Carbonised neolithic plant remains from The Stumble, an intertidal site in the Blackwater Estuary, Essex, England

Peter Murphy

During the first season's excavation of neolithic deposits at The Stumble, Essex, abundant carbonised remains of cereals (Triticum dicoccum, T. monococcum, Hordeum sp. var. nudum) were retrieved, but carbonised remains of rosaceous fruits, Corylus nutshell, and unidentified roots, tubers and rhizomes were also common, indicating a substantial reliance on wild plant foodstuffs. The presence of immature Tilia fruits may be related to the collection of leaf fodder. Sample composition suggests that the assemblages mainly represent accidental charring of semi-clean crop products, though one sample produced crop-cleaning waste. The results from this site provide, for the first time in Eastern England, a firm basis for discussion of a neolithic plant economy.

Introduction

During the early years of this century, the work of S. Hazzledine Warren, F. W. Reader and other investigators established that along parts of the Essex coast a submerged land surface and associated archaeological sites are exposed between tides (Reader 1911; Warren et al. 1936). In response to destruction by marine erosion, sea-wall improvement and other local threats, a systematic survey of the open coast and estuaries of Essex was begun in 1982, with the aim of locating and recording sites on this submerged land surface, and also prehistoric, Roman, medieval and later sites stratified within the overlying Holocene sediment prism (Wilkinson and Murphy 1986; Wilkinson 1987).

In the course of this survey, a group of early to middle neolithic settlements was found within the intertidal zone of the estuary of the River Blackwater. These settlements were originally dry-land sites when occupied and it is estimated that most were approximately 1 km from their contemporary coastline. There is thus no preservation of organic material by waterlogging, although the sites today are some 3 m below Mean High Water. However, they are of unusual significance because the overlying sediments deposited since the area was submerged by rising relative sea-level from c. 2000 B.C. have protected them from disturbance and erosion: the neolithic palaeosol survives essentially intact and shallow features are extant. Only now, as the sedimentary cover is stripped away, are they first exposed and then destroyed by marine erosion. In marked contrast, contemporaneous settlements on the adjacent gravel terraces of the Blackwater have been severely truncated by ploughing, so that only the bases of pits survive.

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Since 1986, one settlement, Blackwater Site 28, on a mudflat known as 'The Stumble', north of Osea Island (National Grid Reference TL 9014 0725), has been surveyed and selectively excavated (Wilkinson and Murphy 1987; Fig. 1). The palaeosol and dug features have been sampled for the retrieval of carbonised plant material, burnt bone and teeth (bone usually survives poorly), over three seasons between 1986 and 1988. In this preliminary paper, results from the 1986 season, when an area of 10 x 5 m was excavated (Site 28A), are presented. Already this one area has produced far more botanical material than any other neolithic site in Eastern England, and for the first time in this area there is a sound basis for discussing in some detail a plant economy for this period. It is intended that the results from all three seasons will, eventually, be published fully with the excavation report in the journal East Anglian Archaeology.

Methods

Sampling and processing of deposits from intertidal sites present a number of unusual problems, and it is thus useful to describe the methods used in some detail.

Samples were collected on a 1 x 1 m grid from the palaeosol during the second and third trowelling passes (samples 1-50 and 51-100 respectively), and from excavated features. Sample size was limited by practical considerations, in particular the weight of soil which could be transported from the site (initially on foot over extensive mud-flats, and subsequently by boat). Samples of 3-6 kg (dry weight) were taken from the palaeosol, and samples of varying weights from the fills of excavated features, depending on the size of the feature. On-site processing was not possible because the clay loam matrix of the deposits would not disaggregate readily.

On the basis of trial processing (Wilkinson and Murphy 1987, 71-3), the following methods were adopted:

(i) the samples, consisting of waterlogged clay loam, were stored in an unheated outbuilding with the bags open, allowing very slow drying;

(ii) after weighing, the dry samples were immersed in fresh water over a 0.5 mm mesh and wet-sieved when they had disaggregated (usually in a few minutes);

(iii) the material retained on the mesh (sand, shells of modern burrowing estuarine molluscs and plant detritus, with carbonised plant remains, bone and artefacts) was transported to the laboratory without drying;

(iv) after wet-sieving and washing with fresh water on a 6 mm mesh (to remove large shells, as well as artefacts, bone and large charcoal fragments), carbonised plant material was separated by flotation/washover with a 0.5 mm collecting mesh. The non-floating residues were wet-sieved on a 0.5 mm mesh. The 'flots' and residues were washed thoroughly to remove as much salt as possible;

(v) the residues were re-floated, because they still contained some charred material;

(vi) the dried 'flot' fractions, which consisted of mats of modern plant detritus with carbonised plant material, were gently broken down manually, before sorting under a binocular microscope at low magnification. After drying, some of the material had surface deposits of salt crystals, despite several stages of immersion in fresh water. It is possible that efflorescence of salt will cause fragmentation in the long term, but re-wetting the dried flots for a further washing would also be destructive;
Figure 1. Location of The Stumble. The modern Low Water Hark (LWM) approximates to the early neolithic High Water Mark.
(vii) finally, the residues were sorted for bone and small artefacts, without magnification. The weights of burnt bone fragments, charcoal and hazel nut shell fragments in the samples were also recorded.

Contamination

It was clear, during sorting, that the samples contained a mixture of carbonised plant macrofossils, burnt bone fragments and small artefacts, with intrusive biological material. The latter included foraminiferans, hydrozoans, mollusc shells, crustacean and insect remains, small fish bones and plant detritus (roots, stems, leaf fragments and seeds - mostly of halophytes such as Suaeda maritima, Plantago maritima, Triglochin maritima, Aster tripolium and Ruppia sp.). This intrusive material is likely to have been introduced into the neolithic deposits by the activities of burrowing organisms in two phases: firstly when the site was submerged in the early 2nd millenium B.C., and again, recently, since sedimentary cover was largely removed by erosion. There is no practicable way of separating macrofossils belonging to these two phases of estuarine conditions but none of them is of any relevance to the neolithic site and they can therefore be ignored. Obviously there is scarcely any possibility that any carbonised plant material or mammal bone has been introduced since the site was submerged by rising sea-level. One of the many advantages that this site has over dry-land sites is that the possibility of such contamination can be ignored - something that is not the case where neolithic settlement features occur within a multi-period, dry-land site.

The carbonised cereals

(i) Wheats (*Triticum* spp.)

Most grains in these samples were in a poor state of preservation, deformed, and with porous or abraded surfaces. Many could not be identified even to genus and others, though certainly of *Triticum* sp., were too distorted or fragmentary to be identified to species. However, of the better-preserved specimens, almost all were of *T._dicoccum*-type. There was a range of forms (Fig. 2 (a-f)). Typical emmer-type grains from two-grained spikelets had rounded or blunt apices, straight or slightly concave ventral surfaces, fairly rounded, often asymmetrical cross-sections, and maximum widths half-way up the grain or above. One specimen (Fig. 2 (c)) retained its apical brush of hairs and had fragments of inflorescence bracts fused to its surface. There were a few drop-shaped grains (Fig. 2 (b); cf. van Zeist 1968, 52). Grains with convex ventral surfaces, possibly from single-grained spikelets, also occurred.

Samples 1 and 9 produced two very battered grains which were thicker than broad and had rather curved, convex ventral surfaces and ridged dorsal sides. Their apices were damaged, but they appeared to have been rather pointed (Fig. 2 (g)). They are tentatively identified as einkorn, *Triticum* cf. *monococcum*. A deformed grain from sample 4 showed features mimicking a hexaploid, free-threshing wheat, but no definite bread wheat-type grains were seen.

The wheat spikelet fragments consisted of spikelet forks, glume bases, detached rachis internodes and 'spikelet bases'. This last term refers to forks that had lost all or almost all trace of their internodes and the outer surfaces of their glume bases: the most fragmented examples were barely recognisable as cereal chaff and none of these 'spikelet bases' could be specifically determined with any confidence. The relatively small proportion of better-preserved wheat chaff has been identified with reference to
Figure 2. Cereal grains from Site 28A: (a-f) *Triticum* dicoccum-type (from samples 81, 25, 59, context 138, and samples 60 and 78 respectively); (g) *cf. monococcum* (sample 9); (h-i) *Hordeum* sp. var. *nudum* (samples 72 and 21 respectively). Scale 1 mm.
unpublished criteria devised by Dr G. C. Hillman and to Jacomet's (1987) guide. The morphological criteria used in identification were as follows: presence/absence of nerves on the outer surface of rachis internodes (to detect any hexaploid wheats present); angle between glume faces on spikelet (viewed from above); angle between glumes on spikelet (viewed from front); prominence of primary and secondary keels and degree of tertiary nerve development on outer glume faces; angles between glume faces on either side of primary and secondary keels; distance between top of rachis internode scar and base of glume insertion; and relative width of rachis internode scar. The degree of precision in identification (e.g. *Triticum* sp., *J._ cf. dicoccum, J._ _ dicoccum*) is related mainly to the numbers of these features surviving on each specimen.

Measurements have not been used as a basis for identification, in part because of the poor state of preservation of the material. Rather few of the spikelet forks remained undeformed or retained the outer surface of their glumes, for example. The only dimension fairly consistently determinable was the width of detached glume bases, since these are often well-preserved. Jacomet (1987, 62) gives width ranges for einkorn of 0.45-0.9 mm and for emmer of 0.7-1.1 mm. However, in these samples, there were some very slender bases (less than 0.6 mm), with distinctively emmer-type morphology. Consequently the distribution of glume widths in this case is not likely to give a reliable separation. It is hoped that more, and better-preserved, spikelet fragments will be recovered in future seasons.

Some of the best-preserved material is illustrated in Fin. 3. Spikelet forms of emmer (*T. dicoccum*) are shown in Fig. 3 (a-d). They show wide angles between the glumes and the internode scars are generally narrow. On many specimens the internode scar was obscured by scraps of tissue remaining from the internode. Fig. 3 (e) illustrates a terminal spikelet fork of emmer. This has no ascending internode scar and the glumes are roughly symmetrical. The specimen shown is illustrated at an oblique angle: the crack in the glume makes it appear rather wide. The fork shown in Fig. 3 (f) is thought to be of einkorn (*T. monococcum*), from near the base of the ear. The surviving glume ascends almost vertically; it is narrow and has prominent primary and secondary keels, partly broken away, though (as in most cases) the outer glume face is rather abraded and damaged. Some of the spikelet forks (e.g. in sample 9 and from a post-hole fill, context 138) had wide internode scars. The example from sample 9 was simply too poorly-preserved to be identified specifically (the glumes were almost completely broken off), and the specimens from 138, though showing this einkorn-type feature, had emmer-type glumes set at an angle when viewed from above. They are assumed to be extreme forms of emmer.

Almost all the identifiable detached glume bases were of emmer. A typical example is shown in Fig. 3 (g). It has quite a prominent primary keel, the secondary keel is marked mainly by an obtuse angle on the glume face, and the tertiary nerves are visible, though rather faint. The glume faces on either side of the primary keel are at an acute angle. There were a few much more robust emmer glume bases with strongly-developed keels and tertiary nerves (Fig. 3 (h)). In context 138 there were some extremely narrow and badly-distorted glume bases, perhaps from immature ears. The slender glume base illustrated in Fig. 3 (i) shows very faint traces of tertiary nerves, and has the faces of its glumes on either side of the primary keel set at just under 90°.

Intact rachis internodes were very rare. The detached examples from 138 mostly had damaged outer faces, but none of them showed nerves on these abaxial surfaces (Fig. 3
Figure 3. Wheat spikelet and rachis fragments from Site 28A: (a-d) _Triticum dicoccum_ spikelet forks (a-c from sample 60, d from 30); (e) _Triticum dicoccum_ terminal spikelet fork, oblique views (context 138); (f) _Triticum cf. monococcum_ spikelet fork from near base of ear (context 138); (g-h) _Triticum dicoccum_ (g - typical glume base, sample 3; h - robust glume base, sample 60); (i-j) _Triticum cf. dicoccum_ (i - slender glume base from sample 60; j - rachis internode from context 138). Scale 1 mm. Blank areas enclosed by dashed lines were those obscured by sediment encrustations.
In summary, features of the grains and spikelet fragments indicate that emmer (T. dicoccum) was the main wheat in these samples. There was a small proportion of einkorn (T. monococcum), but the material is thought to be too poorly preserved to give an exact figure. No evidence for the presence of hexaploid wheats was seen.

(ii) Barley (Hordeum sp.)

Grains of barley were uncommon and the few specimens present were either underdeveloped or poorly-preserved (Fig. 2 (h-i)). Presumably a B-row form is represented, but all the grains in these samples are, or were, symmetrical (the grain shown in Fig. 2 (i) is deformed). The rounded profiles of these grains and, in some specimens, the presence of a central groove on the dorsal surface and a narrow ridge in the ventral furrow establish the presence of naked barley (var. nudum). No barley rachis fragments were seen.

(iii) Grass/cereal culm

Context 138 produced some quite large fragments of charred grass or cereal culm with a few nodes. The fragments were up to 10.5 mm in length and 1.4 mm in diameter, but generally less. There was also a single node from sample 60.

The weed flora

Carbonised fruits and seeds of weeds were uncommon, but in the samples from the palaeosol and most of the features 1/icia/Lathyrus sp(p). and Galium aparine were the two most frequent taxa. The former were represented mainly by badly damaged, separated cotyledons with some whole seeds which, however, did not retain well-preserved intact hila. Nutlets of Rumex sp(p). and Polygonum aviculare, seeds of Chenopodiaceae and small caryopses of Gramineae occurred in a few samples.

The assemblage from context 138 was different. As noted below, this post-hole seems to have contained a proportion of crop-cleaning waste, including weed seeds. In order of abundance, these were of Rumex sp(p)., Gramineae (at least three species), Chenopodium album, Polygonum cf. aviculare, Polygonum sp(p)., Vicia/Lathyrus sp(p)., Stellaria graminea and indeterminate Caryophyllaceae. However, the total weed 'seed' assemblage from this sample only comprised 39 identified specimens.

Nuts, fruits, etc.

Fragments of carbonised hazel-nut shell (Corylus avellana) were amongst the commonest macrofossils, though the density of fragments in the soil was very low. No intact nuts were recovered, apart from one almost complete immature nut, 6 mm in length. As mentioned above, weights of fragments in each sample were recorded.

Fragmentary fruitstones of sloe (Prunus spinosa) came from 15 samples. Most fragments were very small and were identifiable only from the rough surface of the endocarp; tentative identifications refer to abraded fragments. The most complete example, from sample 50, retained its prominent dorsal ridge. Context 164 produced a fruitstone of hawthorn (Crataegus monogyna), 5.0 x 3.7 mm in size. The fruitstone of Rubus sp. from sample 90 was in a poor state of preservation: only traces of the endocarp with its coarsely reticulate surface survived on the finely striated internal tissues. A few samples contained small enrolled fragments of tissue thought to be epidermis of apple (Malus sylvestris). Two immature fruits of Tilia sp. came from samples 52 and 89. Both were sub-spherical with pentagonal symmetry.
Carbonised tubers, rhizomes, roots and stem fragments

Fragments of vegetative plant material occurred frequently in these samples. The specimens were divided into nine main categories and examples of each type were shown to Jonathan Mather (Institute of Archaeology, University of London), to whom I am indebted for many of the comments below.

1. Swollen basal internodes of Gramineae (samples 10, 24, 52, 54, 61, 66, 75, context 164 and unlocated sample f). These pyriform or bulbous swollen basal internodes varied considerably in size (length approx. 3.0-5.4 mm; width 0.9-3.1 mm) and shape, depending partly on their original positions at the stem base, examples of lower internodes being rather rounded, the upper more elongate (cf. Hubbard 1968, 234). Epidermal cells are visible on the outer surfaces of most specimens (Fig. 4(a)) and many of them are fractured longitudinally, showing parenchyma on the fractured surfaces in radial longitudinal section (RLS; Fig. 4 (b-c)). They are similar to swollen basal internodes of the onion couch, Arrhenatherum elatius (L.) Beauv. ex J. & C. Presl. var. bulbosum (Willd.) Spennner.

2. Other Gramineae stem fragments with short interhodes (context 164). A fragment from this context, approx. 3 mm in length, comprises one whole and two incomplete internodes. It is longitudinally fractured and in RLS a central area of parenchyma, with fibre and vessel tissue at the periphery is visible. The very shortlength of the internodes implies an underground or basal stem section. (The presence of aerial grass/cereal stem nodes and fragments in context 138 and sample 60 has been noted above; see also Fig. 4(d).)

3. Monocotyledonous internodes with strong longitudinal ribs (sample 99). The specimen consists of two conjoined short internodes up to approx. 2 mm in width. There are faint traces of epidermal tissue on the ribs. In transverse section (TS), most of the cell structure has been reduced to amorphous carbon, though small lumina (probably of fibre cells) are visible in the 'rib' areas (Fig. 4(e)).

4. Section of dicotyledonous fleshy tap-root (sample 2). The specimen is an incomplete disc, comprising a transverse section across a root, approx. 5 mm in diameter, and about 1.5 mm thick. It is not clear why it has fractured in this way (longitudinal rather than transverse fracturing would probably be expected), though there is the possibility that it was cut before carbonisation. In TS, a radial pattern of linear cavities, very characteristic of degraded xylem parenchyma, can be seen, but the outermost thin band of tissue does not have such cavities and probably consists of degraded phloem and epidermis (Figs. 4(f) and 5(a)). A second fragment (from sample 44) shows similar degraded tissue with radial cavities, but is attenuated to a point at one end (Fig. 5(b)).

5. Central xylem and fibre 'cores' of ?roots (samples 1, 3, 16, 25, 31, 35, 51, 52, 57, 70, 79, 92 and 95). These specimens consist of small 'twig-like' fragments 0.4- 2.0 mm in diameter, irregularly curving, sometimes 'branched', and with numerous small side 'shoots' (Fig. 5(c)). In relation to the main axis, these diverge at all angles, suggesting the material is from roots rather than aerial stems. Their surfaces appear to consist of fibre tissue and they are thought to represent the central vascular and fibrous cores of roots that have lost their periderm, phloem and associated parenchyma. Specimens examined in TS show only solid masses of amorphous carbon. One specimen from 51 partly retains its outer tissues, represented by a sheath of porous and vesicular carbon.
6. Rhizome fragments with prominent circular root scars (samples 8, 10, 30, 34, 39, 40, 45, 62, 84, 85, 91). A typical example is illustrated in Fig. 5(d). Characteristic features are the short internode length, rather irregular longitudinal ribbing on the internode, and conspicuous circular root scars, some of which have hollow centres, whilst others have small central projections. The specimens are very irregular in width and often rather flattened. Traces of epidermal tissue are visible on some specimens.

7. ?Rhizomatous fragments of ill-defined form. Small and/or abraded fragments believed to be rhizomatous because of the short internode lengths and apparent root scars.

8. ?Inflorescence axis (sample 82). Flattened short length of stem with numerous small side shoots diverging at acute angles from stem axis (Fig. 5(e)).

9. Stem/rhizome with whorls of ?shoot or root bases jrt nodes (samples 62, 75, 85). These are quite robust lengths of stem, 2.0-2.6 mm in diameter, with short internodes at which there are whorls of small circular scars. There are also large circular scars on the internodes at intervals (Fig. 5(f)).

Some of these categories of vegetative plant material are quite distinctive, whilst others share features and may indeed have come from different parts of the below-ground structures of the same species of plant. With the exception of the onion couch basal internodes, none of the material is closely identifiable at present, though the author would be most grateful for any comments on identification from colleagues.

**Spatial distribution of macrofossils**

Sampling in a grid pattern across the excavated area has made it possible to draw up plans showing the distribution in the palaeosol of charcoal and burnt bone (as grammes of fragments greater than 2 mm per kilogramme of soil), *Corylus* nutshell fragments (grammes of fragments greater than 0.5 mm per kilogramme), cereal grains and glume bases (numbers per kilogramme), roots, rhizomes and tubers and fruitstones (presence/absence). These plans show that macrofossils are not uniformly distributed across the site: there are definite concentrations, some of which can be correlated positively with artefact distribution. However, it seems that the 1986 excavation was simply too small (10x5 m) for much sense to be made of these concentrations, let alone distinguishing 'activity areas'. It is hoped that results from the samples from the larger areas excavated in the 1987 and 1988 seasons, when added to those of the 1986 season, will produce interpretable patterns.

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Figure 4 (opposite). Scanning electron micrographs of plant remains from The Stumble: (a) Swollen basal internode of Gramineae, *Arrhenatherum elatius* var. *bulbosus*-type. Exterior surface showing epidermal cells (from sample 54).; (b), as (a) - fractured radial longitudinal section (apex at bottom right; from sample 61); (c) detail of specimen illustrated in (b), showing parenchyma cells; (d) grass/cereal aerial culm node (from context 138); (e) monocotyledonous basal internodes with strong longitudinal ribs (from sample 99); (f) dicotyledonous fleshy tap-root in transverse section (from sample 2).
The frequencies of the various plant taxa and elements identified in the samples are summarised in Table 1. Apart from charcoal (and the few bud, catkin and thorn fragments also retrieved), the plant remains fall into four categories: cereals; weed seeds; nuts and fruits; and vegetative material (roots, rhizomes, 'tubers', etc.).

Cereals occurred in the majority of samples (almost 94%), but a high proportion of these remains were too deformed, abraded or fragmentary to be identified more closely. However, it is quite clear that naked barley makes up only a very small proportion of the total assemblage (5.4% frequency, including tentatively identified grains). Wheats predominate: emmer is by far the most frequent and numerically abundant species and einkorn is rare and usually tentatively identified. These samples could be interpreted as indicating that cereal farming was essentially monocultural, based on emmer, with other cereals as contaminants of the emmer crop. However, the 1987 and 1988 samples may prove to contain different proportions of these or other crops. Spikelet fragments were fairly common but not as frequent as cereal grains. Sample composition is summarised in Fig. 6, in which numbers of cereal grains (excluding barley) are plotted against numbers of glume bases (calculated as loose glume bases + (spikelet forks + spikelet bases) x 2) as a scattergram. The cluster of samples containing less than ten grains and five glume bases is omitted for the sake of clarity. In samples composed mainly of two-grained wheat spikelets, a 1:1 grain-to-glume ratio would be expected, but clearly in most samples from the palaeosol there is an excess of grains. Interpreting the samples from this deposit in terms of specific activities is hazardous, for it is very likely that more than one phase or type of activity is represented. However, these samples could be interpreted as a background scatter of material across the site, produced during such domestic activities as spikelet parching and grain roasting. The fragments of inflorescence bracts fused to a grain from sample 59 imply carbonisation in the spikelet. Only one sample (from context 138) seems to contain a proportion of crop cleaning waste: it included culm nodes and fragments, its grain-to-glume ratio is about 1:7.5, and it had a relatively large number of weed seeds. The presence of culm fragments and nodes, albeit in small quantities, does perhaps give some indication that the earlier stages of crop processing were taking place at the site and this does imply production in the vicinity (cf. Hillman 1984, 33).

As has been noted above, the weed flora is very restricted. The two commonest taxa (Vicia/Lathyrus sp(p.) and Galium aparine) both comprise climbing or scrambling plants which would have ascended cereal culms. Their seeds/fruit could easily have been accidentally collected during harvesting, particularly if this involved ear collection by plucking or cutting. Furthermore, the large propagules of these plants would have been less easy to remove from the harvested crop than those of smaller-seeded weeds. In

Figure 5 (opposite). Scanning electron micrographs of plant remains from The Stumble: (a) detail of specimen in Fig. 5 (f), showing central area of degraded xylem parenchyma with linear radial cavities and outer band of phloem and epidermis; (b) dicotyledonous fleshy tap-root, tapering at one end (from sample 44); (c) central xylem and fibre 'core' of ?root (from sample 52); (d) rhizomatous fragment with prominent circular root-scars (from sample 8); (e) ?inflorescence axis (from sample 82); (f) rhizomatous fragment with whorls of small root scars and large circular root scars on the internodes (from sample 75).
Table 1. Frequency of taxa and plant elements. (Frequencies based on a total of 112 samples; figures in parenthesis refer to tentative identifications).

<table>
<thead>
<tr>
<th>Frequency</th>
<th>%Frequency</th>
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<tbody>
<tr>
<td>1. Cereals</td>
<td></td>
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<tr>
<td>Triticum dicoccum-type (emmer: grains)</td>
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<tr>
<td>T. dicoccum SchUbl. (emmer: spikelet fragments)</td>
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</tr>
<tr>
<td>T. cf. monococcum (einkorn: grains)</td>
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<tr>
<td>T. monococcum L. (einkorn: spikelet fragments)</td>
<td>1(+1)</td>
</tr>
<tr>
<td>T. sp(p). (indeterminate wheat(s): grains and spikelet fragments)</td>
<td>65</td>
</tr>
<tr>
<td>Hordeum sp(p). war. nudum (naked barley: grains)</td>
<td>4(+2)</td>
</tr>
<tr>
<td>Indeterminate cereal(s) (grains and fragments)</td>
<td>105</td>
</tr>
<tr>
<td>Cereal/grass (culm fragments and nodes)</td>
<td>3</td>
</tr>
<tr>
<td>2. Weed 'seeds'</td>
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<tr>
<td>Stellaria graminea L. (lesser stitchwort: seed)</td>
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</tr>
<tr>
<td>Caryophyllaceae indet. (chickweed family: seed)</td>
<td>1</td>
</tr>
<tr>
<td>Chenopodium album L. (fat-hen: seed)</td>
<td>1</td>
</tr>
<tr>
<td>Chenopodiaceae indet. (fat-hen family: seeds)</td>
<td>2</td>
</tr>
<tr>
<td>Vicia/Lathyrus sp(p). (vetches/tares: seeds and cotyledons)</td>
<td>42(+1)</td>
</tr>
<tr>
<td>Rumex sp(p). (docks: nutlets)</td>
<td>4</td>
</tr>
<tr>
<td>Polygonum auliculare agg. (knotgrass: nutlets)</td>
<td>1(+1)</td>
</tr>
<tr>
<td>Polygonum sp(p). (nutlets)</td>
<td>2</td>
</tr>
<tr>
<td>Galium aparine L. (cleavers: fruits and fragments)</td>
<td>13</td>
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<tr>
<td>Gramineae (grasses: caryopses)</td>
<td>a</td>
</tr>
<tr>
<td>3. Nuts, fruits, etc.</td>
<td></td>
</tr>
<tr>
<td>Corylus  aequalana L. (hazel: nutshell fragments)</td>
<td>95</td>
</tr>
<tr>
<td>Prunus spinosa L. (sloe: fruitstone fragments)</td>
<td>10(+5)</td>
</tr>
<tr>
<td>Crataegus monogyna Jacq. (hawthorn: fruitstone)</td>
<td>1</td>
</tr>
<tr>
<td>Rubus sp. (?bramble: fruitstone)</td>
<td>1</td>
</tr>
<tr>
<td>Malus sp. (apple: epidermal fragments)</td>
<td>(4)</td>
</tr>
<tr>
<td>Tilia sp. (lime: immature fruits)</td>
<td>2</td>
</tr>
<tr>
<td>4. Roots, rhizomes, tubers, etc.</td>
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<tr>
<td>Gramineae (swollen basal internodes - grass stem 'tubers')</td>
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<tr>
<td>Dicotyledon (fleshy tap-root fragments)</td>
<td>2</td>
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<tr>
<td>Other root/rhizome fragments</td>
<td>29(+9)</td>
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</table>
general, semi-cleaned crop products tend to include a high proportion of weed seeds in approximately the same size category as the crop itself (Jones forthcoming). It therefore seems that the composition of the weed seed assemblages in these samples has been influenced mainly by the growth habit of the weed plants and the limitations of crop cleaning by sieving or winnowing. Certainly the results available at present do not provide any useful information on the overall composition of the weed flora, nor is it possible to draw any inferences about cultivation methods.

Fragments of hazel-nut shell (Corylus avellana) were extremely common (almost 35% frequency, compared with 94% for cereals). However, the quantities of nutshell recovered were very small, rarely comprising more than about a tenth of a nutshell per sample. It is possible that this species was over-represented in terms of frequency, compared with cereals, since its nutshells are woody and would readily have become carbonised. Once carbonised, even small fragments would be durable and could easily have become dispersed across the site. Nevertheless, the high frequency of nutshell fragments does perhaps imply that hazel-nuts formed a significant component of the diet. There are good grounds for thinking that neolithic communities were capable of managing woodlands to produce specific

![Figure 6. Scattergram summarising numbers of grains and glumes in the samples containing more than ten grains and five glume bases.](image_url)
products, such as the hazel rods used in the construction of the Somerset Levels trackways (Morgan 1988, and references therein), and it is quite possible that in this case local ujoods were managed so as to provide suitable conditions for the flowering and nut production of hazel as suggested by Dimbleby (1967, 35 and 146).

Of the rosaceous fruits likely to have been available in nearby woods, *Prunus spinosa* (sloe) was the most abundant species in these samples. This again may in part be related to the durability of its fruitstones. Fruits of hawthorn (*Crataegus monogyna*), bramble (*Rubus sp.*) and *Malus* sp. (presumably crab-apple, *Malus sylvestris*), seem also to have been collected. The two immature fruits of lime (*Tilia sp.*) may indicate that lime branches and twigs were brought to the site in the summer months. These would, of course, have been leaf-covered, and it is possible that we have here some evidence for intentional collection of lime leaves. It has been suggested that the nutritious leaves of this taxon were used in prehistory as animal fodder (cf. Tinsley 1981, 238).

The samples also contained roots, rhizomes and 'tubers'. As Table 1 shows, swollen basal internodes of Gramineae occurred in 8.0% of samples, fragments of dicotyledonous fleshy tap-roots in 1.8% and other root and rhizome fragments in 33.9%. Plant organs of these types contain, in general, a high proportion of fleshy parenchymatous tissue and, hence, of water. It seems probable that such material is more likely to explode or fragment during carbonisation than are cereal grains or nutshells. Consequently such vegetative plant material is, if anything, likely to be seriously under-represented as carbonised macrofossils. The association of this material with undoubted foodplant remains suggests that some, or all, of it was intended for consumption, but close identification has not been possible.

The high density of carbonised plant remains in the deposits at this site is very marked. By contrast, neolithic features on the adjacent gravel terraces of the Blackwater contain very little material. For example, from 17 neolithic pits at the site of Lofts Farm, about 1.5 km north of the estuary, samples totalling approximately 292 litres were collected and processed. Only five of these contexts produced 'seed remains': two indeterminate cereal grains, one indeterminate grass caryopsis, fragments of hazel-nut shell and a scrap of *Prunus* sp. endocarp (Murphy in prep.). On the evidence available, this seems to be typical of neolithic features in East Anglia. Why, then, do the samples from The Stumble contain so much more material? One possibility is that there was a real economic difference between, say, the Lofts Farm site and The Stumble, cereal production being more important at the latter. However, one would have expected that the mainly light gravel-based soils of the river terraces would have been better-suited to neolithic agriculture than the clay-based soils around The Stumble. Furthermore, this suggestion does not account for the abundance of *Corylus* nutshells and rhizomatous material at The Stumble. Perhaps a more likely explanation is to be sought in terms of taphonomy. At Lofts Farm, only comparatively large pits were available for sampling, since the site had been truncated by ploughing. The functions of these pits, and the ways in which they were backfilled, are unknown. It appears that few remains of cereals and other foodplants became incorporated into their fills, perhaps because they were backfilled rapidly. The palaeosol, pestholes and other features which survived at The Stumble were obviously contexts that were 'open' for extended periods, providing ample opportunity for the incorporation of plant remains.

Moffett et al. (forthcoming) list and discuss earlier neolithic material from a number of sites in England and Wales. It is notable that virtually all the material has come from pits at truncated settlement sites or from ditches associated with ritual or ceremonial structures and that at almost every one of these sites densities of plant

36
material in the deposits are very low. The one marked exception (apart from The Stumble) is the site of Hazleton chambered tomb, Gloucestershire, where a buried soil sealed beneath the monument produced abundant cereals and Corylus nutshell. The implication of this for future work seems clear: pits, in general, have produced little material, whereas buried soils seem to be markedly more productive. The nature of the deposits burying the soil is irrelevant: they might be estuarine sediments (as at The Stumble), peats, colluvial deposits, blown sand or artificial earthworks. Whilst more work needs to be done on all types of neolithic deposit, large-scale flotation of buried soils must take a high priority.

In summary, the samples from the 1986 season are thought to provide a picture of a neolithic plant economy based in part on the production of cereals, mainly emmer, and in part on the collection of wild plant foodstuffs, including fruits, nuts, roots, rhizomes and tubers. There are real problems in making any quantitative assessment of the relative importance of cultivated and wild foods, for the different types of foodstuff differ both in terms of cellular structure and in the ways in which they might be prepared for consumption. These factors have probably resulted in differential preservation of the various categories of material. Nevertheless, the very marked contrast between the assemblages from these samples and those from later prehistoric sites in the same area, which are composed almost entirely of cereal remains, does seem to establish a substantial reliance in the neolithic on wild plant foods. This result is quite consistent with the general pattern for British neolithic sites discussed by Moffett et al. (ibid.).

The conclusions made after examining the 1986 samples should, of course, be regarded as provisional; two more seasons' samples await examination. The 1987 samples were taken in part from an area of excavation contiguous with the 1986 area, and it is hoped that these will help to make more sense of the spatial distribution of macrofossils across the sites. Samples were also collected in 1987 and 1988 from areas some distance from the 1986 area, including an apparent midden which contained very large unabraded pottery fragments. It is quite possible that samples containing different crops, crop products or waste material will be found.

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