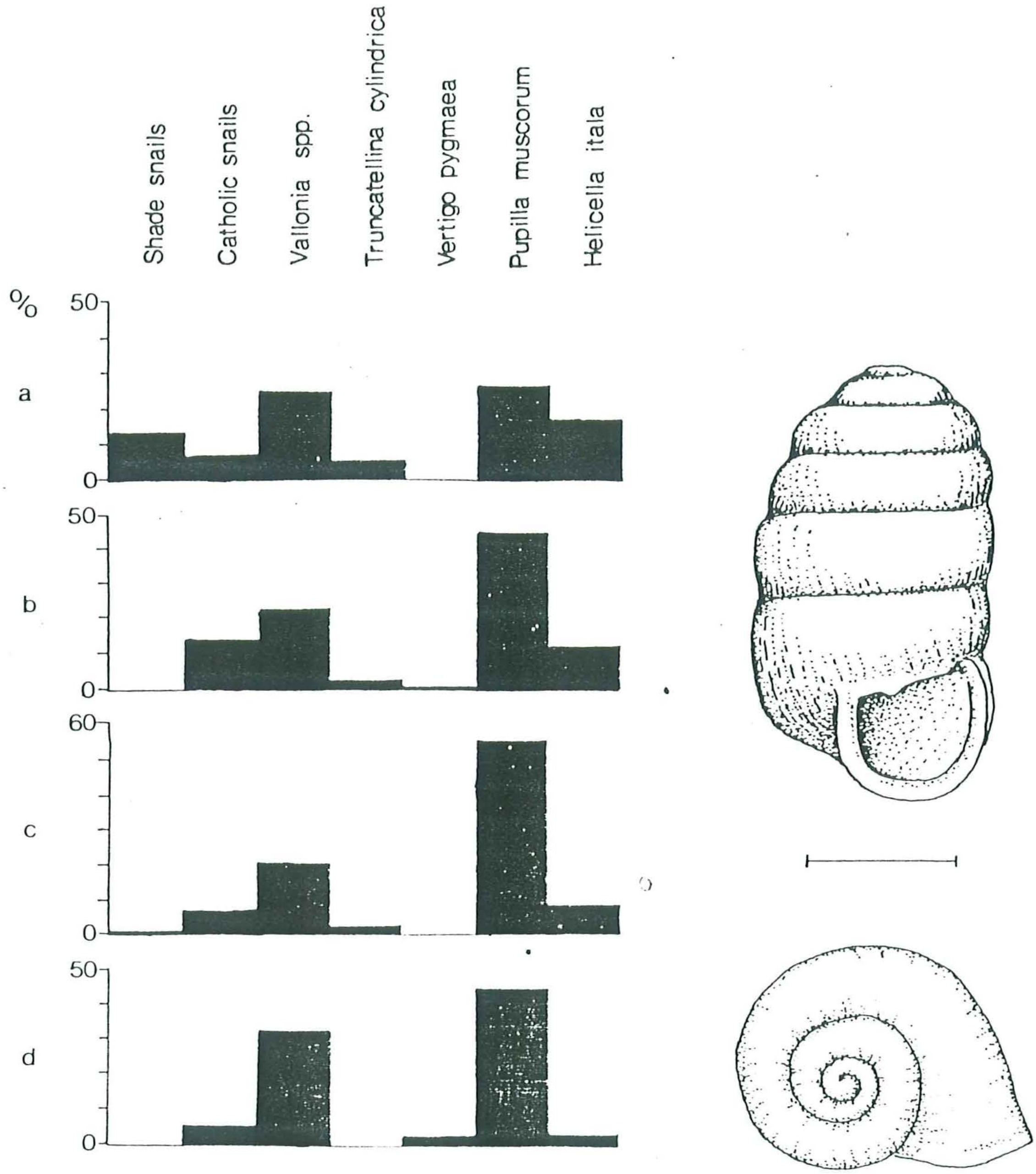
Shade snails
Catholic snails
Vallonia spp.
Truncatellina cylindrica
Vertigo pygmaea
Pupilla muscorum
Helicella itala
%
50
0
a
50
0
b
60
0
c
50
0
d

Fig 3

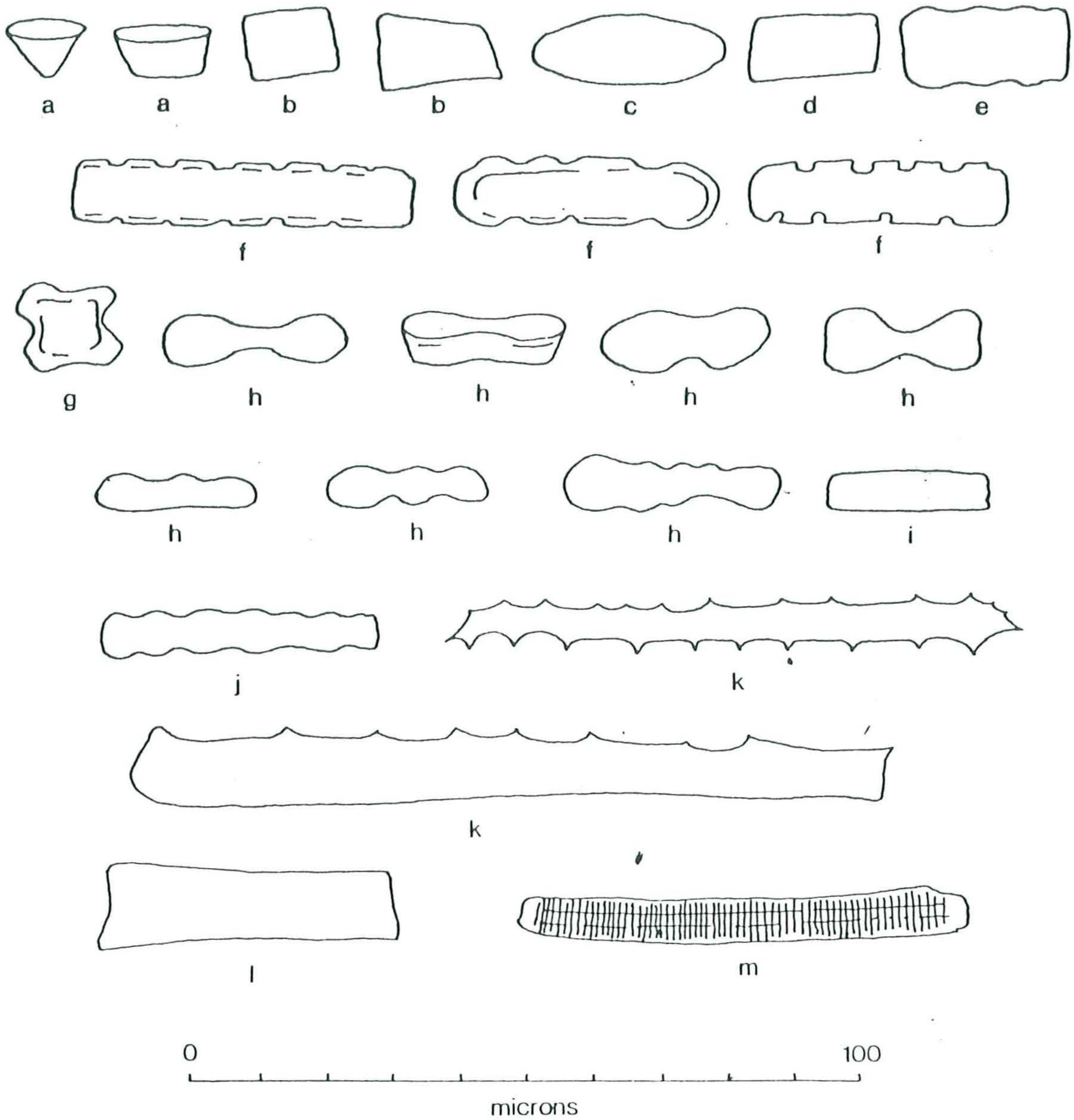

Fig 4.

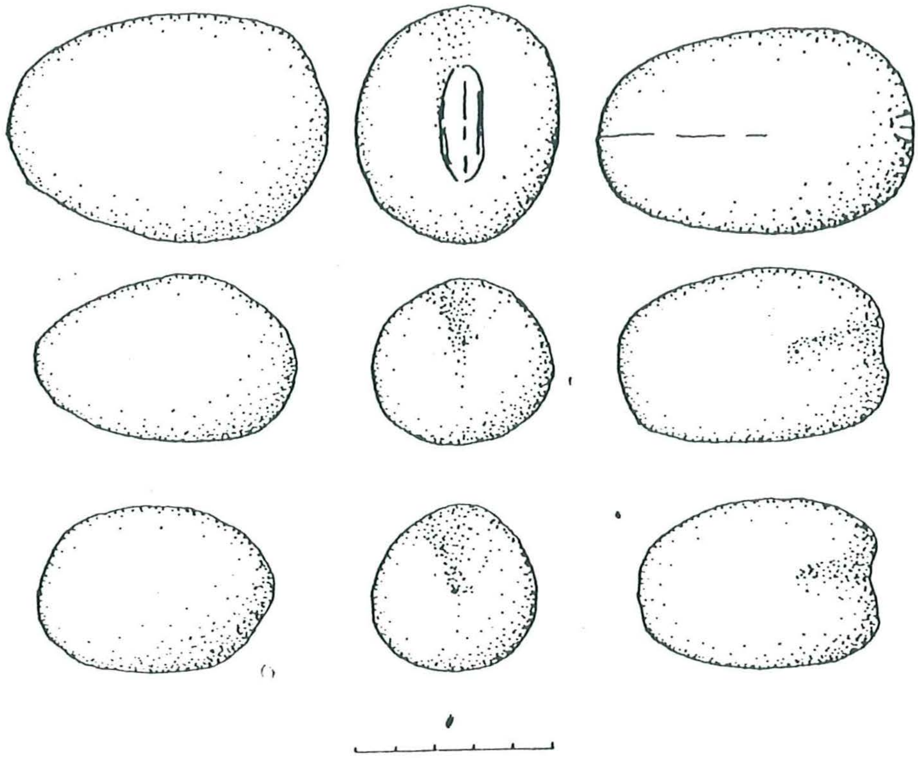

Fig 5.

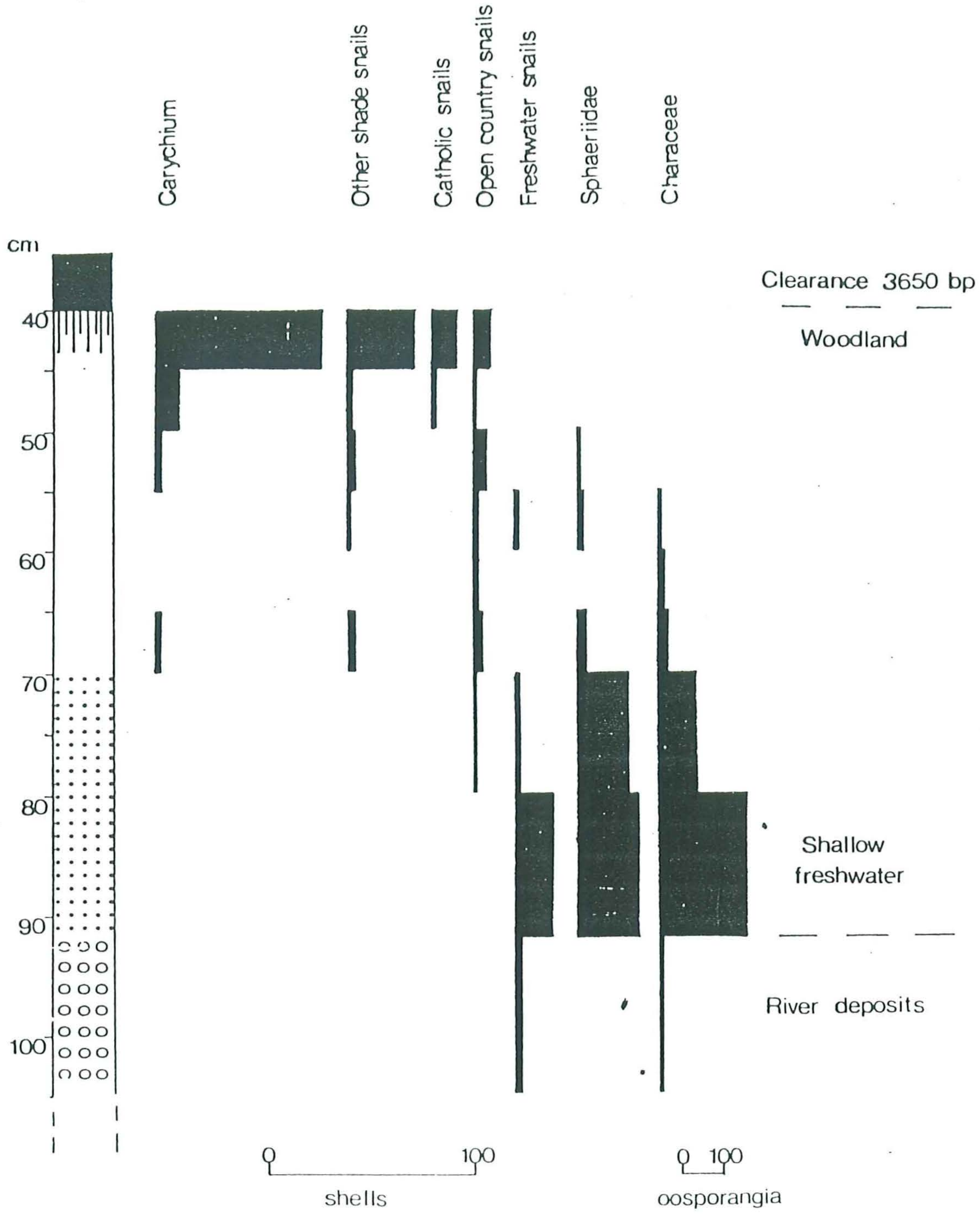
Carychium
Other shade snails
Catholic snails
Open country snails
Freshwater snails
Sphaeriidae
Characeae
cm
40
50
60
70
80
90
100
Clearance 3650 bp
Woodland
Shallow freshwater
River deposits
0
100
shells
0 100
oosporangia

Fig 6.

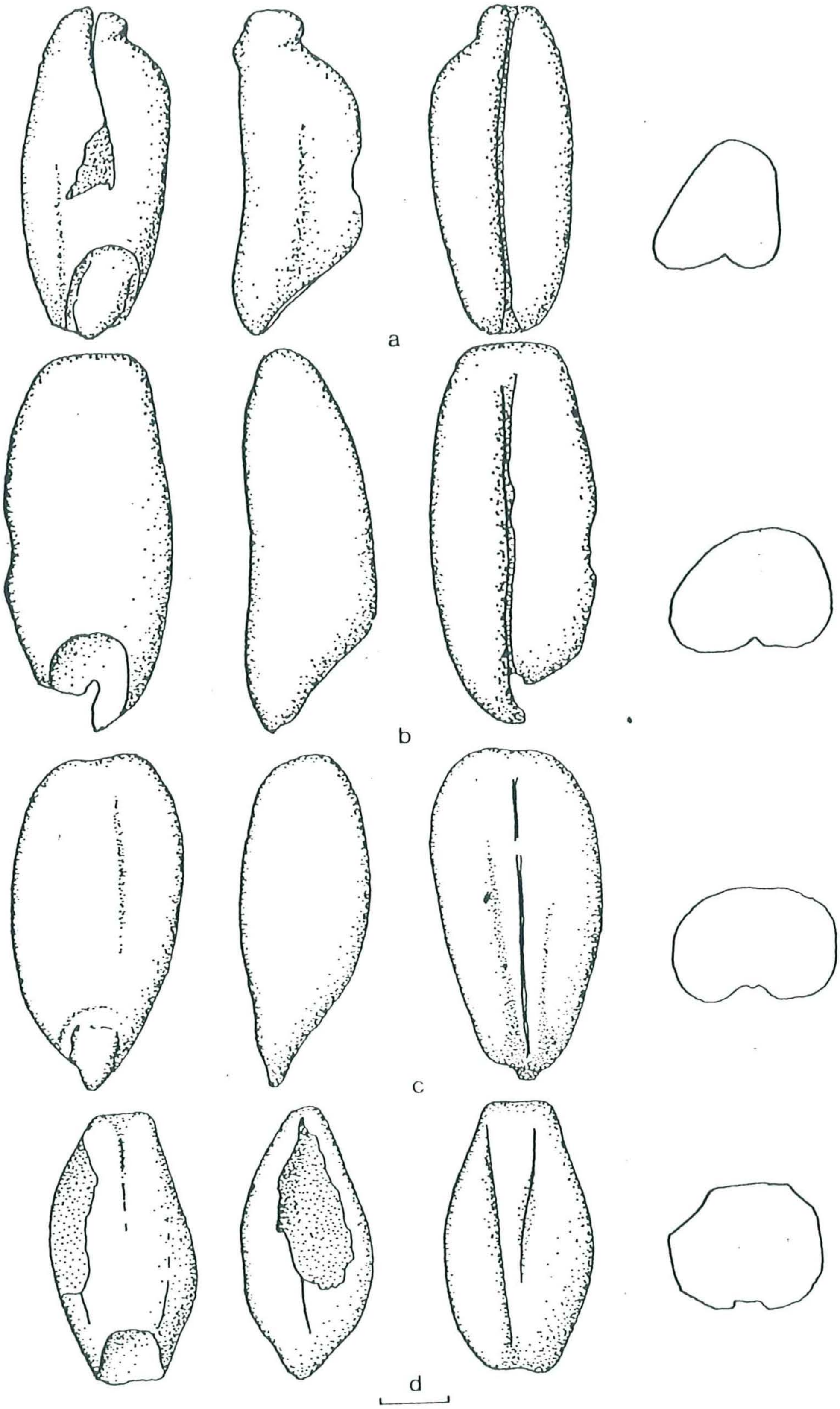

Fig 7.

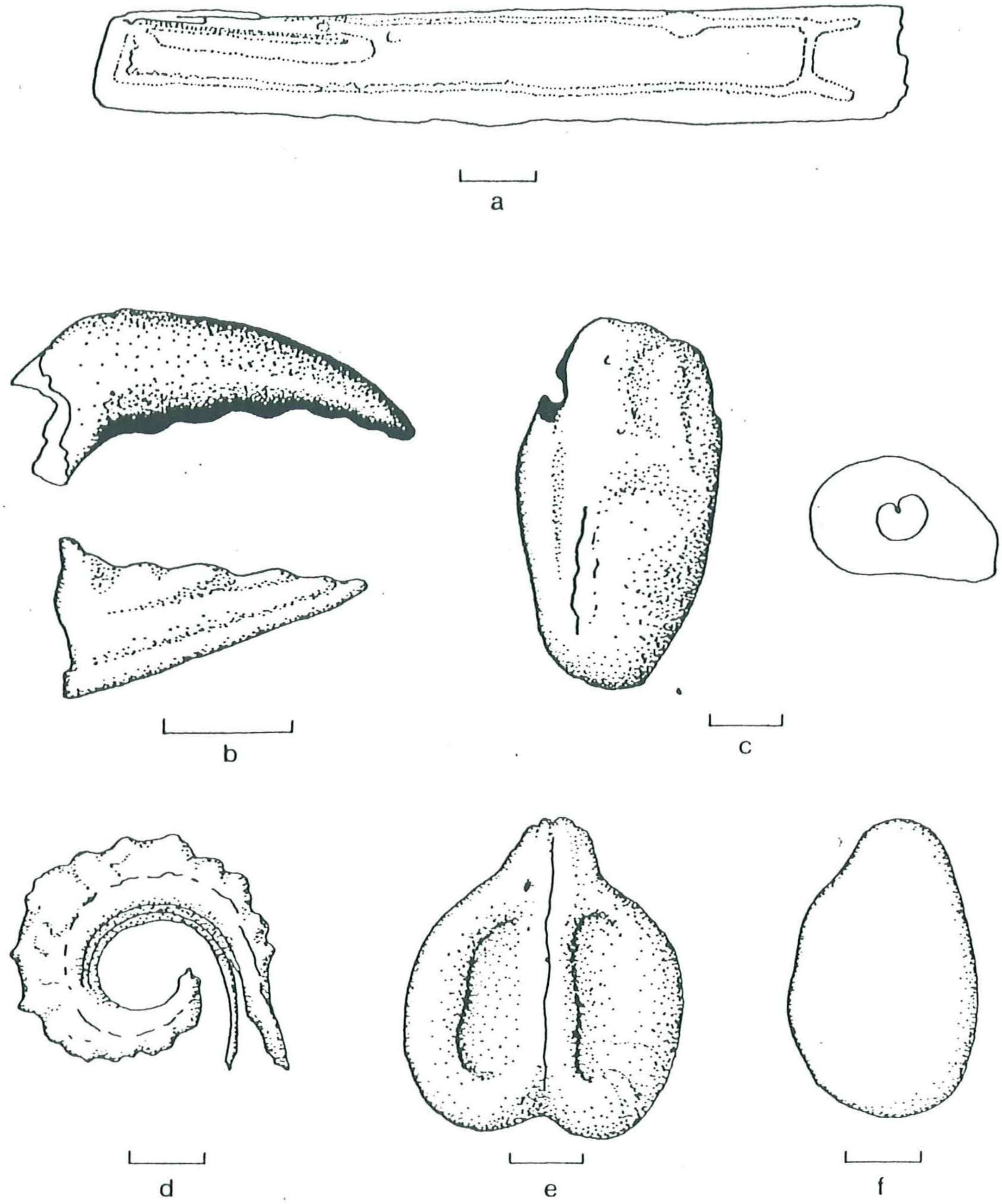

Fig 8.

CONTENTS

1. Introduction

The investigations discussed below will eventually be published fully in the East Anglian Archaeology Reports Series with the appropriate excavation reports, but many of these are unlikely to appear in the near future. Meanwhile it seems useful to give an outline account of the main results and conclusions. Publication as 'site reports' allows relatively little scope for placing results within a wider context, a deficiency which a review of this sort may help to remedy. It is hoped that this will highlight gaps in our knowledge and thereby suggest priorities for future work.

The present 'Rescue' policy of excavation naturally produces disparate, and at first sight unconnected, palaeoecological and palaeoeconomic information, sometimes from unexpected sources. If best use is to be made of this information it is imperative to devise frameworks into which new data may be fitted. For this reason the information from the archaeological sites is presented here in terms of the natural sub-regions of East Anglia within which the sites lie. By considering the data in this way it is often possible to propose simple models of past landscape exploitation and habitat change, the validity of which may be tested at future excavations.

A regional approach has certain obvious drawbacks. There is the practical difficulty of assigning each site to a particular region. Many sites, as might be expected, are located on ecotones and their inclusion here in one specific region may be quite arbitrary. A further problem is that even early prehistoric communities may have exploited more than one region. In the historic period the inter-relationships between the regions would have been still more complex: urban centres (from Iron Age oppida to medieval cities) were obviously suppled with foodstuffs and raw materials from a wide area. Nevertheless, until basic information about the individual regions is available, it will hardly be possible to understand these more complex relationships, and for the time being a simple regional approach seems adequate. However, urban centres are considered in a separate section below.

In the present programme of work, sites from Norfolk and Suffolk were investigated initially, but the area was subsequently extended to cover East Anglia in its wider sense. This review thus shows a bias towards Norfolk and Suffolk though several sites have now been studied in Essex. The selection of particular sites for study has, as yet, rarely been based primarily on their potential for yielding environmental information; the exigencies of development and plough-damage, and the strictly archaeological importance of sites have carried greater weight.

A note on the system of references used here is necessary. References in the conventional form (eg Watt 1940) refer to works already published, which are listed in the bibliography. References to the Ancient Monuments Laboratory Report Series, most of which have not yet been published, are given in the following form: (AML 2518). These are listed separately below.

2. The Chalklands

The pre-glacial chalk escarpment of West Norfolk, Suffolk and Cambridgeshire has been greatly modified by glacial action, so that it is now a low and gentle rise lying west of the Fens. Most of the chalk outcrop is completely obscured by glacial deposits, but a narrow belt along the western margin is drift-free. Here, despite the subdued relief, soils and vegetation resemble other more typical parts of the Chalk Downs of Southern England. Molluscan evidence, particularly from archaeological sites in Wiltshire, indicates that the Southern English chalklands were formerly forested, and that woodland clearance began as early as the fourth millenium B.C. (Evans 1972). It seems reasonable to suggest that the East Anglian chalklands would have had a similar history of habitat change, particularly in view of the evidence for early clearance in the Breckland (see below).

Several of the sites studied in the south-western part of the Breckland had only thin sand cover over chalk, and could be considered as chalkland sites. However, in this programme of work, the only site devoid of drift cover was an Iron Age site at Hunstanton (1396, HUN; AML 2519). Land molluscs from pits at this site were mainly of 'open country' species (Pupilla muscorum, Vallonia spp., Helicella itala). The interpretation of molluscs from pits presents some difficulties since the origin of the pit fill is uncertain. However, these shells are almost certainly derived from the surrounding area, and appear to indicate a local environment of short-turfed grassland, probably including some bare ground and grass tussocks. This interpretation is supported by the predominance of Microtus agrestis, the short-tailed field vole, amongst the small mammal bone. Undated 'natural' features at this site produced different, but somewhat mixed, mollusc faunas including the open-country taxa present in the pits, together with Truncatellina cylindrica, and specimens of Trichia hispida, Carychium tridentatum, Clausiliidae, Punctum pygmaeum, Discus rotundatus, Vitrea contracta, Oxychilus sp and Vitrina pellucida. These features are clearly postglacial, apparently representing a more shaded habitat. They are probably tree-root hollows. Charcoal from the archaeological features indicates the presence of some oak, elm, ash, hazel and Prunus in the vicinity. Cereal cultivation is indicated by charred grains and chaff on spelt wheat and barley. Marine resources were also exploited: shells of mussel, oyster, cockle, scallop and whelk, and remains of a gadoid fish and a shark, possibly the porbeagle (Lamna nasus), were recovered. The large mammal bone awaits examination. The overall picture is of a mixed economy settlement in a generally open environment. How typical this was of Iron Age settlements on the chalk as a whole is, of course, uncertain. The economy of this site was undoubtedly unusual, due to the availability of marine resources, and its coastal situation must have had effects on the local environment.

The reconstruction of early postglacial landscape development on the chalk is clearly a priority for future work. The two main potential sources of information are early prehistoric archaeological sites and dry valley colluvial sediments. Evans (1972) has demonstrated that the study of land molluscs from archaeological sites can produce a detailed picture of habitat change on calcareous soils, and mollusca from sections through colluvial deposits have been used by several workers to reconstruct long term changes (Kerney et al. 1964; Evans 1972; Bell 1980). It is unlikely that time and resources will be available in the foreseeable future for a concerted programme of research on the Chalklands, but meanwhile opportunities to examine sediments and archaeological deposits should be exploited.

3. Breckland

The Breckland consists of an area of sandy soils lying across the Suffolk/Norfolk boundary between Newmarket and Swaffham in a gap in the chalk escarpment. Its boundaries are difficult to define precisely; to the west the Breckland sands merge in a complex fashion into the peat fens, to the south-west sand cover thins onto the chalk, while to the east, north-east and south the Breckland is bounded by the Boulder Clay uplands.

Data on the vegetational history of this area have been provided by pollen analysis of the deep lake sediments at Hockham Mere (Godwin 1944; Sims, 1972, 1978). There is some evidence of temporary Mesolithic forest clearance, and following the elm decline and a phase of forest regeneration ~~there was~~ continuous deforestation begun in the Neolithic. Fluctuations subsequently occur in the pollen frequencies of woodland taxa, but the overall trend is a reduction in arboreal pollen and an increase in the pollen of heathland plants, grasses and ruderals throughout the Neolthic and Bronze Age. At 2750 b.p. the scale of changes in pollen frequencies is taken to indicate more extensive woodland clearance. Sims has suggested that the increase in cereal pollen influx and a decline in pollen from grassland and forest taxa between 2750-1860 b.p. could reflect increased arable farming as part of a mixed agricultural economy during the Iron Age. Cereal cultivation apparently further increased during the period 1860-1610 b.p. though in the late Roman and early Saxon periods there seems to have been increased pastoralism at the expense of arable farming. Between 1300-1140 b.p. cereals appear to have become the major product of the region for the first time. The pollen evidence thus provides a regional picture of the vegetational history and probable human exploitation of the area.

However, the Breckland is a diverse region including several types of landscape capable of being exploited in different ways. Corbett (1973) distinguishes five main 'landscape facets' within the Breckland. Adapting his categories slightly, the facets may briefly be described as follows:

1. Uplands. On the higher areas of the Breckland, at around 30-45, OD., the soils are well-drained acid brownearths and podsols formed on sands over the chalk-sand drift and on high-level Pleistocene gravels. On the deeper acid sands *Calluna* heath locally dominated by bracken, *Agrostis* grassland and stands of *Carex arenaria* are nowadays the main semi-natural plant communities. (Watt, 1940, 1955).

2. Slopes The soils of the slopes are shallow, well-drained redzinas, calcareous brownearths and brownearths, with surface sandy horizons over chalk-sand drift. The slope areas often show characteristic vegetation patterns

reflecting local lateral variations in soil depth and acidity. These variations in soil type result from the presence of fossil periglacial features - stripes and polygons (Watt *et al.*, 1966). The main 'natural' vegetation is grass-heath characterised by *Agrostis* and *Festuca*; the proportion of calcicolous herbs in the grassland varies with edaphic conditions (Watt 1940).

3. *Dry valleys* The soils here are deep and coarse textured, formed on soliflucted parent material.

4. *River terraces* The river gravels are partially overlain by recent blown sand. The soils are well-drained stony brownearths and humus podsols, with raw soils on recent blown sand. The vegetation includes *Calluna*-heath and grass-heath, with sand-sedge (*Carex arenaria*) communities on the blown sands.

5. *Valley floors* Ground water gley soils and organic soils formed on deep eutrophic peat are found in the valleys, supporting fen vegetation; fen woods, carr and wetland herbaceous communities.

Archaeological sites lying within the four main landscape facets (excluding the dry valleys) have been examined.

At Gallow's Hill, Thetford, (5744 THD) an upland site on Pleistocene gravels, a small turf-stack originally thought to be a Bronze Age barrow has been partially excavated. The surviving part of the mound sealed an immature soil formed on blown sand, and influenced by a perched water-table caused by the presence of an impervious sandy clay loam horizon 1m down (AML unnumbered). The soil was base-rich and unsuitable for pollen analysis, but an extensive spread of charred plant remains was found lying just above the soil surface. This gave a C14 date of 1600 ± 70 b.p. or 350 ad (HAR-2905). The deposit consisted largely of stems, leaves and capsules of *Calluna vulgaris*, associated with charred seeds of other heathland taxa and ruderals. Charred seeds of *Juncus* sp, *Carex* sp and *Stellaria graminea* from this deposit are thought to indicate the existence of damper habitats in hollows or small blow-outs. Charcoal of tree species, notably ash, was also present, with carbonised chaff and grains of spelt. The plant remains and buried soil appear to indicate a heath environment with a soil surface subject to wind erosion on the disruption of vegetation cover, perhaps similar to the modern situation described by Watt (1937, III) at Lakenheath Warren, where *Calluna* had developed on thin layers of blown sand and on soils truncated by wind erosion. It is assumed that the ash charcoal and cereals represent material imported to the site. The present base-rich nature of the soil may well be due to relatively recent marling, since surface deposits containing chalk were seen in part of the excavated area (AML 2945).

Several sites on the slope soils have been investigated. Land mollusc assemblages have been described from two Bronze Age barrows, at Risby, Suffolk (RBY 001) and Little Cressingham, Norfolk (5053 CRL) (AML 2524, 2888). The assemblages are characterised by a predominance of open-country species, (Truncatellina cylindrica, Vertigo pygmaea, Pupilla muscorum, Vallonia costata, Vallonia excentrica and Helicella itala). Shade loving snails (principally Discus rotundatus and Carychium tridentatum) are very rare, and there is no evidence for development of scrub on the soil horizons within the barrow ditches. P. muscorum is common in all deposits from these two sites (up to almost 60% of the total assemblage in a few cases). The abundance of this species, and its frequent association with Truncatellina cylindrica suggests that soil surfaces were broken and unstable, a conclusion supported by the fact that Vertigo pygmaea, an open-country snail favouring stable soil surfaces and complete vegetation cover, is rather rare. These unstable conditions result, in part, from the nature of the sediments: the sides of the ditches, cut into the chalk-sand drift, would have been very susceptible to collapse and to erosion. It is also possible that wind-blown sand transported over short distances by saltation would have accumulted in the ditches: particle size analyses of ditch deposits at Little Cressingham suggest the presence of an aeolian component in the sediments. A further factor possibly encouraging high levels of Pupilla may have been the development on the chalky mounds adjacent to the barrow ditches of immature calcareous grassland resembling the modern Breck grassland A, which consists mainly of Festuca ovina with about 50% bare ground (Watt 1940).

A third site, an Iron Age enclosure at Barnham, Suffolk (BNH 009) had two defensive ditches cut into the chalk-sand drift (AML 2837). The outer ditch produced snail assemblages containing a similar range of open-country xerophiles to those in the Bronze Age barrow ditches. However, the soil horizon within the inner ditch at this site did contain a significant proportion, some 13%, of snails characteristic of shaded conditions. One explanation for the difference between the snail faunas of the soil horizons within the two ditches is that the Inner Ditch, partly isolated by the Outer Ditch on one side and by an internal bank on the other was less accessible to herbivores, and patchy scrub development could therefore take place once a stable profile was established. Overall, the molluscan evidence from Risby, Cressingham and Barnham is thought to indicate a heavily-grazed grassland environment.

Close to the Risby barrow, in a small chalk quarry, a partial section across the Black Ditches (RBY 002), a Dark Age linear earthwork, was examined (AML,unnumbered). The section showed the bank sealing a truncated sandy soil over chalk. The interpretation of molluscs from this soil profile is complicated by earthworm disturbance and mixing and rather few shells were recovered, but it appears that two distinct habitats are represented: an earlier shaded habitat represented by shells of Pomatias elegans, Carychium tridentatum, Vertigo substriata, Clausiliidae, Discus rotundatus, Vitrea sp. Aegopinella pura, and a later open habitat characterised by the open-country xerophile snails common at the three sites discussed above. Unfortunately, there is no dating evidence for the earlier 'woodland' phase; it may pre-date the earthwork by millenia. This is, nevertheless, the only direct molluscan evidence at present for woodland on the chalk/sand drift soils.

The Little Cressingham barrow produced small quantities of charred barley grains, and pits within the enclosure ditches at Barnham contained a few indeterminate charred wheat and barley grains. However, it seems probable that the importance of cereal cultivation in this area may have been restricted by available soil moisture, particularly in the supposed dry conditions of the Sub-Boreal. The evidence for cereal production is certainly scanty.

Settlement sites on the terraces have, by contrast, produced abundant evidence for cereal cultivation. An Iron Age site on a gravel terrace of the River Lark at West Stow, Suffolk (WSW 030) has produced large quantities of charred grains and chaff of spelt (Triticum spelta), with some emmer (Triticum dicoccum) and hulled barley (Hordeum sp.) (AML 2831). The weed flora associated with these cereals includes a relatively high proportion of annual weeds and relatively few large-seeded leguminous species; this is thought to indicate adequate levels of nutrients in the soil of the arable fields. The modern soil of the site itself is a humus podsol (AML unnumbered), and podsolisation of the terrace soils is widespread. Charred remains of Calluna vulgaris from the site, indicate that in the Iron Age, as today, heath vegetation was present in the vicinity. Thus, to maintain levels of soil nutrients on the arable land, and also to improve water retention, manuring would have been necessary. The occurrence of lumps of chalk, not available in local surface outcrops, may indicate the importation of chalk from the chalk/sand drift of the slopes for marling.

Small quantities of cereals were also present in samples from the Roman site at Icklingham Suffolk (IKL 063), again in the Lark Valley (AML 2521). These were predominantly of spelt and six-row hulled barley, though a single grain from this site is tentatively identified as rye (Secale cereale). A large deposit consisting mainly of charred rye grains came from a small pit (026) at the nearby West Stow site (WSW 030). This feature, however, post-dates the Iron Age occupation of the site; a C14 date of $\pm$ (HAR) was obtained. The introduction of rye to this area would have been an important agricultural innovation, since the crop is well-adapted to dry sandy soils. Rye has an extensive root system and is thus able to exploit soil water not available to other cereals (Renfrew 1973, 85). Its cultivation would probably have permitted an extension of the arable area onto formerly marginal land, and indeed pollen analysis indicates increased cultivation of cereals and the cultivation of Secale in the Roman period (Sims 1978, 58).

The plant remains recovered some years ago at the main West Stow Anglo-Saxon settlement are currently being studied by Mr A.J. Legge, and the results are not yet available, but impressions of cereals on pottery from the site have been examined. These were predominantly of six-row hulled barley (AML 2944).

Terrace sites in the Little Ouse valley appear to be producing similar results. Spelt, emmer, fragments of free-threshing wheat rachis and six-row hulled barley were recovered in quantity from features at the Roman farm site at Fengate Farm, Weeting, Norfolk. (5636 WWB). (AML, unnumbered). One large deposit from this site is thought to have resulted from accidental charring during large-scale cereal drying. A shallow well here produced seed assemblages containing high proportions of ruderals (Conium maculatum, Aethusa cynapium, Urtica urens, Urtica dioica, Hyoscyamus niger, Solanum nigrum, Atriplex and Chenopodium album). These plants indicate very nutrient-rich soils in the vicinity, and could reflect the presence of a stockyard. On the southern side of the Little Ouse Valley, at Brandon, Suffolk (BRD 018) a Middle Saxon settlement has recently been excavated. Flotation has produced cereals, though these have yet to be examined in detail.

The earliest direct evidence for human activity at a valley floor site comes from Lackford Bridge, Suffolk where a 20 cm thick layer of heat-shattered flint and charcoal was seen sealed within the peats of the Lark Valley floor in a gravel-pit section (AML 2515). The charcoal was largely of alder, with some hazel and oak, and overlay brushwood peat containing wood and fruits of alder (Alnus ghitinosa) and oak (Quercus sp.) and seeds of wetland herbs. In a single pollen preparation alder was found to account for 89% of the total pollen and spores in this peat. The site thus appears to represent a clearance and burning of valley-floor alder carr for some unknown purpose. No artefacts were recovered, (apart from an obliquely-cut alder twig) but the charcoal deposit is dated to 3940 ± 80 b.p. or 1990 b.c. (HAR-2484).

At the northern edge of the excavation at Brandon (BRD 018) a section showed just over 50 cm of peat above slightly stony sand at the floodplain margin. Samples were taken for the examination of plant macrofossils and pollen, and for C-14 dating, but full results are not yet available. However, the section showed clear signs of human activity at two levels: near the base of the sequence the peat was obviously disturbed and trampled, with discrete sandy patches, and at an average depth of 20 cm there was a layer of *Calluna* charcoal, with some fired clay fragments, up to 5 cm thick. The peats contained remains of plants indicating damp, probably acid, grassland (including *Ranunculus acris/repens*, *Ranunculus flammula*, *Ranunculus sceleratus*, *Hypericum* sp, *Montia fontana* subsp, *chondrosperma*, *Hydrocotyle vulgaris*, *Berula erecta*, *Mentha* sp, *Lycopus europaeus*, *Scutellaria* c.f. *galericulata*, *Bidens cernua*, *Juncus* spp, *Iris pseudacorus*, *Eleocharis* spp, *Carex* spp, *Phragmites australis*) together with remains of some plants growing on adjacent dry sandy areas (eg *Rumex acetosella*, *Calluna vulgaris*) and some ruderals (*Chenopodium album*, *Polygonum aviculare*, *Urtica dioica*, *Hyoscyamus niger*, *Sonchus arvensis*). This area was clearly open throughout the sequence with no scrub or carr development, and was potentially available for pasture.

In attempting to draw together the information from these Breckland sites it is helpful to consider the distinction made by Limbrey (1978, 25) between heathland nuclei and marginal areas in the English lowland heaths. The nuclei are seen as areas which, because of the development of summar soil moisture deficits, never justified the effort of manuring and marling, whilst in the marginal areas, at least during the wetter periods of the postglacial, reclamation and arable exploitation was possible. The acid upland soils of the Breckland may be regarded as heathland nuclei; the evidence from Gallows Hill, for example, indicates the presence of Calluna heath with an unstable sandy substrate prone to wind erosion during the Roman period. Such areas would have been suitable only for rough grazing. At the other extreme are the gravel terrace areas, where a true mixed economy would have been possible. Settlements on the terraces, such as those at West Stow, could have exploited the permanent pastures of the valley floor, once the carr was cleared, and also the grassland of the slopes. Adequate supplies of manure would have been available to maintain the fertility of the terrace soils and thus to obtain remunerative yields of cereals. It is perhaps in these areas that Sim's suggested Iron Age arable expansion would have been initiated. In between these two extremes of uplands and terraces are the slope soils. Molluscan evidence indicates an open landscape in the Bronze Age and Iron Age around several sites on the slopes, and suggests heavy grazing. There is, at present, little evidence for cereal farming. It is suggested that the slope areas were used continuously as pasture for sheep and goats, whilst climatic variations would have affected the suitability of these areas for cereal farming.

Although there is clearly more information available about former habitats and land utilisation in the Breckland than for any other region of East Anglia, much remains to be done. In particular, no pre-Bronze Age or medieval sites have been studied in the present programme of work. Moreover the categories of sites investigated in the different regions may well have produced results which are not truly comparable: there is obviously a predominance of sepulchural sites on the slope soils and of settlements on the terraces. Thus, for example, the apparent rarity of cereals at the slope sites may well prove, on further study, to be illusory.

4. Glacial sands and gravels in Norfolk

Preservation conditions for biological remains at sites on these glacial deposits are generally poor. Soils and sediments are normally very well-drained and well-aerated, and are generally neutral to acid; in these circumstances only those plant and animal remains which are biologically inert and resistant to chemical oxidation and attack by soil acids can be expected to survive. Pollen was not preserved at any of the sites investigated during the present programme of work; samples have been examined by Dr R. Scaife and Dr R. McPhail with negative results. At Broome Heath, Ditchingham however, pollen has been recovered from a soil buried beneath a Neolithic bank. It was possible to infer an initial woodland clearance phase, followed by cultivation and then by a pasture phase, showing some evidence for over-grazing (Dimbleby and Evans 1972). More typically, however, only charred plant remains, impressions of plant material on pottery, metal-replaced organic residues and opal phytoliths are available for study. Nevertheless if a balanced picture of former environments and economies is to be gained it is important to examine sites of this type, rather than just concentrating attention on those offering more favourable preservation conditions. The results may, of course, be relatively meagre.

The recovery of adequately large samples of charred plant remains is unfortunately very labour-intensive, requiring large-scale flotation. Where time has been available for such work some interesting results have been obtained. For example, at Spong Hill, Norfolk (1012 ELN) crop plants dating from the Neolithic to Saxon periods have been recovered. (AML 2514, 2844).

	Neolithic	IA/Roman	Roman	Saxon
Hordeum spp. (barley)	+	+	+	+
Triticum dicoccum (emmer)	x	–	?	–
Triticum spelta (spelt)	–	–	+	–
Triticum aestivum (bread wheat)	–	–	–	x
Avena spp. (oats)	–	–	+	+
Secale cereale (rye)	–	–	–	x
Linum usitatissimum (flax)	–	–	+	–
Vicia/Pisum sp. (vetch/pea)	–	–	+	–
Vicia faba var minor (horse bean)	–	–	–	+
Prunus spinosa (sloe)	–	–	–	+
Malus sylvestris (apple)	x	–	–	–
Corylus avellana (hazel)	+	–	+	–

Table : Food plants from Spong Hill

\+ carbonised fruits/seeds x impressions on pottery

Flotation also produces large quantities of charcoal, but the value of examining this material is questionable. On the one hand charcoal may be the only source of information about local woodland, but on the other some selection of wood for fuel will certainly have occurred, biasing the results in favour of particular species. In addition it cannot necessarily be assumed that the charcoal is contemporary with the archaeological feature from which it was recovered. An unusual example of this was a charcoal sample from a feature cutting a Neolithic context at Spong Hill (1334); this was of pine, and gave a date of 8150 $\pm$ 100 b.p. (HAR - 2903). The source of this wood is clearly conjectural, but a possibility is the use of subfossil timber from Boreal valley-floor peats.

Metal replacement of plant remains can occur where they are buried in proximity to metal objects (Keepax 1975). For example, iron shield studs from a Saxon grave at Bergh Apton, Norfolk had impressions of bracken frond (Pteridium aquilinum) on their upper surfaces, and replaced wood, possibly of lime (Tilia) attached to their under-sides (Murphy 1978). Metal replacement has also been observed as a result of iron translocation and re-deposition in podsolised soils, as at Bowthorpe, Norwich, where coffin stains within Beaker graves included replaced fragments of oak (Quercus) (AML, Unnumbered).

Perhaps the most promising type of biological remains for use in palaeoecological reconstruction on these soils are opal phytoliths. Their main advantages are their abundance in a wide range of deposits and their durability (Rovner 1971). However, there is at present insufficient comparative information about the nature of phytolith assemblages in soils beneath modern plant communities. For this reason a collection of modern 'type samples' from a wide range of habitats in East Anglia is being assembled. At Bowthorpe, phytoliths recovered from an apparent 'pillow stain' beneath the skull-stain of a Beaker body silhouette suggested, by comparison with modern type samples, a local environment of heath or acid grassland (Murphy, forthcoming).

5. Areas of Loess-containing Soils

In East Anglia, soils with a loess component, known as Cover Loam, occur principally in North-East Norfolk and in the river valleys of Essex and South Suffolk (Catt 1978, Fig. 1). At the sites examined during the present programme of work, Cover Loam overlay sandy glacial deposits, and provided similar preservation conditions to the sand and gravel soils discussed above. An additional problem here was deep penetration of roots and earthworm burrows. Environmental work at one site, the terminal of a Neolithic *cursus* at Springfield Barns, Chelmsford, Essex (SB 79/1), had to be abandoned due to severe contamination resulting from earthworm activity. The Neolithic features produced large numbers of modern weed seeds, and also seeds of fig, grape, raspberry and strawberry as well as charred short-grained hexaploid wheat caryopses. These plant remains were perhaps derived from the contents of cess pits spread on the fields in relatively recent times (AML, unnumbered). Because of this contamination problem it seems probable that only well-sealed or deep archaeological deposits will repay detailed study in future.

Soils with loess-containing surface horizons are significantly more fertile than soils developed on glacial sands and gravel in the same area (Corbett and Tatler 1974, 108). Their silty textures and large porosity minimise the effects of low rainfall on crop yields, yet being well-aerated they are easily worked. As a rule, they supply adequate amounts of minerals for crop growth. Initially, at least, such soils must have been attractive to early farmers and moreover they would have been amongst the first soils to be encountered by farming communities entering East Anglia via the rivers of Essex and South Suffolk. It might be expected that in these areas of fertile soils, open to agricultural innovation from the continent early records of new crop plants would be obtained. Indeed there is one: a record of field bean, Vicia faba var. minor, dated to 2760 ± 80 b.p. or 810 b.c. (HAR 2502) from Frog Hall Farm, Fingringhoe, Essex (AML, unnumbered). Elsewhere in East Anglia this crop is not known before the Roman period and is not at all abundant until medieval times. However, it will obviously be necessary to obtain far more remains of early crops from sites on loess-containing soils before it can be established whether early agriculture in these areas was as innovative as might be suspected.

The principal problem for early farmers on these soils would have been structural breakdown, following compaction and exposure to direct rainfall, and resulting in increased susceptibility to waterlogging and erosion. Catt (ibid) notes that the widespread occurrence of late Flandrian silty colluvial deposits and floodloams indicates soil deterioration and erosion as a consequence of prehistoric farming. Borehole logs from the Chelmer valley adjacent to the Springfield cursus record up to about 3m of such alluvial deposits, overlying earlier probably Flandrian, peats (AML, unnumbered)). Catt considers, however, that the distribution of the present remnants of the original continuous sheet of Cover Loam is attributable principally to Late Devensian and Early Flandrian solifluction and erosion. On a small scale, the local distribution and thickness of surviving Cover Loam can be difficult to explain. For example, at one ring-ditch of the barrow group at Levington, Suffolk (LVT 024) thick Cover Loam was found inside the ditch, but not outside it. This might be thought to indicate that the barrow mound had prevented, or inhibited, post-Bronze Age soil erosion. However, a short distance away was a discrete, near circular patch of Cover Loam rising to about 1m above the level of the field surface and about 30 m in diameter, but apparently of completely natural origin (LVT 026). It therefore appears that LVT 024 may have been constructed on a similar pre-existent hummock of Cover Loam, but how such a raised feature might have formed is uncertain. Cover Loam does occur in discrete patches in North East Essex, but there is not normally any expression in terms of surface relief (R.G. Sturdy, pers.comm.).

It will be seen that the reconstruction of the processes of soil deterioration and erosion under the impact of early farming is of particular interest in these areas. This can be studied in two main ways: by examining fossil soil profiles beneath earthworks for signs of structural breakdown, and by studying valley-floor alluvium. The latter may prove difficult, since deep open sections are rarely exposed, and borehole logs may give an unreliable picture due to lateral variation, and to phases of erosion.

6. The Boulder Clay Uplands

The wide undulating Boulder Clay plateaux of mid-Norfolk, Suffolk and Essex constitute the largest single natural region of East Anglia, but surprisingly little is known in detail of early environments and economies. On the basis of the present distribution of deciduous woodland and the relative rarity of prehistoric sites it has generally been assumed that deforestation was late in this area. Pollen analyses of lake sediments at Old Buckenham Mere, Norfolk appear to confirm this (Godwin 1968). The pollen is thought to indicate minor temporary clearances in the Neolithic and Early-Middle Bronze Age, moderate deforestation in the Late Bronze Age, more extensive clearance during the Iron Age and Roman periods, and an expansion of arable farming from about 400 AD. It should be noted, however, that the chronology of this pollen diagram is based not on C14 dates but on a conjectural time-scale which, though broadly reliable, may be misleading if used uncritically, Godwin's assumption that rye (Secale) was introduced about the year 0 may be correct, but is as yet unproven for this area.

The environmental information recovered from recent excavations relates principally to Roman arable farming on Boulder Clay soils. At Stowmarket, Suffolk (SKT 008) threshing waste of spelt wheat, barley and oats had been used in a kiln as tempering for the clay superstructure and to kindle the fire (AML 2841). A very large cereal deposit consisting of spelt, a tough-rachis wheat (probably T. compactum) and traces of oats was recovered from another kiln site at Somerton, Suffolk (AML 2949). A few remains of spelt, emmer (?) and oats were identified at Ivy Chimneys, Witham, Essex (IC 79; Murphy forthcoming). At Chignall St James, Essex, recent excavations have revealed part of the field system of a Roman villa, consisting basically of shallow parallel ditches at 5 m intervals, probably for drainage. These ditches presumably became choked and filled only on the abandonment of the field system, and the biological remains recovered from them therefore relate to a very late phase in the history of the site. The mollusca consist of shade-loving species (Carychium tridentatum, Acanthinula aculeata, Clausilia sp., Balea perversa, Discus rotundatus, Aegopinella sp.) open-country snails (Vallonia spp., Helicella sp.) synanthropic species (Helix aspersa) and catholic molluscs including Limacidae. This is thought to indicate the development of dense shaded vegetation in the ditches, with open habitats on the field surfaces between them. Although charred cereals, probably from stubble-burning, have been recovered from Roman field drainage ditches, (eg. at Ilchester, Somerset; Murphy, forthcoming) the features at this site contained only rare charcoal flecks by way of plant remains. Samples from these ditches will be examined for phytoliths in an attempt to provide information about the type of crop cultivated.

On the undulating relative impermeable Boulder Clay surface small sedimentary basins occur. One such has been investigated at Ivy Chimneys, Witham, Essex (IC 79). Under natural conditions this would probably have been a marshy hollow, possibly containing some standing water; but earlier natural deposits were removed when an artificial pond, fed and drained by a complex ditch system and acting, apparently, as a reservoir for a sump, was constructed in the Roman period. The site was of religious significance from the Iron Age onwards, with evidence for post-built temples and a late Roman church. Unfortunately, this pond had clearly dried out periodically, with the consequent destruction of most organic remains. Pollen had not survived (R. Scaife, pers.comm.). Land and freshwater molluscs were abundant in the lower pond sediments, though the upper fill was decalcified. Species typical of pond habitats naturally predominate (Planorbis (Armiger or Gyraulus) crista is particularly abundant), and the ditches associated with the pond included moving-water snails (eg. Valvata piscinalis). The interpretation of the land molluscs from the pond sediments is less straightforward, since species characteristic of a wide range of habitats occur. It is hoped that the 1980 excavation season will expose sediments which have been continuously anaerobic since their formation; these would obviously have greater potential for palaeoecological reconstruction.

Priorities for future work should ideally include investigations of the nature and function of prehistoric clearances on Boulder Clay soils, and of the character of post-Roman arable farming. Small sedimentary basins particularly those directly associated with settlement sites, as at Ivy Chimneys, may be expected to produce well-preserved biological remains of use in the reconstruction of local habitat change on these soils.

7. The fen-edge

The complex junction between the sandy deposits of the Breckland and the sediments of the Fen basin is of particular interest. The reconstruction of environmental change at this ecotone is of importance for an understanding of the economies of fen-edge settlements, since variation in water-table levels and the degree of forest cover have obviously affected the types of activity possible on the fen. Critical changes in relative land-sea levels, and also probably precipitation, have directly or indirectly affected local water levels. This has resulted in a complex of sediments - peats, shell marls and tufas overlying sands and chalky drift - showing marked small scale lateral variations in depth and character. In view of this variability the best approach seems, at present, to examine groups of sites within a restricted geographical area subsequently relating the results to wider changes in the Fenland Basin. This approach has been adopted in the Mildenhall area, where a group of Bronze Age sites around West Row has been examined.

Mildenhall Fen was not directly affected by the Fen Clay marine transgression. The approximate extent of Fen Clay has been mapped by Seale (1975). However, the edges of this deposit are not clearly defined, and marginal facies formed in conditions of relatively low salinity occasionally occur. For example, on Great

Fen (approx. 621791) lumps of greyish-brown silt loam brought up by ploughing are to be seen. These contain abundant shells of Hydrobia ventrosa with immature cockle shells (Cerastoderma sp.) and a few freshwater molluscs. Specimens of freshwater gastropods in this deposit are small, and may represent snails drawfed by the saline conditions. Such deposits represent the extreme edges of the Fen Clay which is currently thought to have been deposited between about 2600 b.c. and 2200 b.c. in the landward part of the fens (Godwin 1978, 65).

The fens to the south and east of the Fen Clay margin may be divided into two main regions: a continuous area of fen peat, generally 30-180 cm thick, to the west, and an area of hummock-and-hollow micro-relief consisting of sandy ridges surrounding circular or elongated closed hollows filled with peat and shell marl to the east (Seale op. cit).

The Bronze Age settlement site at West Row (MNL 130) occupied part of one such sandy ridge and the occupation horizon spread into an adjacent peat-filled hollow. Beyond this occupation horizon the hollow was filled with peats overlain by shell marl in turn covered by surface peats, now humified and disturbed by ploughing. Macroscopic plant remains from undisturbed sediments indicate that the hollow remained damp throughout the sequence, with some shallow standing water fringed with reedswamp and marsh. The rise in frequency of Chara oosporangia at the top of the peats and in the shell marl may reflect an increased influx of calcareous water from the uplands as a result of increased rainfall after the Bronze Age occupation, though it is possible that the growth of Chara was suppressed by organic pollution whilst the site was occupied. The occupation horizon at the edge of the hollow contained wood of alder, oak and willow, showing axe-cuts; this is thought to indicate clearance both of carr and also probably of oak woodland on slightly higher ground. Charred remains of emmer and barley were recovered from features on the sand hummock. AML 2523). Samples taken for molluscs, insects and pollen are currently being examined, as is the animal bone from the site. It is hoped that these biological remains will amplify the picture of the Bronze Age environment and economy inferred from the macroscopic plant remains.

In an adjacent field a section showing quite different sediments - soft calcareous tufa overlying river gravel - was examined (MNL 137). The upper 5 cm of the tufa was humose and appeared to represent an immature rendzina-like soil. Molluscs and oosporangia of Characeae from these calcerous deposits indicate a continuous sere from an open freshwater environment to woodland. At the base of the sequence the molluscs present included Bithynia tentaculata, Lymnaea sp., Planorbis crista and Pisidium spp; ostracods and Characeae oosporangia were common. In the soil horizon Carychium tridentatum was the predominent snail, with Vertigo substriata, Acanthinula aculeata, Clausilia bidentata, Discus rotundatus, Vitrea sp. Pomatias elegans, Cochlicopa, Trichia hispida and others. On the surface of the soil was a 5 cm thick layer of heat-shattered flint and charcoal (of ash, oak, hazel, and hazel/alder) dated to 3650 ± 100 b.p. or 1700 b.c. (HAR -2690). This is interpreted as a Bronze Age woodland clearance horizon of unknown extent. The charcoal layer was covered by humified peat disturbed by ploughing, reflecting a subsequent return to wetter conditions (AML 2947).

At a third site, further north-west (MNL 124) a similar deposit of heat-shattered flint and charcoal of alder, hazel, hawthorn-type, oak and probably sloe overlay a dark brown peaty loam formed on chalky drift. The charcoal is dated to 3720 ± 70 b.p. or 1770 b.c. (HAR - 1876). The peaty loam is interpreted as a Bronze Age land surface, clearly very disturbed and trampled. It contained a mollusc fauna in which Carychium tridentatum and Vallonia costata were the two most abundant species. This is thought to indicate a small-scale woodland clearance; V.costata though typically an 'open-country' snail was also present in primary woodland at low frequencies, and thus it was usually the first 'open country' mollusc to attain large populations in newly-cleared land (Evans 1972). Seeds of ruderal and scrub plants were also present. Cutting through this land surface into the drift were pits and gullies of unknown function. The upper fills of the largest pit appear to be natural deposits formed after the abandonment of the site apparently, from their plant macrofossils, in wetter conditions (AML 2946).

No sites have been examined in detail to the west of the present channel of the Lark though recent agricultural activities have led to large numbers of oaks, yews and pines being dragged up from the peat. These are not precisely dated though some specimens from Great Fen were apparently rooted in the marginal facies of the Fen Clay noted above. These trees should thus be broadly contemporary with the sites already discussed, and give some impression of local woodland composition.

Table is an attempt to correlate the three Bronze Age sites on Mildenhall Fen. There is clearly marked local variation, influenced by the presence of springs etc. and by the nature of the underlying substratum. A picture of mixed woodland-types emerges, developing in conditions varying locally from dry to moist. A short pollen diagram from Mildenhall Fen (Godwin 1942, 275) apparently shows a comparable picture. The predominant pollen-types from a Late Bronze Age level in shallow fen peat were alder, oak and pine. All three sites discussed above provide the evidence for woodland clearance, but it is not as yet clear how extensive deforestation was in the area as a whole. Peats and shell marls, formed in wetter conditions, overlie the

	124	130	137	
	Peat, now humified + disturbed by ploughing	Peat, now humified + disturbed by plouging	Peat, now humified + disturbed by ploughing	
Post-Bronze Age sediments	Natural filling of large pit with amorphous + brushwood peats	Shell marl and peats		
Bronze Age activity	Charcoal + burnt flint layer - woodland clearance (1770 b.c. HAR 1876)	Occupation horizon in hollow; settlement on hummock (1440 b.c. HAR-2517), 1560 b.c. (HAR 2516), 1720 b.c. (HAR 2510)	Charcoal + burnt flint layer - woodland clearance (1700 b.c. HAR 2690)	
Woodland composition (from charcoal + wood)	Oak, alder, hazel, sloe? hawthorn	Alder carr in hollows? Oak on higher ground?	Ash-oak with hazel undergrowth?	
			Soil formation. Swamp, becoming shaded	}
Pre-Bronze Age sediments		Peats developing in hollow	Still or slowly-flowing water	} tufa
	Chalky drift	Massive sand horizon with surface micro-reflief	River gravel	

Table : Sediments and their interpretation at MNL 124, 130 and 137

Bronze Age horizons, but it is perhaps premature to relate the abandonment of these sites directly to rising water levels. The factors influencing these post-Bronze Age higher water levels were probably deteriorating rates of freshwater drainage connected with a marine incursion sometime between 1300 and 300 B.C. (Churchill 1970) and also increased rainfall associated with the climatic deterioration of the first millenium bc (Evans 1975, 142).

The economic functions of these sites are at present unclear. Nor is it known whether they were permanently occupied. It is possible, for example, that they represent summer settlements occupied primarily in order to exploit pasture on the fen, when the productivity of upland pastures on the adjacent sandy soils of the Breckland was reduced by summer soil moisture deficits.

If the exploitation of pasture was the principle reason for the existence of settlements such as MNL 130, then small-clearances like MNL 124 and MNL 137 would have been made in order to open up new grazing. In this context the very thorough disturbance of the peaty loam surface at MNL 124, right down to chalky drift, is worth noting; it certainly looks like the kind of disturbance which would be produced by pigs.

It is clear, however, that the Bronze Age agricultural system in this area was not exclusively pastoral, for remains of emmer and barley were recovered at MNL 130. The location of cereal production cannot, at present, be determined, since very few weed seeds (which would normally provide information about drainage conditions and probably soil pH in the arable fields) were recovered.

Future work along the fen-edge should be concerned with relating individual sites, or preferably groups of sites, to the relatively well-established sedimentary and vegetational sequence of the Fen basin. By this means, and by the recovery of animal bone and crop plant remains, it will be possible to reconstruct in some detail the economic function of such sites.

8. Broadland and coastal environments

The postglacial freshwater and estuarine sediments of Broadland have been the subject of several large-scale investigations (Jennings 1952, Lambert and Jennings 1960, Coles 1977), but the stratigraphy of other coastal areas, is less well understood. In general these natural deposits fall outside the scope of the present programme of work, though obviously changes in relative land/sea levels have been of great importance for the economies of coastal settlements. A few samples and logs from commercial boring and some coastal exposures have been examined, however, and C14 dates obtained, where this seemed relevant. In addition stratigraphic studies have been made of small areas adjacent to Roman sites at Caister-on-Sea and Brancaster.

In 1977 six 30m deep bores were sunk at Great Yarmouth in connection with the Yare Basin Flood Control Study. The complex series of sediments shown in the bore logs cannot at present be interpreted fully, though borehole 1 does show the sequence of Lower peat - Lower Clay - Middle peat - Upper Clay described by Lambert and Jennings (op cit.). The Lower peat in this borehole, at -19.3m OD was a brackish water deposit, containing *Ruppia* fruits and *Juncus* seeds, with shells of hydrobiids (mainly *H. ventrosa*) Cerastoderma sp., *Littorina littorea* and Rissoidae. It can be correlated with a thin peat layer with its base at -21.5m OD recorded in bores made in 1898 (Jennings 1952). These basal organic sediments are thought to have formed in Pollen Zones V, VI and early VII (Lambert and Jennings ibid, 49). Coles (1977, 291) has suggested a date of around 9000-7000 b.p. This is confirmed by a C14 date obtained for the peat in borehole 1 : 7580 ± 90 b.p. (HAR - 2535). A disturbed 'jar' sample of Middle peat in borehole 1, at -7.3 m OD was of brushwood peat containing fruits and wood of alder. A deposit consisting of flints up to 4 cm in a grey-brown silty and sandy matrix at a depth of -17.2 m OD in borehole 2 produced bone of a domestic-sized pigs and cattle (?), probably of early prehistoric date. Borehole 5 produced 13th century pottery from a coarse sand deposit at -5.7 m OD. (Murphy, forthcoming).

The coastal peat bed with tree stools at Sea Palling, Norfolk with its upper surface partly sealed by clay at -0.4m OD, was well-exposed after the storms of January 1978. It represents one of the largest areas of prehistoric land surface visible in East Anglia, but had never been precisely dated. The opportunity was therefore taken to obtain C14 dates. The upper and lower 5 cm of the peat layer gave dates of 2220 ± 70 bp (HAR 2602) and 5040 ± 70 bp respectively (AML 2663). These dates fit well with the current estimates of Middle Peat formation.

At Caister-by-Yarmouth, Norfolk exploratory bores made by the County Highways Department gave a long section across the former coastline to the south of the Roman town. The section showed Upper Clay, Middle Peat and Lower Clay overlying the Norwich Brickearth, the adjacent upland consisting of Mid-Glacial sands with Cover Loam at the foot of the slope. Further hand augering in this area defined the margin of the Upper Clay, which approximates to the Roman coastline. Two shallow inlets were detected, around 51651180 and south of West Road around 52051190. The West Road inlet contained Upper Clay overlying black brushwood peat and reed peat. The clay included unabraded 3rd-4th century pottery. Between these two inlets is a broad promontary of brickearth. The Upper Clay margin at the south of this promontary is visible as a distinct slope downwards, of nearly 80 cm, and a change in the ploughsoil from sandy clay loam to a soft damp clay loam strewn with shells of Cerastoderma edule and Scrobicularia plana. This boundary was confirmed by hand augering. The two inlets seem too shallow for large craft, and no sign of harbour-works was detected. Possibly boats were simply beached, or anchored offshore. (AML 2661).

At Brancaster a transect of auger holes was made in a north-south direction across the modern salt-marsh from the upland. Since little stratigraphic work has been done in the area, this was necessarily a preliminary investigation. The provisional sequence is as follows:

1. Unfossiliferous sands and gravels. Soliflucted deposits?
2. Alder brushwood peat, possibly to be correlated with the Judy Hard peat (Godwin and Godwin 1960,74).
3. Submergence of the peat during the local Flandrian transgression.
4. Coarse sands with shell fragments of *Ostrea edulis* and *Cerastoderma* sp. and the foraminifers *Ammonia beccarii* and *Elphidium williamsoni*. This sand has the form, in section, of a small spit or barrier beach moving shorewards over the peat and any intertidal mud formed in phase 3.
5. Accretion of intertidal mud, containing shells of *Hydrobia ulvae*, *Scrobicularia plana* and *Littorina* sp. No significant changes in sea-level whilst this mud accumulated can be inferred from the foraminifera which it contains.

It is not clear whether the suggested sand-bank was present during the Roman period. However, even before its formation the water could not have been more than 3m deep even at Mean High Water Spring Tides, and generally much less. In the absence of creeks and channels the coast to the north of the Roman fort would have been unsuitable for craft with a deep draught; more extensive augering would be needed to determine whether such channels were formerly present. (AML 2952; Murphy and Funnell 1979).

Our knowledge of the economies of coastal settlements is, at present, very limited, though fish remains and shellfish have been removed from the Iron Age site at Hunstanton (AML 2518), from the Roman settlement area at Brancaster (AML 2442) and Late Saxon to Post-medieval deposits at King's Lynn, Yarmouth and Ipswich (see below). Coastal middens are, for obvious reasons, very rare in East Anglia: early prehistoric middens were submerged during the postglacial transgression and many later midden deposits have been lost due to coastal erosion or buried beneath sand or salt-marsh sediments along accretional coastlines. The midden deposits of the Roman settlement at Little Shelford, Foulness, Essex are thus of particular interest, though, as yet, only a superficial examination has been possible (AML Unnumbered). The deposits consist largely of marine molluscs, with small quantites of fishbone, mammal bone and charred plant remains. The high proportion of 'inedible' molluscs (eg _Hydrobia ulvae_, _Phytia myosotis_, _Scrobicularia plana_ and unidentified abraded Tellinids) in some of these deposits has not been satisfactorily explained. Gulls or other scavaging birds may have deposited some of these in pellets and faeces, and some may have reached the site in flooding episodes, but it is provisionally suggested that the abundance of those molluscs reflects the importation of shelly intertidal deposits to the site in order to raise the ground level. The composition of the cereal assemblages from these deposits suggests local cultivation; cereal farming is perfectly feasible on slightly saline soils.

9. Urban environments and economies

The main urban sites investigated in recent years have been at Norwich, Ipswich and Colchester, with minor studies at Thetford and King's Lynn. Purely environmental studies have been most successful where natural deposits, relatively unaffected by human activity, have been examined. To give a few examples, pre-urban soil horizons have been detected at Ipswich (LAS 4302; a truncated podsolised soil developed on sands and gravels; (AML 2691) and at Norwich (416N; a truncated gleyic brown sand; McPhail, pers. comm.). Laminated sands within an early medieval building at Queen Street, King's Lynn contained Holocene-recent shallow water marine foraminifera (AML 2835), and are interpreted as tidal flood deposits. At Whitefriars, Norwich (421N) early medieval river deposits have produced a typical river molluscan fauna (including <u>Valvata piscinalis</u>, <u>Bithynia tentaculata</u>, <u>Lymnaea peregra</u>, planorbids and <u>Pisidia</u>) and remains of aquatic plants (mainly <u>Chara</u>, <u>Ranunculus</u> subgenus <u>Batrachium</u>, <u>Potamogeton</u> cf <u>perfoliatus</u> and <u>Zannichellia palustris</u>) as well as diatoms (AML, unnumbered). The interpretation of these essentially natural deposits and their biological remains presents few difficulties. This is not the case with true urban deposits. The internal diversity of habitats within a city is further complicated by the importation of material, producing very mixed assemblages of biological remains, which are often not readily interpretable. For this reason greater attention has been paid to biological remains relating to economic activity, rather than attempting to reconstruct urban habitats.

Amongst the faunal remains, the recovery of fish-bone has been given a high priority at urban sites. Reports on fishbone from earlier excavations, at Yarmouth and King's Lynn, have already been published (Wheeler 1977; Wheeler and Jones 1976) and bone from Norwich and Ipswich is currently being studied by Andrew Jones. Taken together, this material should give a good picture of the development of fishing economies from the early medieval period onwards. Marine mollusca are abundant and ubiquitous at urban sites, and the examination of shells from several sites has given information about food preferences and the probable location of exploited shellfish beds. At Whitefriars (421N), for example, the predominance of mussels over oysters, cockles, whelks, and winkles is thought to indicate the importance of estuarine mussel beds in the area now known as Breydon Water, a suggestion supported by the presence of stenohaline Bryozoa on the shells (P.S. Whittlesea, pers. comm.). Crustacea have also been recovered (AML 2674). Remains of Cancer pagurus predominate in medieval deposits at Norwich, and since the fishery is restricted in Norfolk to a stretch of coastline with an offshore bed of chalk between Salthouse and Mundesley (Harden Jones 1976), the general source of the crustaceans can be suggested with some confidence. As yet, few detailed reports on mammal bone from urban sites in the area have been published (though see Gebbels 1975, Noddle 1977). Material from Norwich is currently being examined by Judith Cartledge. Avian remains have received still less attention, though bone from earlier excavations at King's Lynn has been described by Bramwell (1977), and an outline study of eggshell from Norwich has been made (AML 2673).

Plant remains from several urban sites have been studied. The earliest material comes from the Boudiccan deposits at Colchester, where plant foodstuffs were carbonised *in situ* during the destruction of the town (AML unnumbered). At 45-46 High Street the destruction deposits of a building interpreted as a pottery shop produced a wide range of crop plants - stone-pine, figs, flax, gold-of-pleasure, coriander, dill, anise, celery, opium poppy, lentils, horse-bean, barley and spelt. Contemporary deposits from Lion Walk and the 'Cups' Hotel contained cereals, flax, plum and dates. Clearly some of these crop plants must be imported foodstuffs; others could be either imports or new introductions to Britain. An examination of granary deposits from Balkerne Lane (mainly of spelt, emmer and bread wheat) has shown that the grain was stored in a very clean state, containing few weed seeds and little chaff. No obvious signs of insect attack or fungal infestation were observed, and losses due to germination appear to have been negligible.

Crop plants from deposits of Middle and Late Saxon date at Ipswich (IAS 4302, 5502, 7402) and Whitefriars, Norwich (416N) include hulled barley, bread/club wheat, rye, oats, horsebeans, vetches/peas, flax, hemp, hops, grape, cherry, plum, walnut, celery, parsnip, dill (?) coriander, opium poppy and pot marigold (AML 2667, unnumbered). It is clear that almost all the crops recovered from later medieval deposits in East Anglia, with the probable exception of figs, had already been introduced before the Norman conquest, an indication of the innovative character of late Saxon farming in the area.

Later medieval plant remains were recovered on a large scale by on-site flotation at Norwich by Andrew Jones, and these were subsequently identified by the writer. In general, preservation conditions were poor; carbonised and mineralised seeds predominate. The assemblages have been classified into seven main groups:

1. Carbonised deposits consisting of cereal grain, chaff and straw, with large numbers of weed seeds. These are interpreted as harvested crops carbonised accidentally before processing, and probably indicate local production.
2. Carbonised deposits of cereals and pulses with few impurities. Small deposits of this type are extremely common and probably represent small-scale losses during cooking.

3. Carbonised deposits of straw, chaff and weed seeds with few cereal grains. Waste residue from crop processing, often utilised as thatch or litter and as tempering for daub.
4. Carbonised barley grains, including germinated specimens, thought to be waste from malting and roasting.
5. Mineralised seeds from aerobic deposits.
6. Anaerobic deposits from cess pits, wells and refuse pits. These commonly contain the remains of succulent fruits, with some carbonised cereals and pulses and a fairly restricted range of ruderals and segetals. Fragments of bracken frond, reed culm and heather leaves, apparently the remains of thatch and flooring, are also present.
7. Natural and semi-natural assemblages from peats and alluvial depots on the valley floor.

Little work has been done at small towns, though the few samples examined are more rural in character than those from city sites, as might be expected. At Moulsham Street, Chelmsford (MTC 80) a Roman ditch on the floodplain of the Chelmer produced abundant seeds of Urtica dioica and other ruderal species, with some scrub and grassland plants, but no food refuse. It seems reasonable to suggest that the area was used as pasture; organic pollution by cattle could have resulted in the development of a nitrophilous flora in the ditch (AML, unnumbered). At Sudbury, Suffolk (SUY 014) early medieval pits produced charred seeds of *Anthemis cotula*, *Cerastium* sp. and other arable weeds, with a few grains of oats, rye, barley and bread-wheat. These assemblages seem to consist largely of grain-cleaning waste (AML 2526).

With the resources and expertise available in East Anglia at present it is not possible to undertake detailed and extensive studies of urban environments comparable to those now being carried out by teams of workers at York, or London, for example. A somewhat different strategy has to be adopted. In essence this will involve examining sufficient material to establish whether East Anglian city sites produce similar results to those from the major cities of the country. If so, there seems little point in duplicating work being done elsewhere. It seems more profitable to concentrate attention on unique or rare urban deposits, such as the Boudiccan destruction layers at Colchester, and on specific problems. Perhaps the most important of these relates to the process of urbanisation: at what point did individual settlements cease to be self-sufficient or net food producers and become net food consumers? Assemblages of crop plant remains and animal bone from large late Iron Age settlements and Middle-Late Saxon centres should help to elucidate this process.

10. Miscellaneous biological remains

Tree-ring sequences based on timbers from earlier excavations of Roman wells at Scole, Norfolk and a ninth-century well at North Elmham, Norfolk have already been published (Morgan 1977; Fletcher 1980). Suitable oak timber recovered over the last three years has been sent to Jennifer Hillam at the Sheffield Dendrochronology Laboratory. Ring-width sequences from Bronze Age fen-oaks from West Row, Mildenhall, Suffolk have been described. Obviously these have, at present, no chronological value, but may contribute to the establishment of a 'floating' sequence (AML 3003). Timber from Cecelia Street Ipswich has also been examined, but since the individual sequences of separate timbers were very dissimilar it proved impossible to produce a mean site curve (AML 3006). Planks from the Roman well at Weeting, Norfolk and wood from the early medieval waterfront at Whitefriars, Norwich are currently being studied at Sheffield.

The study of human bone from recent excavations has been retarded since the death of Dr Calvin Wells, due to the shortage of specialists willing and able to take on these remains. Dr Wells' death deprived East Anglia of an experienced and innovative worker, who has left a series of valuable papers (see *inter alia* Wells and Cayton, 1980). However, human remains are now being studied by Dr D. Birkett, Janet Henderson and Ann Stirland. Small numbers of burials have been recovered from several sites over the last few years, but by far the most important group came from the excavation of the early medieval cemetery at the Anglie Television extension, Norwich (416N).

On the acid sand and gravel soils of East Anglia conditions are unsuitable for the preservation of unburnt bone, and here body silhouettes, sometimes with residual traces of bone are the norm (Keeley, 1978). Dr Helen Keeley has reported on the chemical composition of silhouettes from Saxon graves at Spong Hill, Norfolk (AML 2902) and samples from silhouettes at the Bowthorpe barrow have been submitted for examination.

11. Conclusion

The one overall conclusion to emerge from this review is that our understanding of habitat change and palaeoeconomies in the different sub-regions of East Anglia is very variable. In some regions (eg the Glacial Gravel areas) we have yet to develop and exploit fully a reliable and widely applicable technique which can be used to follow environmental change. In others (eg the Chalky Boulder Clay areas) techniques suitable for the prevailing preservation conditions are there, but too few sites have been investigated for any coherent picture to emerge. The study of some areas is more advanced; in the Breckland it is possible to propose a simple model of landscape utilisation, but even here the model is based on very little information. The different needs of these regions will require several distinct approaches in future, but as a result of the last three years' work it has at least been possible to propose a number of potentially profitable lines of research.

12 Acknowledgements

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14. List of reports

Copies of reports on Environmental studies of sites in East Anglia are included in the Ancient Monuments Laboratory Report Series and may be consulted at the A.M. Lab. Library. Reports in this series by the writer are in the form of 'first drafts' and may differ markedly from the final versions already published or to be published in the East Anglian Archaeology Reports. Additions and alterations have proved necessary in order to include the results and discussion of additional samples examined subsequently, to correct erroneous identifications and, most frequently, to extend or revise the interpretation of the material in the light of new information.

Unless otherwise attributed, the reports listed below are by the writer. For completeness reports by A.M. Lab. Staff and Consultants on sites not visited by the writer are included. Reports completed after March 1980 have, as yet, no number, and are indicated by an asterisk.

Chalklands

2518 Hunstanton, Norfolk: Botanical remains, mollusca, small mammal and amphibian bone (by J. Goldsmith), Fishbone (by Dr A. Wheeler).

Breckland

2469 Philip Taylor, 'Icklingham - A Roman footslope site'

2515 Lackford Bridge, West Stow, Suffolk

2521 Icklingham, Suffolk : Fruits and seeds

2524 Little Cressingham, Norfolk : General Environmental Studies

2665 Icklingham, Suffolk : Charcoal

2666 Icklingham, Suffolk : Marine molluscs

2831 West Stow, Suffolk (SWS 030) : Carbonised cereals and crop weeds

2837 Land molluscs from the Iron Age enclosure ditches at Barnham, Suffolk (BNH 009)

2838 'Land molluscs from the barrow at Risby, Suffolk'

2944 West Stow, Suffolk : Impressions of plant material on pottery and fired clay

2945 Gallows Hill, Thetford, Norfolk : Charred plant remains from a Bronze Age barrow. (N.B. This was subsequently shown to be of Roman date.)

* Fengate Farm, Weeting, Norfolk (5636 WWB) : Plant remains, molluscs

* Black Ditches, Risby, Suffolk : Land molluscs

* Richard McPhail, '<u>Report on soil associated with a mainly Iron Age site at West Stow, Suffolk</u>'

* Richard McP-ail, '<u>Soil report on turf stack and buried soil at Gallows Hill, Thetford, Norfolk</u>'

Glacial
Outwash sands and gravels in Norfolk

2514 Spong Hill, Norfolk, Interim reports

(1) Impressions of plant material on pottery

(2) Carbonised fruits and seeds

2519 Caistor St Edmunds, Norfolk : Biological Remains

2844 Interim report on Environmental Studies 1977-78, Spong Hill, Norfolk

* Bowthorpe, Norwich, Norfolk : replaced wood, charred plant remains, phytoliths

Areas of loess-containing soils

2839 Levington, Suffolk : Silt loam (Cover Loam) deposits associated with the barrow group.

2915 Aylsham, Norfolk (12772) : Prehistoric pits and ditchesm sediments and charred plant remains.

* Flandrian sediments of the Chelmer Valley, adjacent to the Springfield Barns sites : A preliminary assessment.

* Springfield Barns, Chelmsford, Essex (SB 79/1) : Plant remains.

The Boulder-Clay Uplands

2517 Carbonised cereals and crop weeds from Tasburgh (TAS 2258

2841 Plant remains from the Stowmarket Roman Kiln (SKT 008)

2843 Hales Court, Nr Loddon, Norfolk

2949 Somerton, Suffolk : A Roman cereal deposit

The Fen-Edge

2523 West Row, Mildenhall, Suffolk (MNL 130) : General environmental studies

2946 West Row, Mildenhall, Suffolk (MNL 124) : A Bronze Age woodland clearance.

2947 West Row, Mildenhall, Suffolk (MNL 137) : A calcareous tufa deposit and Bronze Age clearance horizon.

2950 Southery, Norfolk : Roman cereals and crop weeds

Broadland and coastal environments

2442 Julie Bond, 'Mollusca from the Roman Fort at Brancaster, Norfolk'

2661 The 'Upper Clay' coastline at Caister on Sea, Norfolk

2663 A note on the Coastal peat-bed at Sea Palling, Norfolk

2941 Caister-on-Sea Norfolk : Botanical Remains

2952 P. Murphy and B.M. Funnell. Brancaster Marsh, Norfolk : A preliminary study of the Holocene coastal sediments

* Little Shelford, Foulness, Essex: Holocene intertidal sediments, mollusca, cereals

Urban environments and economies

2374 Philip Taylor, 'Soil Report : Colchester'

2470 Philip Taylor, 'Gryme's Dyke, Colchester 10 B.C. to 43 A.D. The Base of the Rampart'

2516 Fruits and seeds from St Barnabas' Hospital, Thetford

2522 Cecelia Street, Ipswich : Wood

2526 Carbonised cereals and crop weeds from Sudbury, Suffolk

2667 Fruits and seeds from three sites in Ipswich (IAS, 4302, 5502 and 7402).

2668 Turret Lane, Ipswich (IAS 4302) : Land molluscs

2669 Turret Lane, Ipswich (IAS 4302) : Wood and Charcoal

2673 Norwich : Avian Eggshell

2674 Norwich : Marine Crustacea

2691 Helen Keeley and R. McPhail, Report on a soil at Ipswich, Suffolk.

2832 Recent Sediments of the Wensum Valley at Norwich : An interim report

2835 Queen Street, King's Lynn, Norfolk : Biological Remains

2836 Molluscs : St Barnabas' Hospital, Thetford

2939 Plant remains from two medieval floors, King's Lynn, Norfolk

2940 Foundation Street, Ipswich (IAS 5801): Plant remains

2952 Macroscopic Plant Remains from the Norwich Survey Excavations

* Balkerne Lane, Colchester, Essex (BJC J, K and T): Carbonised cereals and crop weeds

* Middleborough, Colchester : Miscellaneous samples

* Whitefriars, Norwich (421N) : Fruits, seeds etc.; wood; marine mollusca and other invertebrates; freshwater and land molluscs

* 45-46 High Street, Colchester: Carbonised fruits and seeds

* Anglia Television Extension, Norwich: Plant remains; soil report (by Richard McPhail)

* Moulsham Street, Chelmsford, Essex : Macroscopic plant remains

<u>Miscellaneous reports</u>

2494 Helen Keeley, 'Soil Report : Castle Rising, Norfolk'

2662 Buxton Mill, Norfolk : River valley sediments

2664 The contents of four Bronze Age Urns (Witton 7020, Runton 2778).

2829 Helen Keeley, 'A report on some soil samples from Earith, Cambs'

2833 Witton, Norfolk, Urnfield II : Plant remains from a late Bronze Age Urn

2834 Elsing Church, Norfolk : Miscellaneous biological remains

2840 Impressions of plant material on fired clay from a Roman kiln at Lakenheath, Suffolk (LKH 061)

2948 Thorington, Suffolk : Miscellaneous samples

* Some impressions of plant remains on prehistoric pottery from East Anglia I (Spong Hill, Orsett, Springfield Barns)

Dendrochronology

3003 Jennifer Hillam, 'Tree Ring analysis of Fen oaks from the Bronze Age settlement at West Row Fen, Mildenhall, Suffolk

3006 Jennifer Hillam 'Tree Ring Analysis: Cecelia Street, Ipswich (IAS 5001)

Human remains

2202 T O'Connor, 'Human Remans, Rivenhall Church, Essex'

2348 Justine Bayley, 'Human Bone: Chelmsford'

2900 Justine Bayley, 'Brancaster; the Human Remains'

2902 Helen Keely, 'Spong Hill, Norfolk. A report on Trace Element Analysis of Soil Samples from Two Graves'

Reports on charcoal and wood (by Carole Keepax)

2204 'Replaced organic material, Colchester'

2347 'Wood identification, Spong Hill'

2457 'Charcoal Identification; Inworth, Essex'

2561 'Wood Identification; Castle Acre Priory'

2599 'Remains of organic materials in association with metals; Brancaster, Interim report'

2608 'Iron-replaced Wood; Chelmsford'

2609 'Identification of Charcoal; Chelmsford, Site AR'

2658 'Identification of Charcoal; Chelmsford, Essex, Site AA'

2863 'Fe Replaced Wood; Chelmsford'

2865 'Replaced Organic; Brancaster'

2888 'Replaced Wood : Castle Acre Castle'

2889 'Replaced Wood : Chelmsford'

2895 'Organic etc. : Waltham Abbey'

2910 'Charcoal (and Mollusca) from Chelmsford (Mansio)'

3042 'Charred timbers from a Roman building at Chelmsford, Essex'

3048 'Charcoal samples from pottery kilns, Chelmsford, Essex (4th century)