The Eskmeals Project 1981–5: an Interim Report

Clive Bonsall, Donald Sutherland, Richard Tipping and Jim Cherry

INTRODUCTION

The Eskmeals Project is a study of the interaction between Mesolithic communities and their environment in a coastal setting, and centres on the area around the estuary of the River Esk, south-west Cumbria, on the edge of the English Lake District (inset, *Fig. 1*). The impetus for a major research project was provided by the important series of surface finds made here in the 1960s and 1970s by J. and P.J. Cherry (Cherry 1969; Cherry and Cherry, in press).

Fieldwork began in 1974 with a pilot excavation to test the potential of the area for further research; and was followed in 1975–7 by rescue excavations at Monk Moors Sites 1 & 2, in response to the persistent threat from ploughing (Bonsall 1981). Over the past five years the fieldwork has been intensified. The project has developed as an interdisciplinary investigation in which archaeological survey and excavation are integrated with detailed palaeoenvironmental studies. This research is directed at specific questions concerning the nature of late Mesolithic settlement in the Eskmeals area, the age, duration and season of occupation of the individual sites, and the environmental conditions at the time of their occupation. An important objective is to document the changing relationship between sea-level, coastal evolution and settlement patterns during the Mesolithic period, and to assess what impact the Mesolithic population had upon the local environment. It is with these aspects of the research that this paper is principally concerned.

The authors are all actively involved in the fieldwork: *Clive Bonsall* is overall coordinator of the project and has directed the archaeological investigations; *Donald Sutherland* has supervised the geomorphological studies; *Richard Tipping* has undertaken the palynological work and has helped to coordinate related studies of soils, diatoms, insect remains and plant macrofossils; while *Jim Cherry* has done much of the survey work, spending many hours in the field searching for, and locating, new sites.

Financial support has come from many sources: the British Academy, the Center for Field Research, the Carnegie Trust for the Universities of Scotland, the Cumberland and Westmorland Antiquarian and Archaeological Society, the Historic Buildings and Monuments Commission for England, the Society of Antiquaries of London, and the University of Edinburgh. Radiocarbon dates have been provided by the Scottish Universities Research Reactor Centre at East Kilbride (funded by the Natural Environment Research Council), the British Museum, and the Universities of Belfast and Glasgow. The support of all these institutions is gratefully acknowledged.

It should be emphasized that this paper is in no sense a final report.The Eskmeals Project is still in progress. What follows, therefore, is an *interim* statement of some of the results already obtained.

Eskmeals – the General Situation

The Eskmeals coastal foreland lies to the south of the present estuary of the River Esk. The eastern margin of the foreland is defined by a sharp break-of-slope that can be traced from the River Esk north of Newbiggin to south of Stubb Place (*Fig. 2*). To the landward, glacial sediments underlie an undulating topography of moderate relief that rises steadily inland to over 250 m in a few kilometres. The coastal foreland itself is formed by marine, estuarine and aeolian sediments resting on an eroded surface of glacial deposits. A complex sequence of shingle ridges has been produced by the dominant northwards-directed longshore movement of littoral sediment and in the lee of the shingle ridges estuarine sediments have accumulated. The aeolian deposits that have developed on the surface of the shingle ridges comprise a seaward area of constructional dunes eastwards of which a large, nearly flat, sand sheet has developed.

A series of channels transect the glacial deposits and apparently terminate at the edge of the coastal foreland. It is likely, however, that the lower portions of some of the channels continue below the coastal sediments. These channels, particularly along their present lower portions, have sediment infills that accumulated contemporaneously with the formation of the coastal foreland and thus preserve valuable evidence of mid- to late Flandrian environments.

Traces of Mesolithic occupation have been found mainly on the glacial deposits along the edge of the foreland, within a few hundred metres of the break-of-slope which marks the limit of the Flandrian

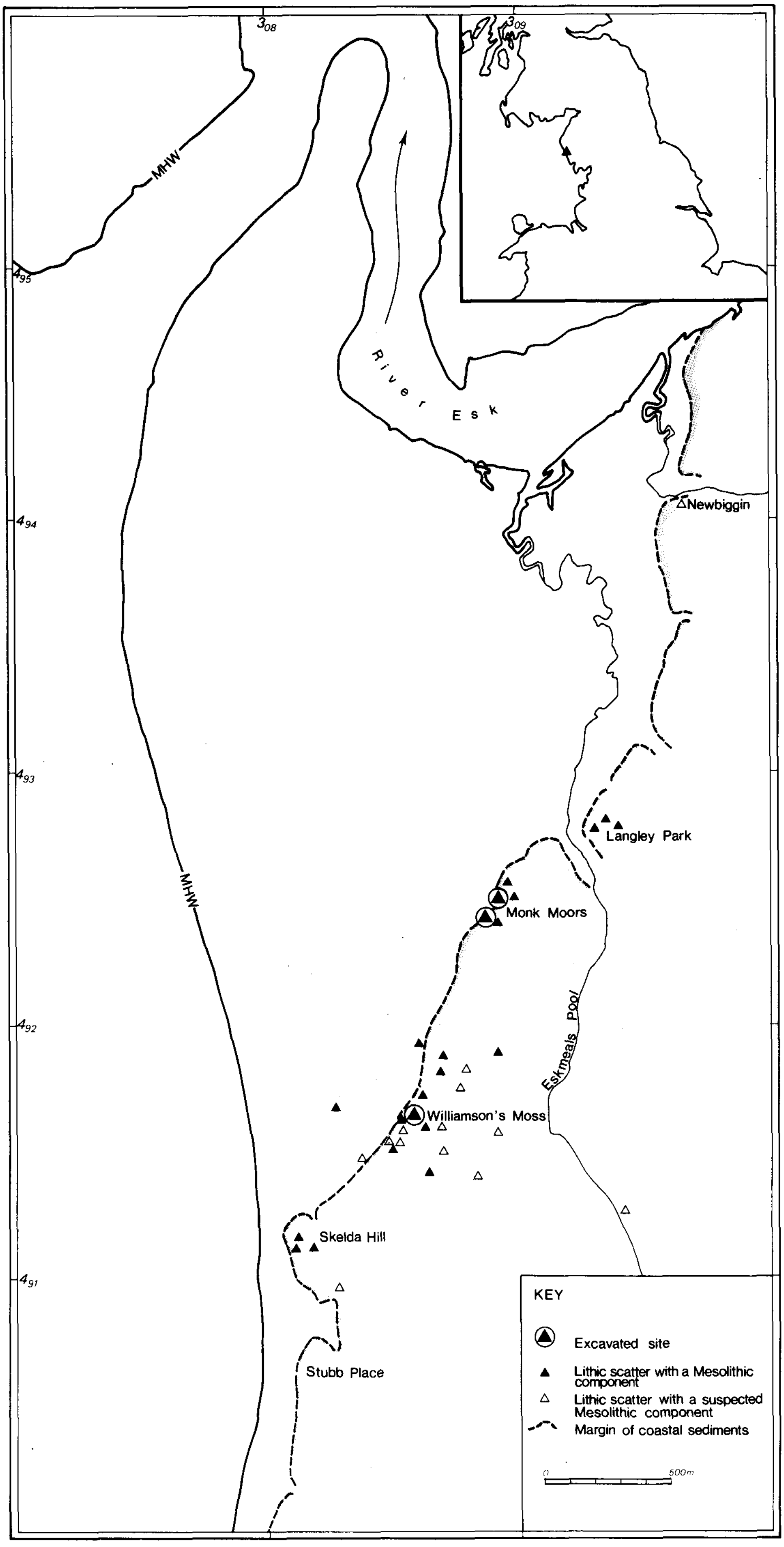
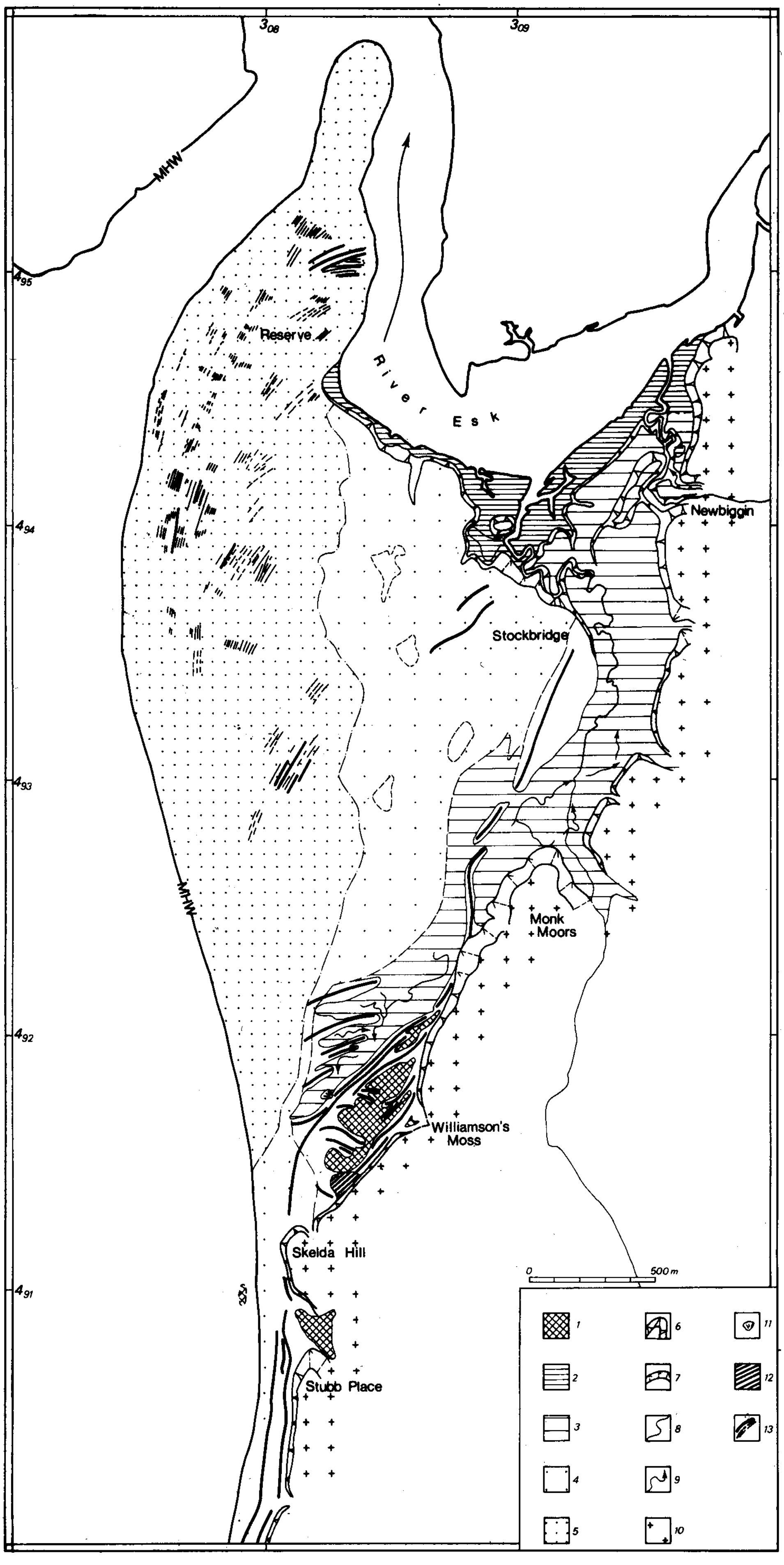


Figure 1 Distribution of Mesolithic sites in the Eskmeals area.



Key:
1. Peat-filled basins;
2. Present salt marsh;
3. Estuarine sediments;
4. Wind-blown sand sheet;
5. Constructional sand dunes;
6. Sharp break-of-slope;
7. Moderate break-of-slope;
8. Present streams;
9. Former stream channels;
10. Glacial sediments;
11. Alluvial fans;
12. Made ground;
13. Shingle ridges.

Figure 2 Geomorphological map of the Eskmeals area.

marine transgression (*Fig. 1*). Material has also been recovered from the shingle ridges surrounding the Williamson's Moss basin which are known to have formed by 6000 B.P. Of the 35 lithic scatters recorded to date, almost all were exposed where the present vegetation had been disturbed by ploughing or burrowing animals.

Archaeological distributions are frequently more a reflection of the activities of fieldworkers than of the original settlement pattern, and Eskmeals is no exception. The known sites are concentrated in areas where accessibility and modern agriculture have provided the best opportunities for fieldwalking. Some of the later shingle ridges may also preserve evidence of Mesolithic activity, and there are probably more sites to be found in the area north of Monk Moors and on the slopes above Eskmeals Pool. When a more uniform survey has been achieved, the distribution may alter substantially.

DEVELOPMENT OF THE COASTAL FORELAND

Introduction

A number of previous studies have published information relating to sea-level change along the Cumbrian coast during the mid- and late Flandrian (e.g. Walker 1966; Andrews *et al.* 1973; Huddart and Tooley 1972; Tooley 1974, 1977, 1978, 1982). No synthesis of these data in the form of a sea-level curve has been published. To the south, however, in northern Lancashire, Tooley (1974; 1978) has shown that Mean High Water of Spring Tides rose rapidly from below -15 m O.D. *c.* 9000 B.P. to reach O.D. *c.* 6500 B.P., thereafter rising to its present level of *c.* 4 m O.D.[1] To the north, in southern Scotland, Jardine (1975) has presented data that show that Mean High Water of Spring Tides rose above O.D. during the early Flandrian and reached *c.* 9 m O.D. by *c.* 6500 B.P., thereafter declining to its present level of *c.* 5 m O.D. The differences in the history of sea level between the areas north and south of Cumbria are largely the result of the diminution of glacio-isostatic uplift with increasing distance from the zone of maximum ice thickness in Scotland. These differences notwithstanding, the published work suggests that the evolution of the Eskmeals foreland must be understood in the context of a rapidly rising sea level during the early Flandrian followed, after *c.* 6000–7000 B.P., by a relatively stable, possibly slightly declining sea level.

Coastal development

The landforms and sediments of the Eskmeals coastal zone are shown in *Fig. 2*. The most notable features are the shingle ridges that underlie the foreland. The innermost shingle ridge can be traced from south of Stubb Place along the margin of the glacial sediments as far as Monk Moors. North west of Monk Moors the ridge is no longer in direct contact with the glacial sediments but can be traced as a clear feature as far north as Stockbridge. Instrumental levelling of this ridge indicates that it has an altitude of 8.27 m O.D. by Stubb Place, 7.52 m O.D. by Williamson's Moss and 7.63 m O.D. south of Stockbridge. The slight decline northwards suggested by these figures is in accord with observations on the modern beach. Shingle along the present beach opposite Stubb Place is moved by the sea to an altitude of 6.21 m O.D. whilst along the northern part of the foreland modern shingle is moved to an altitude of 5.36 m O.D. Comparison of the figures implies that the innermost shingle ridge was formed when sea level was 2–2.2 m higher than today.

The innermost shingle ridge was the earliest formed. Thereafter, Skelda Hill has operated as a 'hinge' northwards of which the shingle ridge complex has developed. The second group of shingle ridges to develop was that around Williamson's Moss thus isolating that basin from the sea. The main shingle ridge complex was built out subsequently with the recurving ends of the progressively-formed ridges being traceable within the area of blown sand to the north west of Stockbridge and into the Nature Reserve that occupies the northern margin of the ridge complex (*Fig. 2*). Levelling of these ridges reveals three distinct altitudes at which they were deposited. The first group includes those ridges that isolate Williamson's Moss and form the inner group of ridges as far as the Nature Reserve. These have been levelled at three separate localities from Williamson's Moss to the Nature Reserve, giving mean altitudes at each locality of 7.29 m O.D., 7.37 m O.D. and 7.48 m O.D. The altitudes imply only a very slight fall in relative sea level between the time of deposition of the innermost shingle ridge and the formation of the greater part of the shingle ridge complex.

The second group of shingle ridges is represented by the most seaward ridge at Stubb Place and a sequence of ridges within the Reserve and immediately to the south of there. At Stubb Place the ridge occurs at 7.18 m O.D. whilst in two localities in the Reserve, where there is a clear break-of-slope between the first and this second group, the ridges have altitudes of 6.38 m O.D. and 6.45 m O.D. By comparison with the figures on modern shingle given earlier, these altitudes imply a sea level during deposition of these ridges of 0.9–1.1 m higher than that of the present.

The third group of ridges has only been located in the Reserve where altitudes on three sets of these ridges have given average figures of 5.31 m O.D., 5.25 m O.D. and 5.66 m O.D. These altitudes are indistinguishable from that to which modern shingle is moved, implying no net relative sea-level change since formation of these ridges.

The development of the shingle ridges has allowed the accumulation of estuarine and lagoonal sediments on their landward sides. The first areas of such sedimentation were in the lee of the innermost shingle ridge in the area between Monk Moors and Newbiggin and in the channel mouth just north of Stubb Place. With the extension of the shingle ridge system similar sediments began to accumulate throughout the whole area landwards of the shingle ridges between Williamson's Moss and the River Esk. Two distinct surfaces can be identified in the area of estuarine sediments. The higher occurs at 5.80–6.00 m O.D. and the lower, found only to the west of Newbiggin, at 4.64 m O.D. The inner margin of the present salt marsh along the River Esk estuary has an altitude of 3.82 m O.D. implying that the two levels identified in the estuarine sediments were formed when sea level was 2–2.2 m and 0.8 m above that of today. There is therefore good agreement between the inferences concerning altitudes of shoreline formation that have been drawn from the shingle ridges and from the estuarine sediments.

Chronology

Radiocarbon dating of samples associated with the construction of the shingle ridge complex has established an outline chronology of the events discussed above.

A trench was excavated across the inner margin of the earliest formed shingle ridge at Williamson's Moss (*Fig. 5*). Small wood fragments were recovered from the basal layers of the shingle ridge where it rested upon an eroded till surface. These wood fragments gave an age of 7020±80 B.P. (SRR-2655). In the same trench, an organic sand layer with abundant rootlets, which had accumulated to the rear of the shingle ridge and was overlain by a tongue of washover gravels, was sampled. Because of potential contamination from rootlets, 'coarse' and 'fine' fractions were dated (SRR-2656), the former giving an age of 5060±50 B.P. and the latter 5640±50 B.P. These results imply a degree of rootlet contamination and hence the older date is considered a minimum. Taken together, however, the dates from this trench imply that the innermost shingle ridge was formed after 7020 B.P. but at some time prior to 5640 B.P.

The Williamson's Moss basin was formed by growth of the shingle ridges on its seaward side, hence dates from the basal sediments in the basin provide a limiting age on the formation of these ridges. Sample SRR-2657 was divided into alkali soluble and insoluble fractions because of possible humic acid contamination (Pennington in Harkness 1981) and these gave ages of 6140±170 B.P. and 5910±50 B.P., indicating negligible contamination. As a further check, an alkali insoluble date was obtained from the sediment immediately overlying the above sample. This gave an age of 5760±50 B.P. (SRR-5657) again confirming the reliability of the lower dates. These dates may be compared with one reported by Tooley (1982) on a 'regressive overlap' from Williamson's Moss of 6230±85 B.P. (HV-5227). This is statistically indistinguishable from the alkali soluble fraction of SRR-2657. Taking the dates together, they imply formation of the shingle ridges seawards of Williamson's Moss by *c.* 6100 B.P. Further, this also implies that the formation of the innermost shingle ridge, which is landwards of Williamson's Moss, was prior to 6100 B.P. and, given a period of time for construction of the shingle ridges around Williamson's Moss, may have formed prior to 6500 B.P.

No *in situ* marine shells have been found in association with the uppermost group of shingle ridges. However, in deflation hollows in the sand dunes *in situ* shells are abundant on the two lower groups of shingle ridges. Two samples, each of fragments of *Arctica islandica* in a good state of preservation, were recovered from the intermediate sequence of shingle ridges. These were dated as 4830±60 B.P. (outer) and 4800±60 B.P. (inner) (SRR-2659) and 4070±60 B.P. (outer) and 4020±60 B.P. (inner) (SRR-2660). The close agreement between the inner and outer fractions of each sample indicates minimal contamination. These shell dates have been normalized for isotopic fractionation and hence, to be comparable with dates on terrestial material, should be adjusted for the apparent age of sea water. The present best estimate for the sea around Britain is 405±40 years (Harkness 1983). Making this adjustment implies that the intermediate set of shingle ridges was being formed between 4395±70 B.P. and 3615±70 B.P.

Conclusions

The evolution of the Eskmeals coastal zone is illustrated in *Fig. 3* and may be summarized as follows. Early Flandrian sea-level rise culminated in the contemporaneous erosion of the landward glacial deposits and formation of the innermost shingle ridge between *c.* 6500 B.P. and 7000 B.P. Estuarine sedimentation began in the lee of this shingle ridge (*Fig. 3A*). Mean High Water of Spring Tides was then *c.* 2 m above that of today. Subsequently, and with only a slight fall in sea level, the greater part of the shingle ridge complex that underlies the Eskmeals foreland was constructed. The shingle ridges around Williamson's Moss were deposited prior to 6100 B.P. and a new phase of shingle ridge development, which had been preceded by a net fall in the relative sea level of *c.* 1 m, was underway by 4400 B.P. It seems likely, therefore, that the bulk of the Eskmeals foreland had been deposited by 5500 B.P. (*Fig. 3B*). The intermediate sequence of shingle ridges continued to form till after 3600 B.P. by which time most of the earlier estuarine sediments landwards of the shingle ridges had been abandoned (*Fig. 3C*). The sea subsequently fell by 0.8–1.1 m and a further phase of shingle ridge development began. This remains undated.

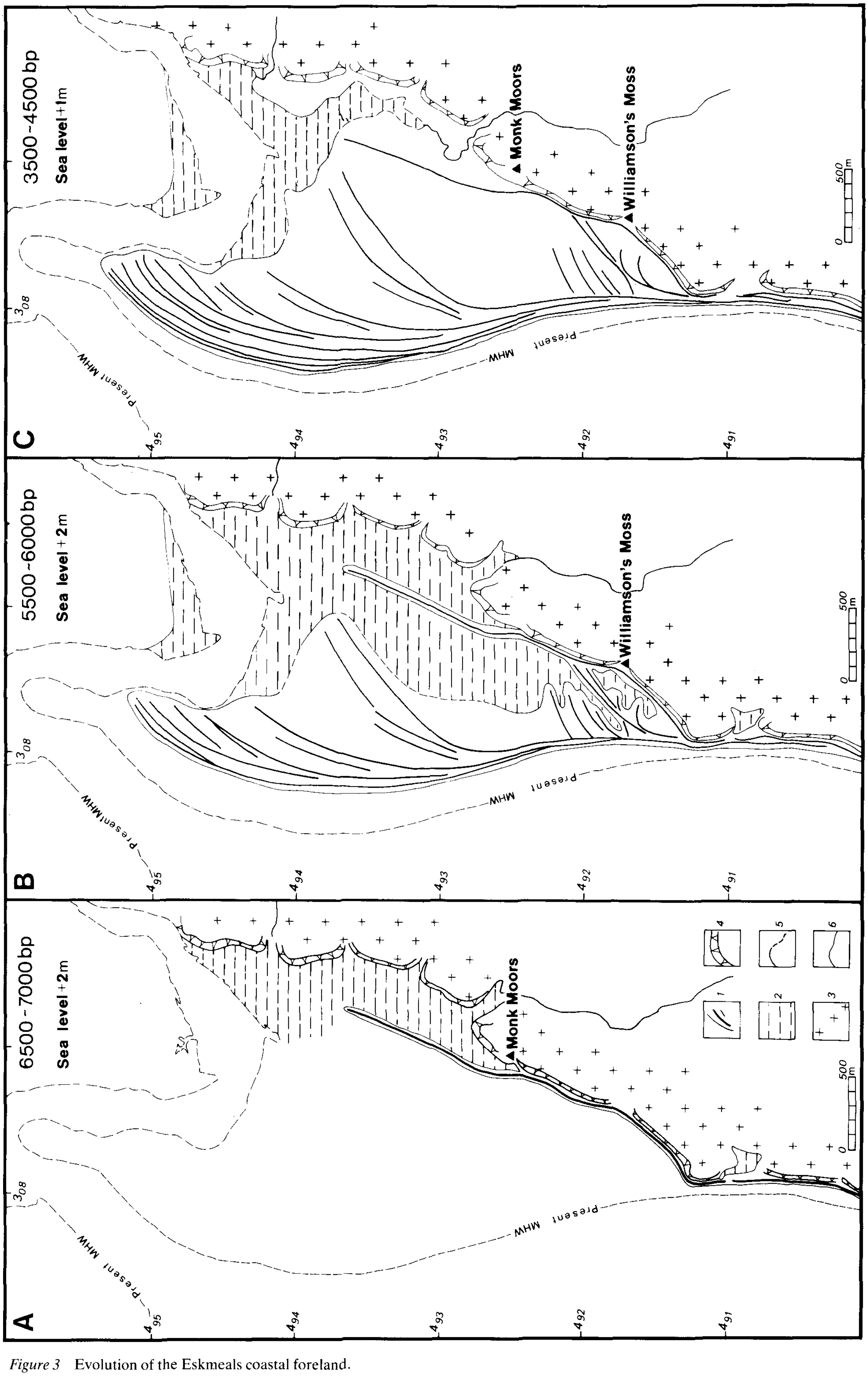


Figure 3 Evolution of the Eskmeals coastal foreland.
Key: 1. Shingle ridges; 2. Estuarine areas; 3. Glacial sediments; 4. Marked break-of-slope; 5. Feature boundary; 6. Streams. (On each diagram the archaeological sites known to have been occupied at the relevant period are shown).

ARCHAEOLOGY

Introduction

The excavations at Monk Moors were the first systematic investigation of Mesolithic sites in north-west England.[2] Their significance derived from the fact that they produced large lithic assemblages in association with structural remains, and provided the first Mesolithic floor plans and radiocarbon dates for a part of Britain where, previously, little research had been undertaken. Nevertheless, the evidence recovered was subject to major limitations. The sites occurred within the A-horizon of a shallow, free-draining and relatively acid soil, and had suffered extensive disturbance by ploughing. As a result, the archaeological material was unstratified and no faunal or other organic remains [3], which would have provided an insight into economic and social aspects of the Mesolithic occupation, were preserved.

As the Eskmeals Project continued, attention shifted to the area around the basin of Williamson's Moss where fieldwalking revealed widespread evidence of Mesolithic and later habitation (*Fig. 4*). The generally low-lying, ill-drained situation and the fact that much of the land bordering the Moss had been under rough pasture for a considerable time with few signs of past cultivation, seemed to offer much better prospects of locating sites with good organic preservation, where damage from ploughing would be minimal.

The Williamson's Moss site

Location

The site chosen for excavation is situated on the glacial deposits immediately landward of the shingle ridge formed by the highest Flandrian sea level, which extends along the eastern margin of Williamson's Moss (*Fig. 6*). At the time of ridge formation the edge of the glacial sediments was being eroded and a cliffline formed to the north west and south east of the Moss. Landwards of the shingle ridge the ground rises steadily for a distance of about 250 m to a height of about 15 m O.D.

The site itself occupies an area which is centred on the crest of a low ridge formed of glacial till at *c.* 8 m O.D. Those parts of the site that lie below the 7.5 m contour have been subjected to periodic flooding

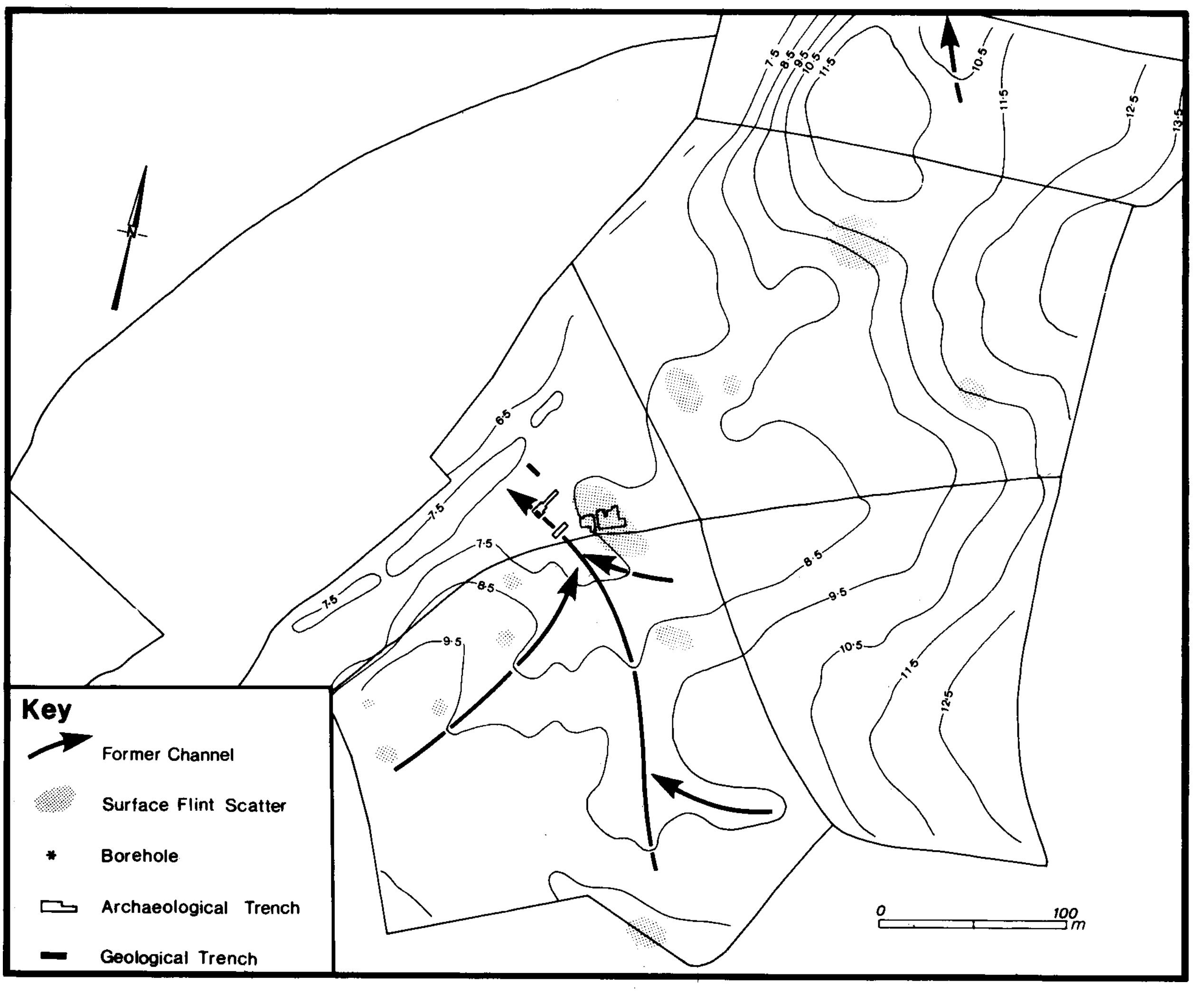


Figure 4 Map of the Williamson's Moss area showing the excavated site in relation to local topography.

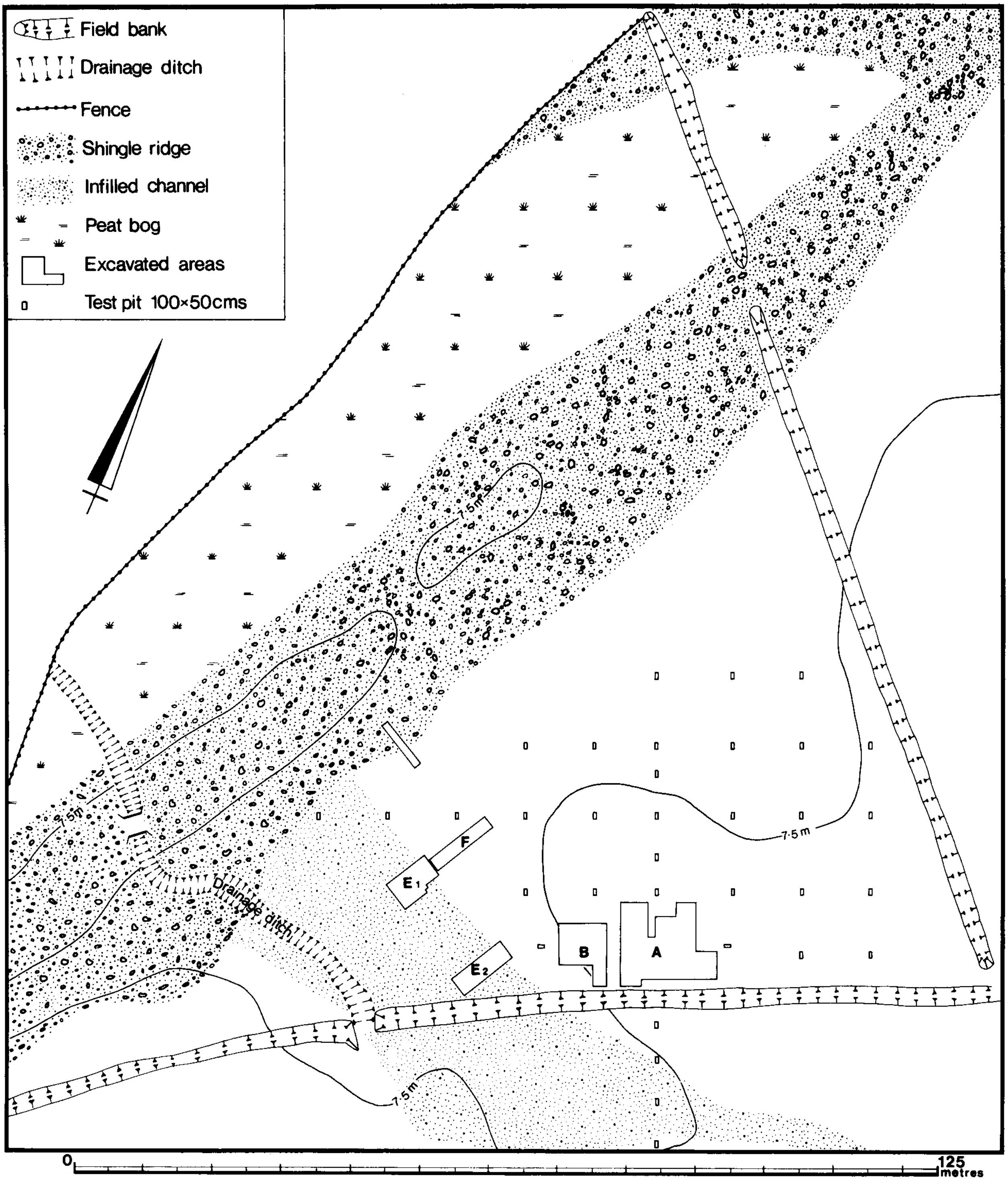


Figure 5 Map showing the Williamson's Moss excavation in relation to the shingle ridge and the infilled channel.

which resulted in the accumulation of fine alluvial sediments. These reach their greatest depth in the southern part of the site where they infill a narrow channel cut into the till – one of a series of channels that once drained the immediately landward area. This process of alluviation was initiated by the formation of the shingle ridge which dammed up the channels and caused ponding of surface run-off from the surrounding slopes.

The *buried land surface* beneath the alluvial sediments appears as a thin layer of fine sand overlying the till, and can be traced over a significant area of the site. The origin of this sand is uncertain. It may contain a windblown component derived from the coastal sediments; but it is likely to be largely the product of rainwash acting upon a partially devegetated till surface which resulted in the selective removal of clay and organic matter. This palaeosurface has considerable archaeological significance, since the artifacts and structural remains associated with it are effectively *in situ* – the first time at Eskmeals that traces of Mesolithic occupation have been found in a *sealed* context.

Excavation

Trial excavations were undertaken on the Williamson's Moss site in 1975–6 and again in 1979–80, with full-scale investigation beginning in 1981.

To date, an area of *c.* 275 m^2 has been exposed. This, however, represents only a very small portion of what is evidently a large and complex site. The precise limits of the site have yet to be determined, but traces of occupation have been shown to extend well beyond the area which contains the main concentration of lithic material. The excavation has been tied in to a continuous grid system. Individual one-metre and 50 cm squares have been excavated by trowel, and all the material sieved through a 3 mm mesh. Soil samples for pH, phosphate and magnetic susceptibility measurements have been taken at regular intervals across excavated areas and within stratigraphic units.

Soils, stratigraphy and archaeological preservation vary considerably over the site area. By far the best organic preservation is found in the waterlogged channel sediments, although pH values ranging from 4.2 to 5.0 have meant that very little faunal material has survived. The site is remarkably free from modern disturbance; the only major feature is an open drainage ditch which cuts through the southern part of the infilled channel (*Fig. 5*).

While the lithic assemblage gives an impression of typological homogeneity, it is clear from radiocarbon evidence and from the stratification of occupation debris in certain parts of the site that there was more than one episode of prehistoric occupation, spread over at least two millennia. The major structural remains can be related to Mesolithic settlement, although there is evidence of re-use of the site during the Neolithic and Bronze Age.

For present purposes, the site may be divided into three parts: the till ridge (Area A); the lower-lying areas where the Mesolithic land surface is preserved beneath alluvial sediments; and the infilled channel which offers the best preservation and stratification of archaeological remains.

Area A

Interest focused initially on the till ridge which forms

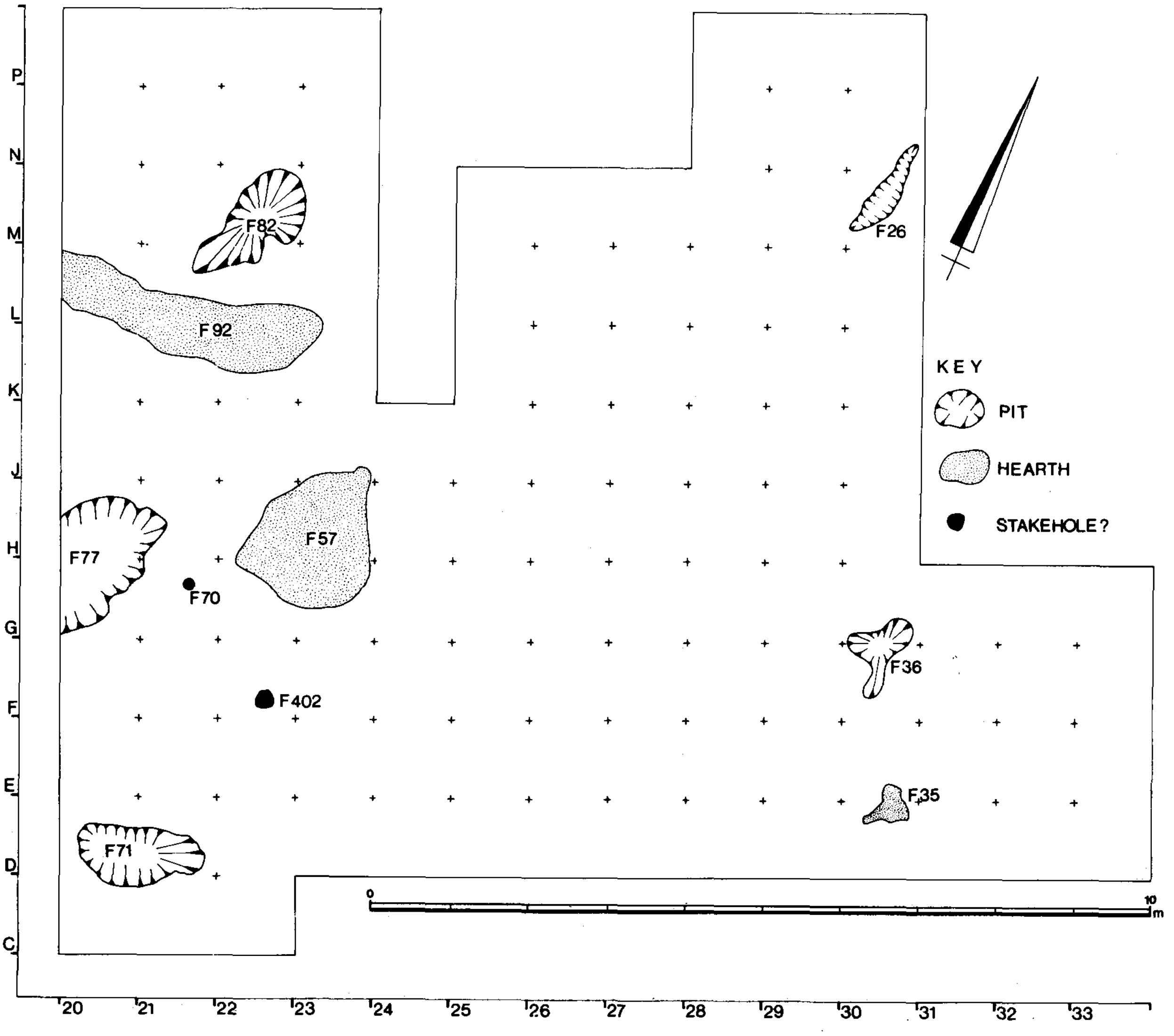


Figure 6 Area A: structural remains as exposed at the end of the 1985 season.

the highest ground in the site area. This affords a relatively well-drained situation and it seemed possible that it formed a focal point for settlement, and therefore would be the part of the site most likely to contain the remains of dwellings. In fact, nothing was found to suggest that it had functioned primarily as a residential area.

The most notable feature was the massive concentration of artifacts – more than 34,000 worked pieces of flint, chert and volcanic tuff, including over 600 finished tools, have been recovered from an excavated area of just 125 m^2. Within this same area were a variety of structural remains comprising hearths, small pits and possible stake holes (*Fig. 6*).

Marked differences in the character of the hearths and of the pit infillings suggest that these features are not all of the same age, but represent a kind of 'palimpsest' resulting from successive occupations. Evidence of Neolithic and Bronze Age activity elsewhere on the site suggests that some of the features at least post-date the Mesolithic occupation. So far the only tangible evidence to support this interpretation is the presence of a few sherds of pottery of 'Middle Neolithic' type.[4]

Another obvious product of human activity was the presence of large quantities of introduced material. Several features were infilled with loose, medium sand; while the entire area was littered with stones, many of them well-rounded cobbles. Since this material is not a normal component of the till underlying the site, it may be inferred that it has been removed from the nearby shingle ridges.

There has also been considerable vertical movement within the soil. Artifacts, imported stones and charcoal have been found dispersed through the upper 50 cm of the profile. The actions of roots, earthworms and moles, and movement down dehydration cracks in the till, have all contributed to this; but the major factor was most probably *trampling* associated with successive episodes of occupation. The effects of human trampling are probably widespread on prehistoric sites in Britain, particularly those on clay soils, yet often go unrecognized. At the early Mesolithic site of Deepcar in the southern Pennines, for example, Radley (Radley and Mellars 1964: 3–4) noted that flint artifacts were dispersed through 40 cm of an unusually compact clay soil, with the largest pieces tending to occur lower down the profile. No explanation for this was offered. The same phenomenon, however, has been observed in damp clay soils in caves, where it has been attributed to trampling during human occupation (Stockton 1973). The archaeological implications of trampling are important, since re-utilization of a site can lead to severe disturbance of the remains of an earlier occupation. At the Williamson's Moss site it is therefore possible that certain kinds of structural evidence (e.g. hearths and post-holes) associated with Mesolithic occupation have been destroyed by subsequent Neolithic or Bronze Age activity.

The evidence from Area A presents similar problems of interpretation to those encountered on the Monk Moors sites. There has been no appreciable build up of sediment during the Flandrian, and hence there is no clear stratification of the archaeological remains. The only organic material to have survived is wood charcoal and a few carbonized fragments of hazelnut shells; these samples were often too small for conventional radiocarbon dating. The most difficult problem, therefore, has been to establish the relative and absolute ages of the different features here, and to determine which, if any, were contemporary with the Mesolithic occupation. Through a detailed comparison of the archaeological sediments by means of magnetic susceptibility measurements, micromorphological examination and pollen analysis, together with the application of small counter and accelerator techniques of radiocarbon dating, it should be possible to reconstruct the sequence of events in this part of the site.

The lithic assemblage

The lithic assemblage from the site was concentrated mainly in an area about 50 x 30 m, coinciding with the till ridge. The major component is undoubtedly Mesolithic, and is represented by large numbers of microliths and microburins. The microliths are typical of those found in 'Narrow Blade' industries, which in the North of England have a time-range from *c.* 8800–5200 B.P. The dating evidence discussed below suggests that the Williamson's Moss industry falls towards the end of that time-range. A Neolithic and/or Bronze Age component is also suspected but is difficult to identify, because of the nature of the raw material used (small beach pebbles) and the lack of stratification in this part of the site. The only clearly post-Mesolithic artifact recovered so far is a single leaf-shaped arrowhead.

The lower-lying areas

The artifact concentration declines rapidly away from the higher ground. Material has been found over the rest of the site, but the distribution is sporadic and densities rarely exceed 5 per m^2. On the other hand, structural remains are widespread in these lower-lying areas.

Work so far has concentrated in a zone bordering the infilled channel (Area B and Area F); although test pits have been dug at regular intervals over the northern part of the site. Outside the channel area, the deposits overlying the till can be divided into two stratigraphic units: a thin layer of fine sand which defines the buried land surface; and, above this, a series of alluvial sediments which are up to 60 cm thick.

The alluvial sediments formed through intermittent flooding of the areas immediately behind the shingle ridge. They contain abundant evidence of human activity. Considerable quantities of well-sorted sand and fine gravel occur as shallow lenses or, where there has been mixing as a result of trampling, as irregular pockets of coarser material. This sand and gravel resembles beach material and contrasts with the surrounding sediments. It is therefore interpreted as material brought onto the site by man. Traces of fire are also widespread. High carbon and potassium values were recorded in Area B indicating the presence of large amounts of wood ash within the soil. Recognizable hearths either consist of dark lenses of charcoal powder up to 50 cm across and 10 cm thick, or appear as more extensive spreads of charcoal fragments, sometimes associated with fire-cracked stones. The absence of baking of the underlying sediments suggests that the majority of these features are the remains of low temperature fires (cf. Butzer 1981: 84). Three hearths at different levels within the alluvial sediments have given dates of 3665±40 B.P. (UB-2568), 3756±104 B.P. (BM-1396), and 4925±165 B.P. (UB-2711), consistent with their relative stratigraphic positions (*Table 1*). The earliest of these occurred at a level just above the buried land surface.

On the basis of the evidence recovered so far, it would appear that the archaeological remains in the alluvial sediments relate mainly to Neolithic and later activity. No dwellings or other large-scale structures have been recognized. The overall impression is of frequent, but short-term, use of the site, with no indication of major or prolonged settlement.

Table 1: Radiocarbon dates for the Williamson's Moss site

Lab. No.	*Context*	*Date B.P.*
UB-2544	Area E1. Wood (oak). Part of timber lattice of Structure 1.	6015 ± 75
UB-2545	Area E1. Bark fragments (birch). Part of brushwood covering of Structure 1.	5650 ± 50
UB-2545	Area E1. Bark fragments (birch). Part of decayed brushwood covering of Structure 1.	5555 ± 40
UB-2712	Area F. Bark fragments (birch). Part of bark floor on buried land surface.	5520 ± 85
GU-1664	Area F. Bark fragments (birch). Part of bark floor on buried land surface.	5500 ± 70
UB-2713	Area E1. Bark fragments (birch). Part of bark floor on timber and earth platform (Structure 2).	5480 ± 90
UB-2711	Area F. Charcoal from hearth in alluvial sediments overlying buried land surface.	4925 ± 165
BM-1396	Area B. Charcoal from hearth (F23) in alluvial sediments overlying buried land surface.	3756 ± 104
UB-2568	Test Pit AP36. Charcoal from hearth in alluvial sediments overlying buried land surface.	3665 ± 40
UB-2715	Area E2. Charcoal from hearth overlying Structure 5.	3480 ± 80

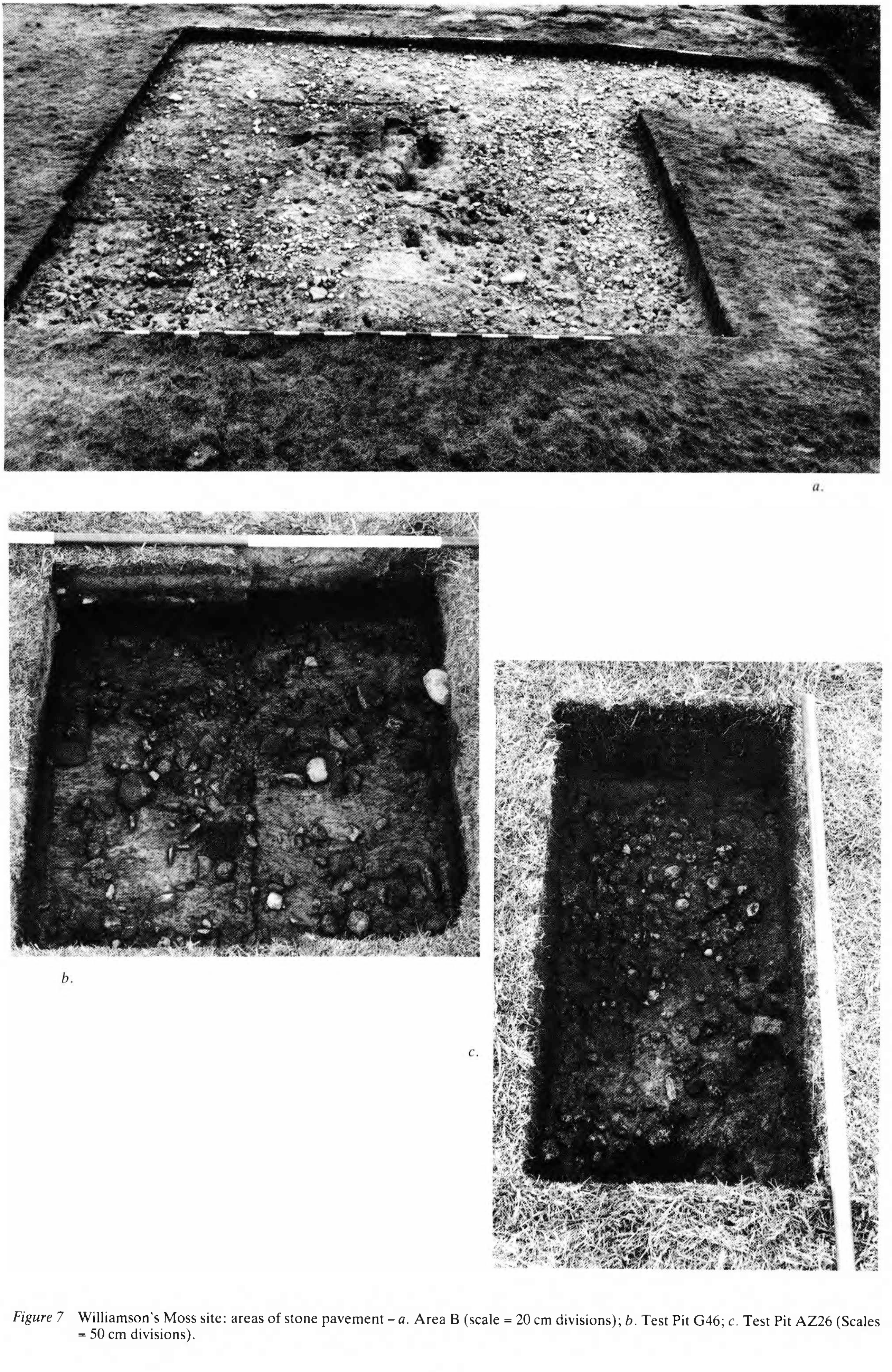
Structural remains associated with the buried land surface are quite different in character, and comprise a number of areas of *stone pavement*. These were constructed of densely packed, well-rounded pebbles and cobbles put down as a thin layer on the contemporary ground surface. Again, these stones can only have been obtained from areas of exposed shingle along the coast. The main example uncovered so far occurs in Area B where the buried land surface slopes down towards the edge of the infilled channel (*Fig. 7a*). Similar stone concentrations have been located in test pits in the area north of the till ridge (*Fig. 7b*). As yet these features are undated, but their stratigraphic position suggests that they are related to Mesolithic occupation of the site.

Stone pavements are known from only three other Mesolithic sites in Britain – Barsalloch in Wigtownshire (Cormack 1970), Culver Well in Dorset (Palmer 1976) and Dunford Bridge A in South Yorkshire (Radley *et al.* 1974). They are found much more widely, however, on mainland European sites. Newell (1981: 245) has suggested that such features were integral parts of dwellings. This provides a plausible explanation for those examples where the paving forms a tightly defined rectangular, oval or circular area, or is related to other structural elements such as hearths and post-settings. However, interpretation of the stone pavement in Area B of the Williamson's Moss site as a 'dwelling surface' presents several difficulties, not least of which is the absence of associated structural features, and the lack of floor matting which occurs elsewhere on the site. Rather, this feature is best interpreted as a means of creating a firm, stable surface where the ground, by virtue of the damp clay subsoil, was naturally soft. The use of stones to consolidate a surface that was liable to 'puddling' as a result of constant movement of people across it does not necessarily imply a residential function.

It would be premature to suggest an interpretation of the other areas of stone pavement identified on the Williamson's Moss site. These may indeed prove to be hut floors, but a full analysis will only be possible when further excavation has been carried out.

The infilled channel

This is a small feature, less than 30 m across at its widest point. It begins a few hundred metres behind the site and is incised quite deeply into the glacial deposits, reaching a depth of 3 m where it abuts against the shingle ridge (*Fig. 5*). Once the channel had been dammed up by the shingle ridge – an event that occurred between 6500–7000 B.P. – it filled in rapidly with sediment, initially sand and subsequently silt and clay washed down from the surrounding areas. Within less than a millennium it was converted from an active stream channel into a strip of low-lying and presumably very soft ground which, at times of high rainfall, would have been liable to flooding.



a.

b.

c.

Figure 7 Williamson's Moss site: areas of stone pavement – *a*. Area B (scale = 20 cm divisions); *b*. Test Pit G46; *c*. Test Pit AZ26 (Scales = 50 cm divisions).

Such waterlogged ground seems an unlikely place for human occupation. Yet the channel sediments contain the clearest traces of structures found so far on the Williamson's Moss site. The construction of these features involved the use of substantial amounts of timber, made up largely of branches and sections of trunks of mature oak trees, together with quantities of brushwood and bark. These features mainly relate to a level about a metre below the present land surface.

Two trenches (Areas E1 and E2) have been opened on the north side of the channel (*Fig. 5*). These exploratory excavations are unfinished. The following discussion, therefore, is a preliminary assessment.

Area E1

Remains of two different types of structure have been uncovered in this trench (*Figs. 8 & 9*).

Structure 1. This is a raft-type foundation or platform, and is made up of two basic elements. The first is a series of oak branches laid horizontally on the channel surface. There are two sets of branches, one on top of the other, arranged in a grill or lattice pattern. The other element is a layer of black, well humified peat up to 30 cm thick composed of twigs, thin branches and bark, which occurs between and on top of the main timbers (*Figs. 10 & 11*). This is interpreted as the decayed remains of a layer of birch brushwood placed on top of the timber lattice. This type of structure would have formed a stable foundation on which other structures could be built or which would support the weight of people. The use of this type of foundation for houses, jettys, trackways, etc. built on soft marshy ground is well-documented in both ethnographic and archaeological contexts (Edwards 1934; St. George Gray and Bulleid 1953; Manning 1961; Coles 1984). A timber lattice provides a rigid base that will counteract the tendency for differential settlement in response to any variation in loading. In other words, any load placed on top of such a foundation will tend to be distributed evenly across the underlying surface. Such a structure is made more stable if the timbers are fixed at the cross points. Interestingly, tool-marks have been found on one of the timbers of Structure 1 (T13) close to the point where it crosses over one of the underlying branches. These consist of fine cuts and the characteristic 'chatter-marks' left by whittling or shaving the wood with a sharp-edged implement. On another part of the branch are a series of fine grooves which may have been caused by some form of binding (*Fig. 12*). However, it is difficult to be certain if any of these traces resulted from attempts to stabilize the timber lattice. Given the low-lying, wet situation, it is suggested that this timber and brushwood structure was designed to provide a platform raised above a surface that was periodically inundated by water.

Structure 2. The two larger timbers (T1 and T2) form part of a second structural complex (*Figs. 8 & 9*). Both are sections of oak trunks, and have been placed on approximately the same alignments as the branches which form the timber lattice of Structure 1. T1 was laid on the buried land surface at the point where the channel sediments lap onto the till. T2 is a much larger piece which extends from the same point out across the channel surface. Infilling the area along the north side of T1 to a level corresponding to the upper surface of the timber, and extending in a narrow zone across the trench, is a heterogeneous mixture of clay, sand and stones with a distinctly uneven surface. This is not a naturally formed sediment, but consists of materials from different sources that were deliberately mixed together and dumped. Similar redeposited material seems to infill the area along the east side of T2, although this needs to be confirmed by further excavation.

This complex of features, then, represents an alternative method of constructing an artificial raised surface or platform, and of building it out across the soft ground of the infilled channel – that of using earth and stones to fill in behind a timber revetment. The ground behind these two retaining timbers has been built up to a level about 40 cm above the contemporary channel surface.

Associated with this platform are the remains of extensive areas of bark flooring. In places the flooring is very well preserved and has been made up of superimposed layers of bark fragments laid down as a dense mat up to 10 cm thick (*Fig. 13*). Elsewhere it has decayed to form a thin layer of peat with a distinctly 'platy' structure. The largest area of bark matting (F80) can be traced for a distance of over six metres from the point where it overlies the 'made ground' into the adjoining trench (Area F), where it rests directly on the buried land surface (*Fig. 9*). The presence of bark matting on the platform and the adjacent land surface suggests that this part of the Williamson's Moss site was a 'living area'. The use of bark as insulation for hut floors is attested at Mesolithic sites in Denmark and neighbouring areas of Northern Europe (Clark 1975). Birch bark was often preferred to other types because of its water-repellent properties and the ease with which it could be removed from trees.

Chronology

In order to date Structures 1 & 2, six samples were submitted for radiocarbon dating (*Table 1*, Samples 1–6).

A sample of oak from the timber lattice of Structure 1 gave an age of 6015±75 B.P. Two samples of birch bark from the base and upper part of the overlying layer of decayed brushwood respectively gave dates of 5555±40 B.P. and 5650±50 B.P. Three samples of birch bark from the two areas of bark flooring associated with Structure 2 gave ages of

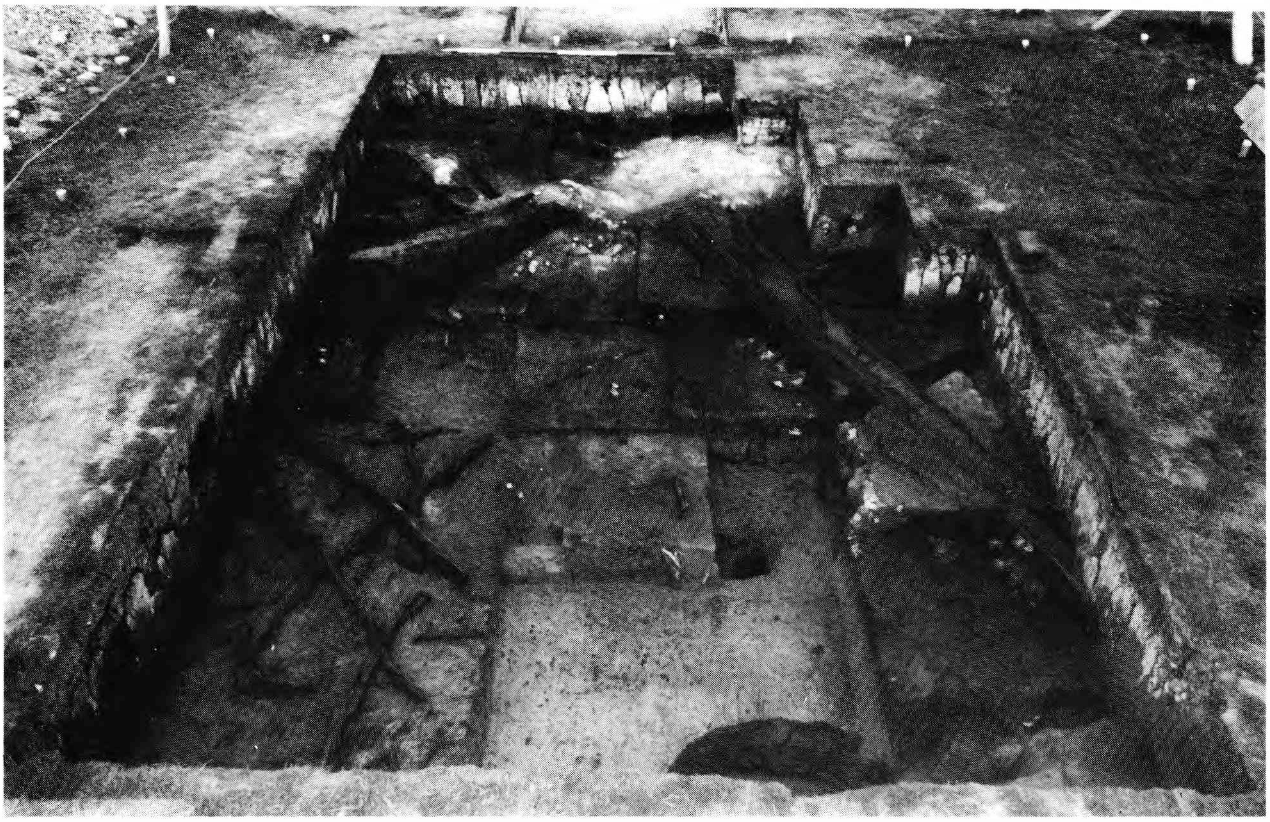


Figure 8 Area E1: structural remains as exposed at end of the 1983 field season (scale = 50 cm divisions).

5520±85 B.P., 5500±70 B.P. (F80), and 5480±90 B.P. (F53).

Since dates on bark are contemporaneous with the removal of the bark from trees and its incorporation in the structures concerned, then these dates closely relate to the period of construction. The bark dates are statistically indistinguishable and indicate that Structures 1 & 2 were built *c.* 5550 B.P.

No diagnostic artifacts have been found in direct association with either Structure 1 or Structure 2. Such artifacts as do occur within or immediately below the bark flooring could belong to a Mesolithic or post-Mesolithic industry. Elsewhere on the site there is a preponderance of diagnostically Mesolithic artifacts and no clearly Early Neolithic artifacts (either of stone or pottery). It is therefore concluded that the structural remains in Area E1 were contemporary with occupation of the Williamson's Moss site by people who possessed a late Mesolithic technology.

The date of 6015±75 B.P. on a sample of oak from one of the foundation timbers of Structure 1 is *c.* 450 years earlier than the decayed brushwood covering of this feature. In common with the other oak timbers found in the channel area this sample comprised heartwood and hence would have an initial age of perhaps 100–300 years (cf. Rackham 1976; Campbell and Baxter 1979). This does not explain the whole difference. However, it is notable that there is little evidence for *in situ* decay of the timbers, implying that the bark and sapwood had already decayed prior to the use of the timber for constructional purposes (this is also implied by the well-preserved traces of working on T13). Given the limitations of Mesolithic technology[5] it may be inferred that dead timbers were utilized for the structures under discussion, and that this explains the remaining difference in age between the oak timbers and the other platform elements.

Area E2

As in Area E1, the description and interpretation of the structural remains in this trench are hampered by the incomplete state of the excavation. However, a similar pattern can be discerned (*Figs. 14 & 15*).

Structure 3. At the southern end of the trench another group of crossed timbers has been uncovered (*Fig. 15A*). This feature resembles the timber lattice of Structure 1, and is enclosed by the same type of peat deposit. It is suggested therefore that this is the remains of a second raft-type foundation of timber and brushwood. However, certain differences may be noted. The larger timbers appear to be radial sections of oak trunk with relatively flat surfaces, rather than branches as were used for Structure 1. The lowermost timbers rest on a surface at *c.* 6.25 m O.D. – some 20 cm higher than the surface underlying Structure 1. The uneven character of this surface and the presence of lumps of irregularly-mixed sand and clay, suggest that this is another example of 'made ground'. Therefore, the difference in level between Structures 1 and 3 need not necessarily imply a difference in age.

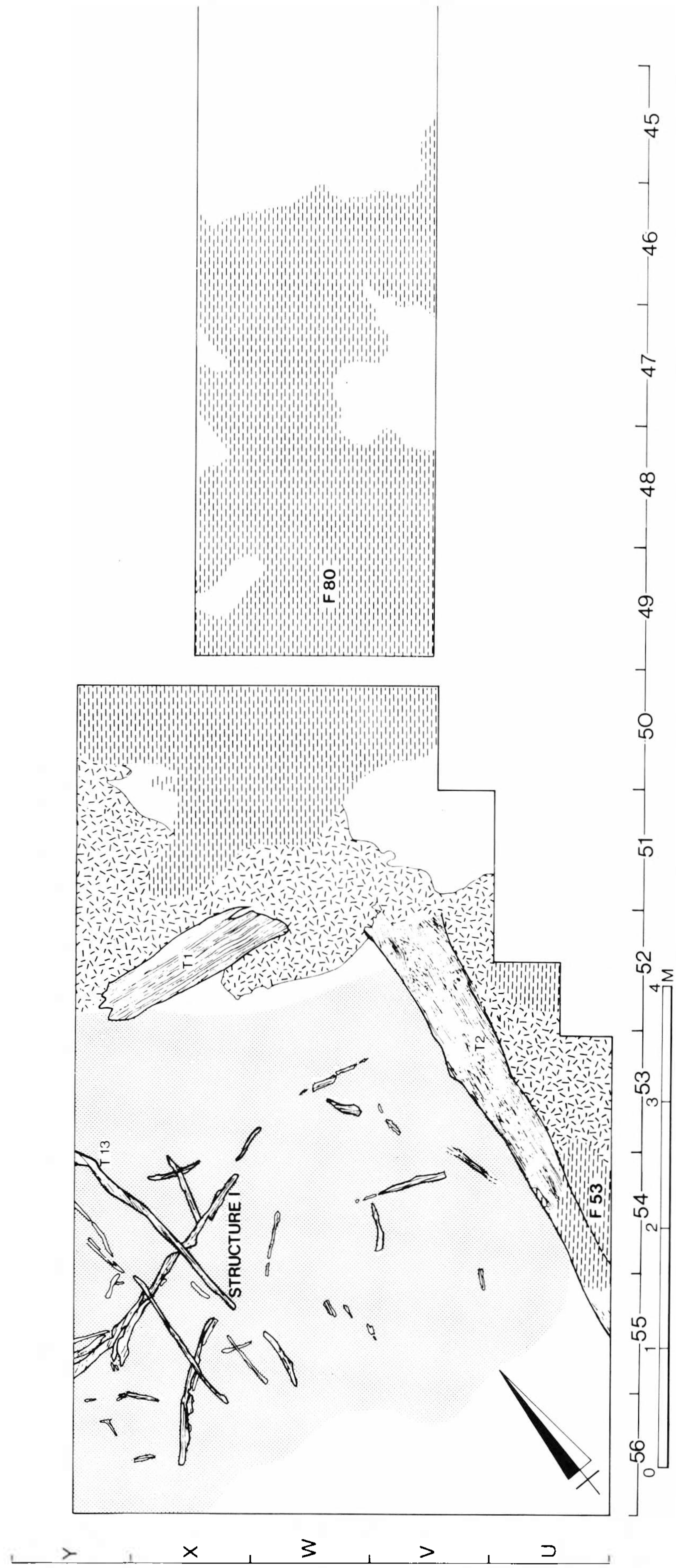


Figure 9 Area E1: plan of structural features.

Figure 10 Area E1: Structure 1 – timber lattice and decayed brushwood covering (Scale = 50 cm divisions).

Structure 4. The timber lattice of Structure 3 abuts against a raised area of clearly redeposited material. This feature has not been fully exposed, but it appears to extend in a narrow zone along the eastern side of the trench for some 6–7 m until it abuts against the buried land surface at the northern margin of the channel sediments. It consists of the same compact mixture of clay, sand and stones that characterizes the 'made ground' associated with Structure 2 in Area E1, and has been built up to approximately the same level. The western edge, where exposed, presents an abrupt, vertical face – suggesting that the dumped material was at one time contained by a timber revetment which subsequently decayed or was removed. Unlike Structure 2 in Area E1, no traces of bark matting have been found associated with this feature. One interpretation, therefore, might be that it was a kind of earthen road or causeway linking the timber and brushwood platform to the drier, firmer ground at the edge of the infilled channel.

A mixture of sand, clay and stones provides a very suitable material for building a causeway across soft ground. If built entirely of clay, this would become deformed when put under load – it would tend to 'squeeze out' when walked on; whereas pure sand and gravel would tend to shift and fall apart, since it has little natural cohesion. On the other hand, a mixture of clay, sand and stones (in the right proportions) can be compacted to form a firm, stable surface – the clay acting as a filler giving cohesion to hold together the coarser material in a kind of natural 'concrete' (Tomlinson 1972; O'Flaherty 1974).

No radiocarbon estimates are available for either of the structures described, although in character and general configuration they resemble the structural features in Area E1 which have been dated to the mid-sixth millennium B.P.

Structure 5. At a higher level within the channel sediments, the remains of a another structure were encountered (*Fig. 15B*). This consists of two overlapping and partially decayed timbers. The soil between and immediately above these timbers contained numerous fragments of bark – evidently the remains of a small area of floor matting. This may originally have been supported on a layer of branches and brushwood laid across the foundation timbers. On top of the bark layer was a small but clearly defined hearth consisting of an oval concentration of charcoal and heat-shattered stones. Traces of bark were found adhering to the undersides of some of the hearth stones.

It is evident from *Fig. 14* that the foundation timbers of this structure relate to a level well above that of the features already described, and were not in contact with either the timber and brushwood platform or the 'earthen causeway'. It is likely therefore that Structure 5 belongs to a later episode of occupation. A radiocarbon date of 3480±80 B.P. (UB-2715) on charcoal from the hearth provides a limiting date for this occupation.

Summary

It would be premature to draw too many conclusions from an unfinished excavation; but a point worth stressing is that the structural evidence from the Williamson's Moss site – in particular the use made of timber, earth and brushwood for the construction of platform foundations, and the evidence for extensive use of bark as a flooring material – is without precedent in the British Mesolithic. It remains, however, to establish the extent and precise configuration of these structures. The frequency with which buried timber has been encountered in systematic probing of the unexcavated areas of the infilled channel suggests that those features already uncovered form only a small sample of what is evidently a large and impressive structural complex.

VEGETATION HISTORY AND LAND USE CHANGES

In this section emphasis will be placed on the importance of pollen analysis in the clarification of events during the mid-Flandrian. Sophisticated models (e.g. Mellars 1976) have recently been generated to account for the short-lived and essentially indiscriminate clearances of upland forest recognized in pollen diagrams and dated to the Mesolithic period, whereby the presence of charcoal in peat-beds has been interpreted as being due to deliberate firing of the vegetation. This is thought to have increased the plant biomass available to herbivores, which in turn increased the yield of meat from hunting. Human interference in the Lake District during the Mesolithic period has been recorded principally from the upland pine–birch forests (Pennington 1975) where temporary clearings are thought to have been created. Evidence for clearings in the lowland deciduous forest is comparatively limited, although Pennington (1975) described such effects from her analyses at Williamson's Moss (see below). The Neolithic clearance phase is more marked in the lowlands, and appears to be widespread and possibly synchronous, and often associated with a distinctive elm decline. The uplands appear little affected by this activity, but in common with the lowlands are strongly affected by Bronze Age activity. These clearance episodes continue into historic times.

The pollen site selected for analysis and discussed in this report lies at the deepest point of the central basin of Williamson's Moss (*Fig. 4*). The ground surface lies at 5.69 m O.D. A series of overlapping 1.0 m Russian cores was sampled to a depth of 432 cm (see *Fig. 16*) in July 1984.

In the palynology of archaeological environments changes in pollen taxa through time are in many cases of a very small scale, and it was thought important at the outset of the investigation at Williamson's Moss

Figure 11 Area E1: compressed birch branch – part of the decayed brushwood covering of Structure 1 (scale = 5 cm divisions). Radiocarbon dating of this wood (UB-2545) gave an age of 5555±40 B.P.

to be able to clarify what was a significant change in relative or absolute values between spectra. Thus, for example, in the discussion of the elm declines at the site, their validity in statistical terms has been demonstrated using Mosimann's (1965) equations for calculating 95% confidence limits for the counts. Statistical significance does not, of course, imply real vegetational change (which must be argued for on ecological grounds), but can aid in an objective approach to environmental archaeology.

The various lines of evidence for vegetational and environmental change at Williamson's Moss have been combined in a summary diagram (*Fig. 16*). A provisional and approximate time-scale is applied (*Fig. 16*: right-hand columns). The basal date of 6000±90 B.P. comes from a 2 cm bulk-sampled slice of gyttja at 350 cm (SRR-2657, mean of both fractions). The second date used is derived from Pennington's (1970, 1975) analyses at Barfield Tarn, 4 km to the south east of Williamson's Moss. At Barfield Tarn Pennington reported a well-marked elm decline, dated to 5340±120 B.P. (K-1057). At Williamson's Moss two significant declines in elm values can be recognized. The date from Barfield Tarn is located at 300 cm on the Williamson's Moss diagram (*Fig. 16*), that is, at the second elm decline, on the correlation of certain palynological features which appear in common between the two diagrams. Until both elm declines at the site are securely dated, however, this correlation can only be assumed rather than established, and in the discussion that follows the uncertainties of the data base should be appreciated. Assuming the Barfield Tarn date to be applicable, a linear sedimentation rate for the Williamson's Moss sediments can be calculated (*Fig. 16*). The assumption of uniform sedimentation is unlikely to hold true, but until radiocarbon dating can provide clear estimates of the ages of key horizons this assumption will be maintained to allow the estimation of approximate ages and durations of events in the pollen record.

In the following discussion the sequence is compared with Pennington's (1975) palynological investigation of the same site. Attention will be drawn to the problems encountered in this initial appraisal of the findings, and to the work which in the future will hopefully clarify these uncertainties.

Before *c.* 5900 B.P. the environment appears to have been relatively undisturbed by man. Evidence for anthropogenic effects before 6000 B.P. must come from lacustrine deposits nearby which predate the uppermost Flandrian sea level.

At around 5900 B.P. several broadly synchronous changes occur within different communities. The first of these, marginally earlier than other changes, is an apparent phase of lowered water level within the lake, indicated by increased proportions of *Salix* and carr–fen herb pollen, interpreted tentatively as representing a period of rapid extension into the basin of lake-edge willow carr. An alternative explanation for the expansion of willow and shade-intolerant herbs

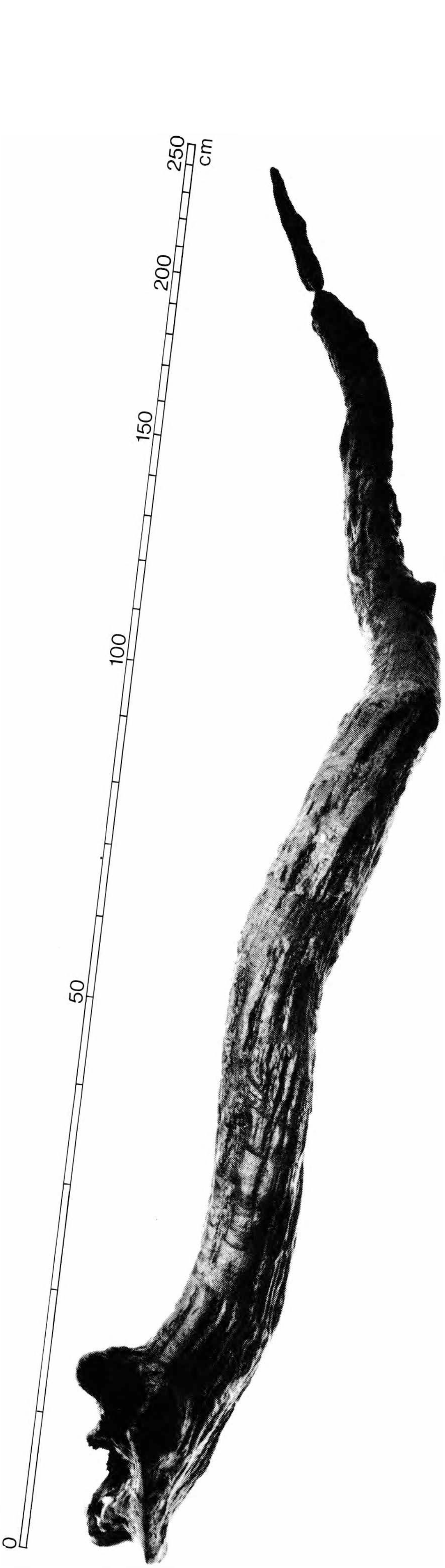


Figure 12: Opposite and above.
Area E1: oak branch (T13) with traces of working from timber lattice of Structure 1.

Figure 13 Area E1: area of birch bark matting (F53) overlying structure 2. Radiocarbon dating of this bark (UB-2713) gave an age of 5480±90 B.P. (scale = 10 cm divisions)

presents itself, however, in the light of the evidence for human activity at around this time (above), and it is possible that the initial clearance by settlers was of damp woodland and carr–fen communities adjacent to the lake.

The initial clearance of woodland at *c.* 5900 B.P. led either to the establishment of a hedge of hawthorn and associated shrubs, or alternatively to the growth of these shrubs in newly created openings in the forest. Also at this time pollen of ruderal herbs associated with pasture is recorded. Because of the lack of direct stream inflow (*Fig. 4*) it is likely that the herb pollen originated close to the basin, and a lake-edge clearing is most easily visualized. This interpretation is supported by evidence at this time of disturbed sedimentation rates and the inwash of 'fresh' topsoil from slopes immediately adjacent to the basin.

Plantago lanceolata is present in all counts at low percentages from near the base of the diagram. However, it is uncertain whether the ruderal herbs are indicative at this time of pastoral land, or were present as weeds within a general settlement area. Between *c.* 5900 and 5800 B.P. grass percentages decline, which is perhaps not the expected response if pasture had been present. It is therefore feasible that what is represented initially in this period is a clearing for settlement. The development of pasture may be seen with the limited expansion of grass pollen between *c.* 5800 and 5675 B.P., but this is uncertain. This interpretation is perhaps supported by the decline of inwashed 'fresh' topsoil above 330 cm (*c.* 5750 B.P.), which could be seen as the result of the stabilizing of bare ground by a grass sward.

A few decades after the initial creation of openings or clearings adjacent to the lake a significant elm decline occurs, from *c.* 5830 B.P., lasting for about 40 years. The decline appears to represent a selective fall in *Ulmus*. A 'pre-Neolithic' elm decline was described from Williamson's Moss by Pennington (1975). Her diagram (Pennington 1975: fig. 11) shows only a slight decline of elm pollen over several spectra, and might be open to criticisms concerning the statistical significance of this feature. This study has authenticated some aspects of her interpretation. An estimated age of between 5500–4700 B.P. was given in Pennington's paper for this first occupation of the site, but on the time-scale employed here this event was markedly earlier. In addition, Pennington's diagram suggests that this elm decline lasted for several centuries, whereas in the present study it appears to have been quite short-lived.

Other Lake District sites show evidence for anthropogenic disturbance of the woodland at around this time. A few are thought to show early elm declines. These sites include Ehenside Tarn (Walker 1966) on the west Cumbrian lowland 20 km from Eskmeals, and possibly Thrang Moss on the edge of Morecambe Bay (Oldfield 1960*a*, 1960*b*, 1963). It is not intended to discuss in detail the numerous interpretations of the elm decline. Smith (1981) considers these arguments, and useful summaries can be found in Rackham (1980) and Huntley and Birks (1983). It is important to note that the event at *c.* 5830 B.P. at Williamson's Moss is probably not of the same age as that discussed by these workers, but is similar in appearance.

The first elm decline at Williamson's Moss is contemporaneous with a clearance episode. More importantly this phase appears to coincide in age with a number of archaeological finds indicating late Mesolithic occupation of the area around the Moss. The simplest explanation for this elm decline must, then, be that man systematically harvested elm (cf. Troels-Smith 1960). From ethnographic parallels it is believed that such selective collecting of elm leaves and wood was for the feeding of stalled animals, usually cattle (Troels-Smith 1960). There is no direct evidence at Williamson's Moss of such domestication, and there are no preserved bones of *Bos* or other ungulates. The evidence is entirely palynological, and requires support, perhaps from coleopteran analysis of organic remains at the site, or from phosphate analysis of the sediments. The importance of the feature lies in its early date. Consequently the age of the deposits needs to be determined by absolute dating.

At Williamson's Moss the first elm decline is coincident with a 'landnam' phase (cf. Iversen 1941), and does not precede it as is usual with the Neolithic elm decline (Troels-Smith 1960; Oldfield 1963). Thereafter oak also appears to have been removed. The reasons for and the mechanisms by which the woodland was cleared are unknown. The technique of tree removal is also unknown. The lithic assemblage identified at the site contains no implements suitable for logging. Therefore, it is possible that ring-barking was adopted. If so, the settlers may have begun to remove oak at the same time as they started to select elm, since ring-barked trees take 15–20 years to die (Coles 1976). Firing of the vegetation is common after ring-barking. No charcoal was recorded despite other features of inwashed origin being noted, but the limited catchment would restrict the representation of such activities away from the shore. The oak decline appears to last for some 35–40 years, during which time hazel colonized newly created open ground in the woodland. Regeneration took place within *c.* 50 years. The duration of the entire clearance episode varies according to the evidence examined. Pastoral herbs persist for some 50 years after regeneration is thought to have been complete.

Activity around Williamson's Moss appears to have continued according to the still fluctuating sediment supply. The persistent record of *Plantago lanceolata* at a time of apparent forest regeneration and in the general absence of other ruderal herbs is difficult to interpret. Evidence for continued woodland clearance is equivocal at present, and few other indications of occupation are seen. Further palynological investigation of this phase is required, not only from this sampling point but from sites near or within the settlement area. At *c.* 5375 B.P. a renewed occupation seems certain, with disturbed sedimentation and increased input of corroded grains possibly signifying the erosion of soils developed during the preceding 300 years. There is a re-establishment of pasture, which with the significant expansion of *Plantago lanceolata* and Gramineae is regarded as being markedly more extensive and/or intensive than the earlier phase. At the same time a second elm decline, lasting *c.* 100 years, occurs. It is this phase that is believed to correlate with the Barfield Tarn sequence (Pennington, 1975).

In her analyses of Williamson's Moss, Pennington (1975) detected a reduction in willow carr at this second elm decline. At the adjacent small hollow of Pritt's Field (Pennington 1970, 1975) a clay band was seen at this horizon in one profile, with increased representation of Gramineae assumed in this instance to be derived from expanding marginal reed-belt. These effects, together with changes in lithostratigraphy at several sites, were argued (Pennington 1975) to represent greater run-off due to an increased precipitation/evaporation ratio (see also Pennington 1984). In the present study willow carr gives way to alder–birch carr some 400 years before the second elm decline, and there is no marked change at this later stage. The periods of disturbed sedimentation have here been correlated with periods of forest clearance. The evidence at Williamson's Moss for changes in soil acidity at this time is not clear. The appearance of *Sphagnum* spores with Ericaceae grains occurs later at *c.* 4700 B.P., and this may indicate the date of soil acidification.

At Barfield Tarn this phase is marked by a change from organic mud to minerogenic clay, indicating pronounced erosion around the site. Tutin (1969) argued for occupation of the catchment on this basis. No such dramatic effects are seen at Williamson's Moss, and the evidence for soil erosion is more subdued than in the earlier clearance episode. Whether this indicates less intensive land-use at this time is uncertain but possible. Certainly the fluctuating pollen concentration values cease at *c.* 5275 B.P., close to a possible temporary abandonment of pasture, and the focus of anthropogenic attention appears to have moved away from the lake edge.

The origin of the second elm decline is again unclear. Direct correlation with dated archaeological finds from the excavation cannot be made for this period. This decline does coincide with a 'landnam' phase of regional significance, and the assumption is that anthropogenic activity again involved the selective use of elm. There is as yet no evidence for disease at the site, and soil acidification does not seem to occur until much later (*c.* 4700 B.P.).

Little significant change is recognized at Williamson's Moss in the 1000 years after the second elm

Figure 14 Area E2: state of excavation at the end of the 1983 field season.

decline. The prolonged decline in oak over this period may be seen as the general retreat of woodland as pasture occupied more space. The ratio of open ground to woodland cannot be calculated from pollen analyses due to the much higher pollen production of tree species. The apparent change from pasture to rough grassland at *c.* 5050 B.P., leading to the possible abandonment of pasture at *c.* 4700 B.P., needs to be examined from other sites before its validity can be confirmed. However, these changes coincide with the rise of acidophilous Ericaceae and *Sphagnum* grains, and soil impoverishment may have been the reason for the decline in land use. The limited replacement of oak by hazel may have been a result of this soil deterioration also.

Cereal-sized grains are recorded from the Neolithic elm decline onwards at both Barfield Tarn and Williamson's Moss by Pennington (1975). Large grass grains were not seen in the present investigation at any level, and this anomaly is problematic. Both sets of cores were from lacustrine mud, and the effects of restricted dispersal of cereal grains is not thought a likely reason for their absence in this study. In the absence of such grains in the present analysis the period following the second elm decline resembles that from Ehenside Tarn (Walker 1966), where

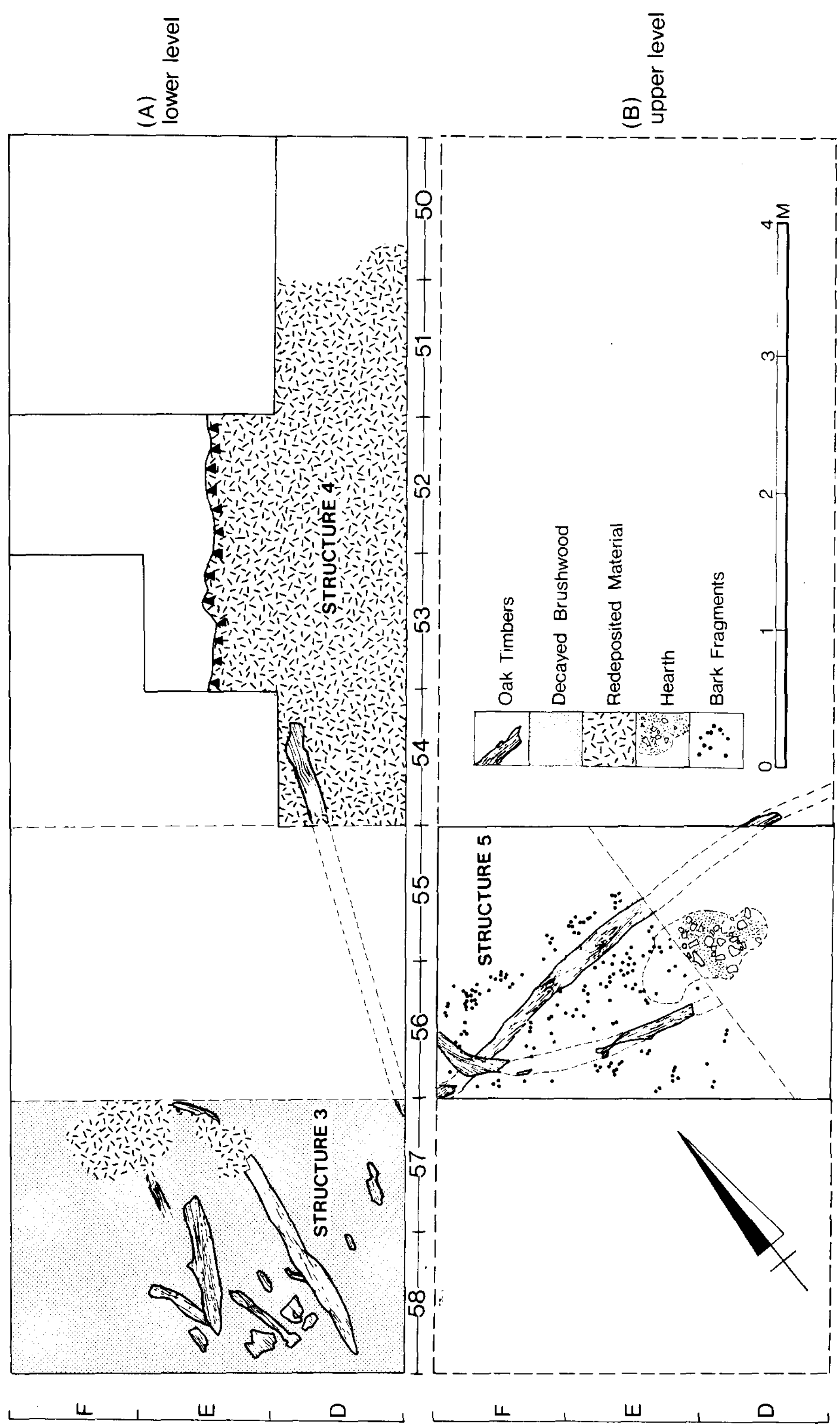


Figure 15 Area E2: structural remains – A. lower level; B. upper level (excavation unfinished, cf. *Fig. 14*).

clearance for stock-keeping preceded cereal cultivation by several hundred years.

DISCUSSION

The preceding sections have outlined some of the results of the Eskmeals Project, and have stressed the interdisciplinary nature of the research. The following discussion will focus on three aspects of the Mesolithic settlement of the Eskmeals area: settlement location, chronology and subsistence.

Settlement location

Many factors could have influenced the location of Mesolithic sites in the Eskmeals area. Most important, perhaps, was food supply. Several authors have stressed the attractions of river estuaries in this respect (Jacobi 1973; Bonsall 1981), and it is interesting to note that nearly all the known sites at Eskmeals (*Fig. 1*) are situated on seaward-facing slopes overlooking stretches of former coastline which experienced predominantly *estuarine* conditions during the period of Mesolithic settlement.

Conversely, settlement traces are lacking in areas where estuarine conditions were never established during the mid-Flandrian, for example south of Stubb Place.

The role of other resources should not be overlooked. The only locally available source of flint would have been the shingle deposits of the coastal foreland. These deposits would also have been the most accessible sources of sand and stones for construction purposes. It is worth noting that the main site locations – at Monk Moors and Williamson's Moss – would have been ideally situated to exploit these resources.

The coast may also have been a vital source of timber for groups which lacked heavy tree-felling equipment. One reason for the apparent preference for oak heartwood as a building material exhibited by the mid-sixth millennium B.P. inhabitants of the Williamson's Moss site, apart from its tendency to split naturally, may have been its availability as driftwood on the foreshore.

One particularly interesting feature to emerge from the current survey is the tendency for sites to occur along the margins of former channels which cut across the glacial sediments. This relationship is particularly evident to the landward of Williamson's Moss (*Fig. 4*), and also at Monk Moors where the excavated sites lie on either side of a small channel where it meets the former shoreline (*Fig. 1*). The significance of these channels for Mesolithic settlement is not certain. Certain of the channel mouths would have provided a means of access to the foreshore, particularly in the area between Monk Moors and Stubb Place where, at the maximum of the Flandrian transgression, the sea was actively eroding a cliff some 3–15 m high. It is also possible that where estuarine conditions obtained the channels had economic significance. Salmon and sea trout are known to spawn in large numbers in the mouths of small channels and feeder streams leading off the present estuary. To what extent the channels acted as sources of fresh water is, however, problematic. While they would undoubtedly have carried rainwater running off the slopes adjacent to the coastal foreland, it seems unlikely that during the mid-Flandrian they were occupied by perennial streams.

Chronology

Three types of information relate to the chronology of Mesolithic settlement in the Eskmeals area: radiocarbon dating of archaeological features; the constraints imposed by the development of the coastal foreland; and the evidence for land use changes from the palaeobotanical evidence.

Radiocarbon dates are available from the Monk Moors and Williamson's Moss sites. Two radiocarbon dates were obtained on charcoal from a hearth at Monk Moors 1, these giving ages of 6750±155 B.P. (BM-1216) and 7380±370 B.P. (Q-1356) (Bonsall 1981). The former of these dates was from a much larger sample (hence the smaller standard deviation) and is therefore considered more reliable. It implies occupation of Monk Moors at around 6800 B.P. Post-Mesolithic occupation of the Monk Moors area is indicated by radiocarbon dates on charcoal from two hearths and a pit of *c.* 4050 B.P., *c.* 3650 B.P. and *c.* 2850 B.P. The radiocarbon evidence from Williamson's Moss has already been discussed. The earliest evidence for occupation is around 5550 B.P., and subsequent occupation during the Neolithic and earlier Bronze Age at *c.* 4900 B.P. and *c.* 3700 B.P. has also been documented.

It is apparent from the available radiocarbon evidence that both the sites investigated have been occupied on several occasions, indicating that the coastal foreland retained its attraction for settlement long after the Mesolithic period. This pattern also suggests that other site locations have witnessed repeated use over several millennia and, by extension, opens the possibility of more than one episode of Mesolithic occupation.

In the preceding section, site location was related to various environmental factors such as the nearby presence of estuarine conditions. It may therefore be presumed that the chronology of settlement at the different sites will relate to coastal evolution and the progressive establishment of suitable conditions in the Eskmeals area. For instance, as estuarine conditions were first established (between 6500–7000 B.P.) in the area between Monk Moors and Newbiggin, settlement may have first occurred in that area at that time. In contrast, the Williamson's Moss site faced on to the open coast till after the construction of the shingle ridges that formed the Williamson's Moss basin at *c.* 6100 B.P., implying that after this date that locality would have been more attractive for settlement. It is therefore interesting that the earliest dated occupation at Monk Moors was at *c.* 6800 B.P., while the earliest dated occupation at Williamson's Moss was at *c.* 5500 B.P. This apparent relationship between periods of site occupation and environmental conditions suggests that as sea level fell, occupation may have continued longest in the Monk Moors–Newbiggin area where estuarine conditions lasted longest (cf. *Fig. 3*), and that Williamson's Moss retained its attraction as long as an open lake occupied the area of the present moss.

The palaeobotanical evidence from Williamson's Moss discussed earlier indicated several phases of vegetational clearance and soil instability that have been summarized in *Fig. 16*. The chronology established for these phases is not in accord in detail with the direct dating of the archaeological evidence at the Williamson's Moss site, although the discrepancy is only of the order of 100–350 years. In this connection the tentative nature of the pollen chronology, based on a linear sedimentation rate interpolated between a basal radiocarbon date and an assumed age for the second elm decline has previously been emphasized.

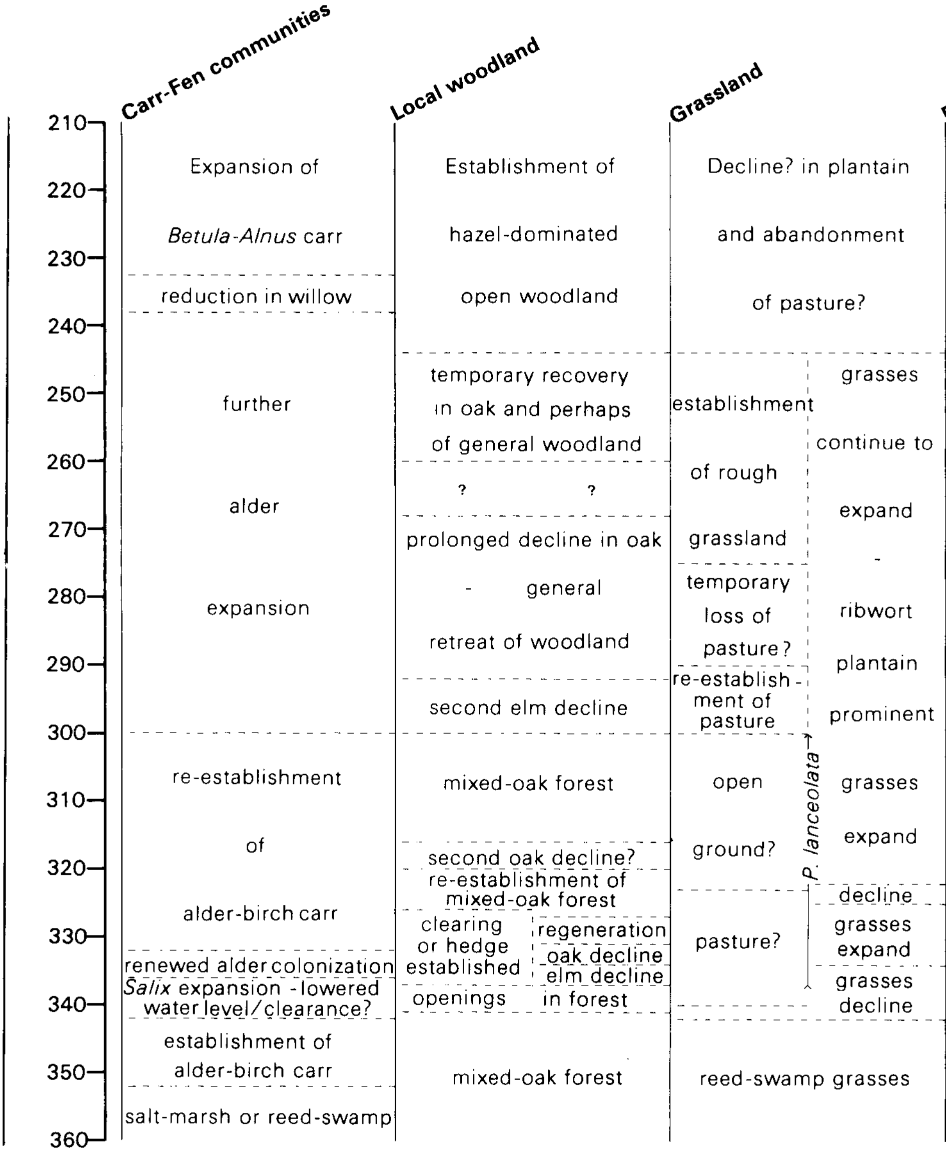
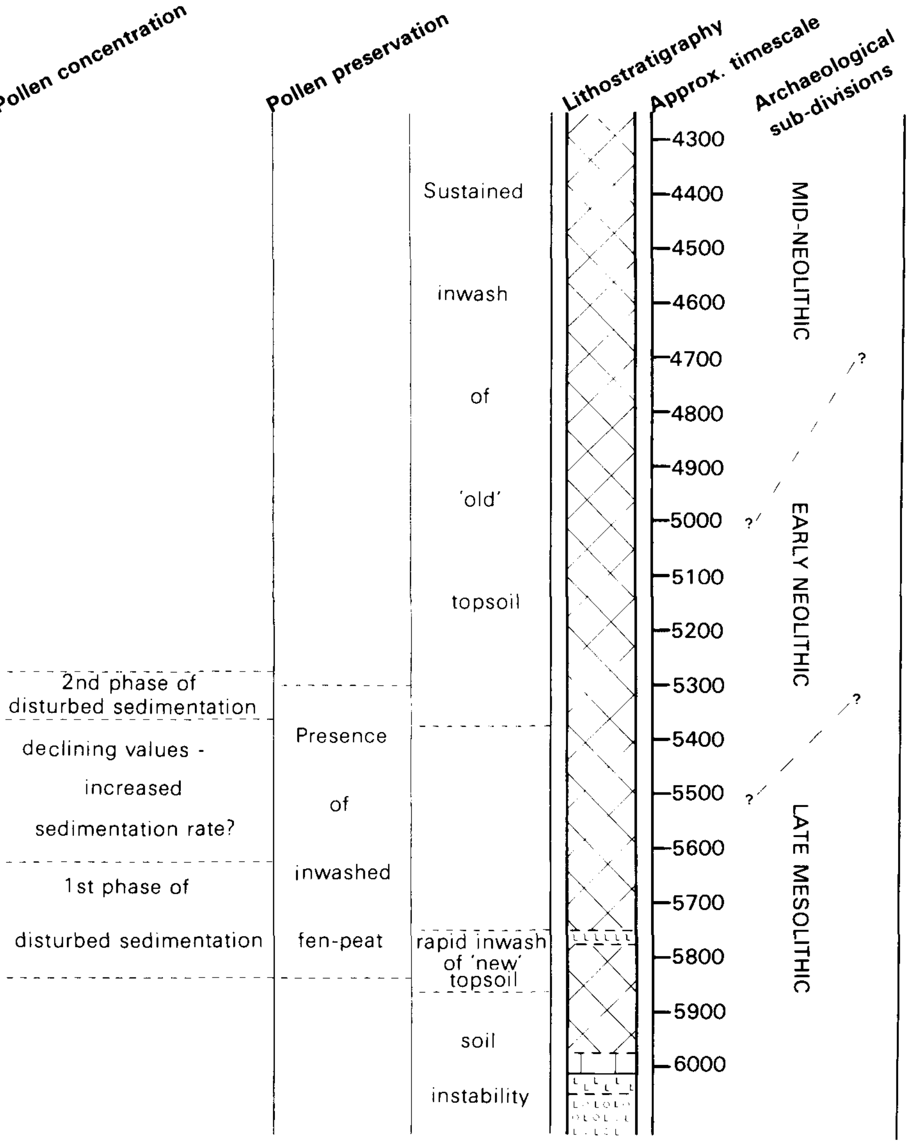


Figure 16 Williamson's Moss: vegetation history and land use changes.


Pollen concentration
Pollen preservation
Lithostratigraphy
Approx. timescale
Archaeological sub-divisions
Sustained
inwash
of
'old'
topsoil
2nd phase of disturbed sedimentation
declining values - increased sedimentation rate?
1st phase of disturbed sedimentation
Presence of inwashed fen-peat
rapid inwash of 'new' topsoil
soil instability
4300
4400
4500
4600
4700
4800
4900
5000
5100
5200
5300
5400
5500
5600
5700
5800
5900
6000
MID-NEOLITHIC
EARLY NEOLITHIC
LATE MESOLITHIC
?

Clearly, this problem will not be resolved without a number of radiocarbon dates on the pollen profile.

Subsistence

The stereotype which contrasts mobile 'Mesolithic' food-collectors with sedentary 'Neolithic' farmers is still firmly entrenched in the literature on British prehistory. Little attention has been devoted to the processes by which one form of society developed into, or was replaced by, the other, or to establishing the chronology of the transition. Recent studies of the North European Mesolithic, outside Britain, have tended to stress the evidence for an increase in settlement size and a decrease in mobility of human groups throughout the period, and a change in subsistence emphasis away from hunting and towards the exploitation of more static resources such as fish, shellfish and plant foods (e.g. Welinder 1978).

In an earlier paper, Bonsall (1981) proposed a model of the subsistence economy of late Mesolithic groups in the Eskmeals area during the early seventh millennium B.P., based primarily on inferences drawn from a reconstruction of the contemporary environment. This model emphasized the role of fishing and coastal resources, and the potential for year-round settlement.

In the present study it has been shown that people with a Mesolithic stone tool tradition continued to occupy the Eskmeals area until at least the middle of the fifth millennium B.P. – a time which some workers would suggest coincides with the pioneer phase of agriculture in northern England (Bradley 1978). Potentially, therefore, the Eskmeals Project has an important bearing on the debate concerning the Meso–Neolithic transition in this part of Britain.

The Williamson's Moss excavation has revealed extensive evidence for Mesolithic occupation. More importantly in subsistence terms, the excavation has exposed areas of the site, such as the infilled channel, where organic sediments are preserved. As yet this material has not been shown to contain faunal or other food remains. As a consequence, direct evidence to test the suggestions put forward by Bonsall (1981) is at present unavailable.

Alternative approaches to understanding the subsistence of prehistoric settlers include techniques of palaeoecological reconstruction. The major method employed here has been pollen analysis. This has a bias towards identifying resources within the terrestrial ecosystem. As a consequence the assertions made earlier in this section regarding the location of the site in relation to estuarine resources cannot be tested. The analyses reveal, however, a succession of clearance episodes and forest regeneration phases that probably relate to the Mesolithic occupation at the site. More importantly the analyses perhaps indicate a level of subsistence not previously suspected.

The initial elm decline is considered to indicate the selective removal of elm from surrounding woods for feeding to animals. If this is the correct interpretation it perhaps implies some form of pastoralism in societies possessing a Mesolithic technology. There are, however, degrees of pastoralism. The evidence does does not imply, for instance, the stalling of animals at the site. It does not necessarily indicate the concentration of animal foodstuff on the occupation area, for supplies could have been maintained within the woodland. It does, however, imply some form of stock-control by the human population. Previous models of Mesolithic subsistence in the British Isles (e.g. Mellars 1976) have emphasized the likely seasonal transhumance of hunting bands in pursuit of large game, generally assumed to have been deer. The collecting of fodder for herds of game is an attempt to circumvent the natural periodical local scarcity of resources which necessitate migration. This interpretation is similar to that presented by Simmons and Dimbleby (1974) in support of the idea that the relationship between man and ungulate in the Mesolithic was more than one of hunting. Their data refer to the presence of anomalously high amounts of ivy pollen on occupation areas, which they relate to the storage of animal feed on site, whereas the evidence discussed here is for the utilization of elm for the same reason. Such subsistence patterns have been postulated before (Evans 1975) but palaeoecological evidence for stock-control has not been accepted by all authors (Smith 1981: 105). The evidence from Williamson's Moss is believed to be the first of its kind in this country for this type of economic activity at this early period, and has a considerable bearing on the subsistence of pre-Neolithic peoples.

This proposal in turn leads to considerations as to the possible sedentism of the Mesolithic settlers at Williamson's Moss. Certainly the scale of the timber, earth and brushwood platforms indicates that considerable effort, both in terms of labour and man-hours, was invested in their construction. This activity suggests that the builders intended to remain at the site for a prolonged period. The pollen analyses imply a period of occupation of at least forty years, but this could have been much longer. In the absence so far of indicators of seasonality it remains unclear whether the site was occupied on a seasonal or year-round basis.

The apparent sedentary nature of the settlement and abandonment of transhumance are significant characteristics that in later chronological contexts would most likely be recognized as implying an economy based on food production. Evidence for domestication of ungulate herds has not yet been noted at Williamson's Moss, and a true agricultural economy is not implied. However, as Evans (1975) has suggested, areas of open maritime woodland would have presented promising environments for the initial domestication at least of cattle.

These proposals are tentative but, if substantiated, would provide support for new and challenging models of late Mesolithic economic behaviour.

Notes:
1. British Ordnance Datum (O.D.) relates to mean tide level at Newlyn, Cornwall. High Water of Spring Tides, particularly in estuaries, can therefore be several metres above O.D.
2. The excavations at Monk Moors Site 1 were undertaken in collaboration with Dr P.A. Mellars, and will be the subject of a separate report.
3. A small amount of carbonized plant material was recovered in the excavations at Sites 1 and 2, but the archaeological context was uncertain.
4. A report on the pottery from the Williamson's Moss site is being prepared by Dr I.H. Longworth of the British Museum.
5. Stone axes and other tools suitable for felling large trees are unknown from later Mesolithic contexts in northern Britain.

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