Pollen analysis and vegetional history of the 'akeld' basin

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POLLEN ANALYSIS AND VEGETATIONAL HISTORY OF THE 'AKELD' BASIN

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ABSTRACT

A pollen diagram has been constructed for the Akeld Steads region of the Glen Valley in Northumberland. This diagram provides an interesting variation in the vegetational history of the area. Evidence suggests that although the late post glacial vegetation was similar to that of the rest of the region, Quercus appeared before Ulmus in this area. This feature is contrary to the usual pattern suggested, however, it is seen on other northern diagrams but has not been commented upon by their authors. The persistence of pine in the area until the late Boreal period may be associated with the Cheviot Hills which overlook the basin.

The lack of deposit during the late Boreal and early Atlantic periods may be attributed to local hydrological conditions prevailing at that time.

There is some evidence for the presence of Man in the area from the Boreal period onwards. This evidence comes from the pollen diagram and stratigraphy of the site and is further substantiated by the archaeological discoveries made in the area.

INTRODUCTION

It is recognised and acknowledged in the field of Quaternary Ecology that vegetational change follows and reflects climatic change. Vegetational change is necessarily slow due to the time required for migration and the establishment of the various species in the newly formed habitats. The evidence for this vegetational history comes from two forms of fossil remains. These are, firstly the macroscopic fragments of fruits, seeds and wood and secondly the microscopic pollen grains. The latter have the highest resistance of all plant parts to bacterial and fungal decay, although they may be less resistant to oxidation. This resistance is due to the sporopollenins in the exines of the pollen grains.

These fossil remains occur in peat deposits and in fresh water and marine sediments and much of the evidence of plant distribution during the post glacial period comes from pollen preserved in peat bogs which began forming during this time.

The pollen is extracted from various levels of the deposit, the individual pollen grains identified and the number of grains of each species or taxa counted. These numbers are then presented in a form of a pollen diagram. The numbers plotted on the diagram may be either Absolute, that is the actual number of pollen grains counted for each species or taxum, or they may be Percentages, that is the number of grains counted for each species or taxum calculated as a percentage of total tree pollen. Therefore, both absolute pollen counts and percentages have been used to describe vegetational changes. Although Hesselman maintained that the former may record changes in species abundance more truthfully, von Post pointed out that these might be misleading due to insufficient knowledge of sedimentation rates. However, Davis (1967) has shown that although absolute counts record changes more faithfully than percentage diagrams, the changes thus demonstrated are almost identical to those appearing in percentage diagrams for the period of forest vegetation at least.

When interpreting pollen diagrams it is important to realise that pollen falling onto a peat bog may have come from a close local source or from a regional one. The latter being particularly represented by anemophilous plants whose pollen may disperse into the air currents above the tree canopy. Another problem arises from the differential production of pollen and schemes have been devised to correct this factor. The most recent scheme produced by Anderson (1973) for north-west Europe forest vegetation proposes that the tree pollen grains counted should be multiplied as follows:-

Pinus, *Betula*, *Quercus*, *Alnus*	x ¼
Carpinus,	x 1/3
Ulmus, *Picea*,	x ½
Fagus, *Abics*	x 1
Filia, *Fraxinus*,	x 2

Pollen production may also depend on climate, soil conditions and vegetation form. *Corylus*, for instance, seems to be a low pollen producer in dense forest, where it is seen in the role of an understorey shrub but a great pollen producer in the open.

Bearing these problems in mind and making allowances for them the vegetational history of an area can be described with some degree of confidence.

This project, as originally envisaged was an investigation of the vegetational history of a small region of Northumberland. A potentially interesting site had been noted by Dr. J. Turner, Department of Botany, University of Durham, as containing a peat deposit of some depth. If old enough this deposit could reveal interesting information as to early post-glacial history of the area and if much younger in age, of the changes in the forest vegetation broughout about by prehistoric and historic man. It was known from work by local archaeologists that the area was occupied during Neolithic and Saxon times.

CHAPTER 1

AREA AND SITE DESCRIPTION

1.1 Location and Topography

The site of study (Akeld Steads O.S. Nu 966305) is part of a large basin of some 16 square miles which is bounded on the south and west by the north eastern foothills of the Cheviot Massif and on the north and east by the Ford and Doddington hills (Fig. 1 and 2). For the purpose of this study the basin will be referred to as the "AKELD BASIN".

The hills of the Cheviot Massif occupy some 250 square miles and rise to 900 feet in places. They represent the north-eastern extremity of a prominant range of uplands known as the Cheviot Hills. The latter are aligned predominantly from south west to north east and rise to 1800 feet. As such they form an important watershed dividing streams draining south east and east into the North Sea and those flowing northwards into the river Tweed.

Although the Cheviot Massif is part of the Cheviot Hills it differs structurally from the rest of them giving rise to distinctive topography. Its hills are predominantly gentle sloping with broad areas of plateau between the deep valleys. However steep sided valleys do occur in the northern and eastern peripheries including Akeld Hill and Harehope Hill which form the southern boundary of the basin. (Fig.3). Outcrops of bedrock are rare occurring chiefly as tors and crags.

The Massif is drained by a fairly dense network of streams some of which, like the Coquet, become principal streams,

FIGURE 1

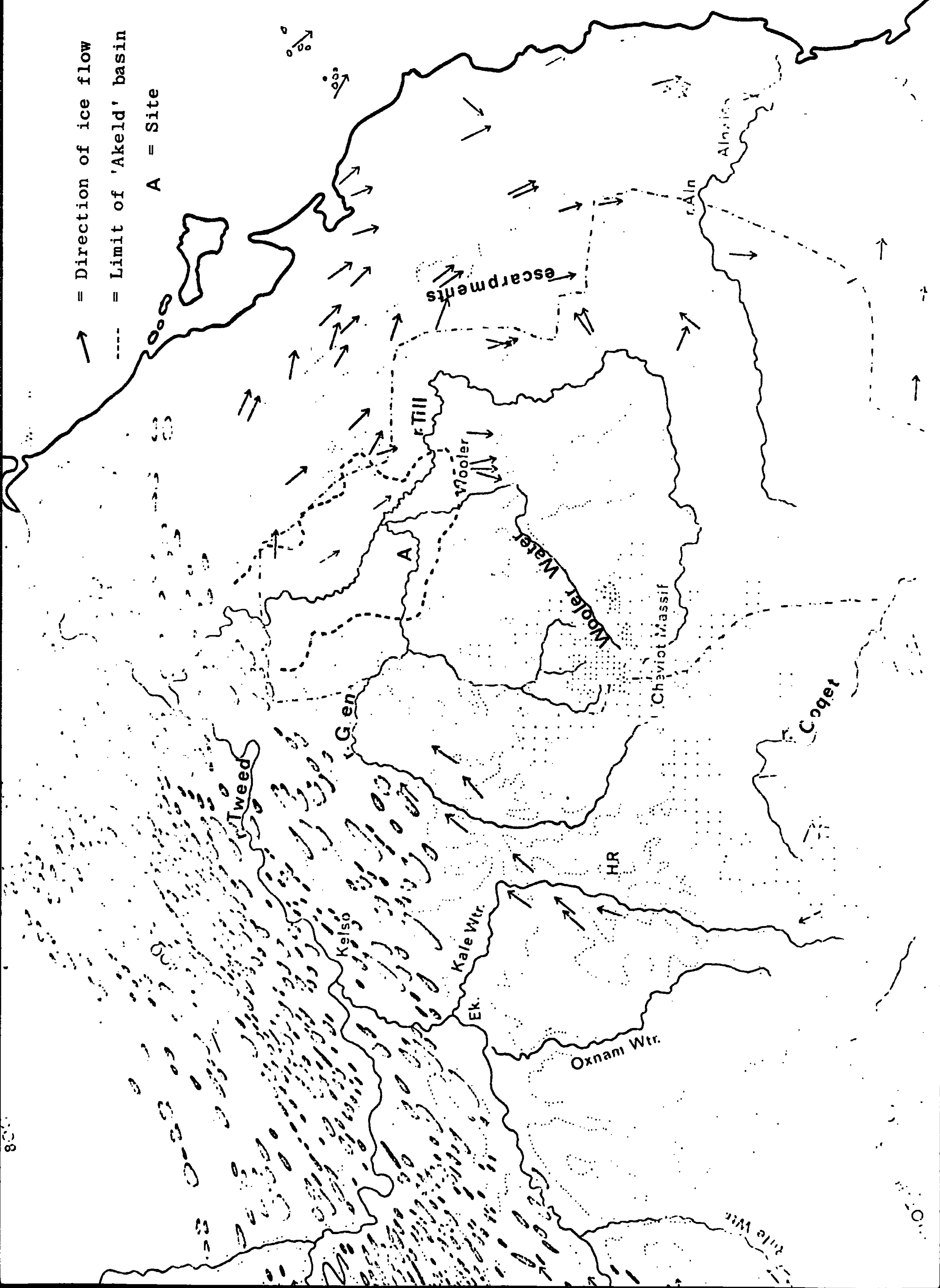
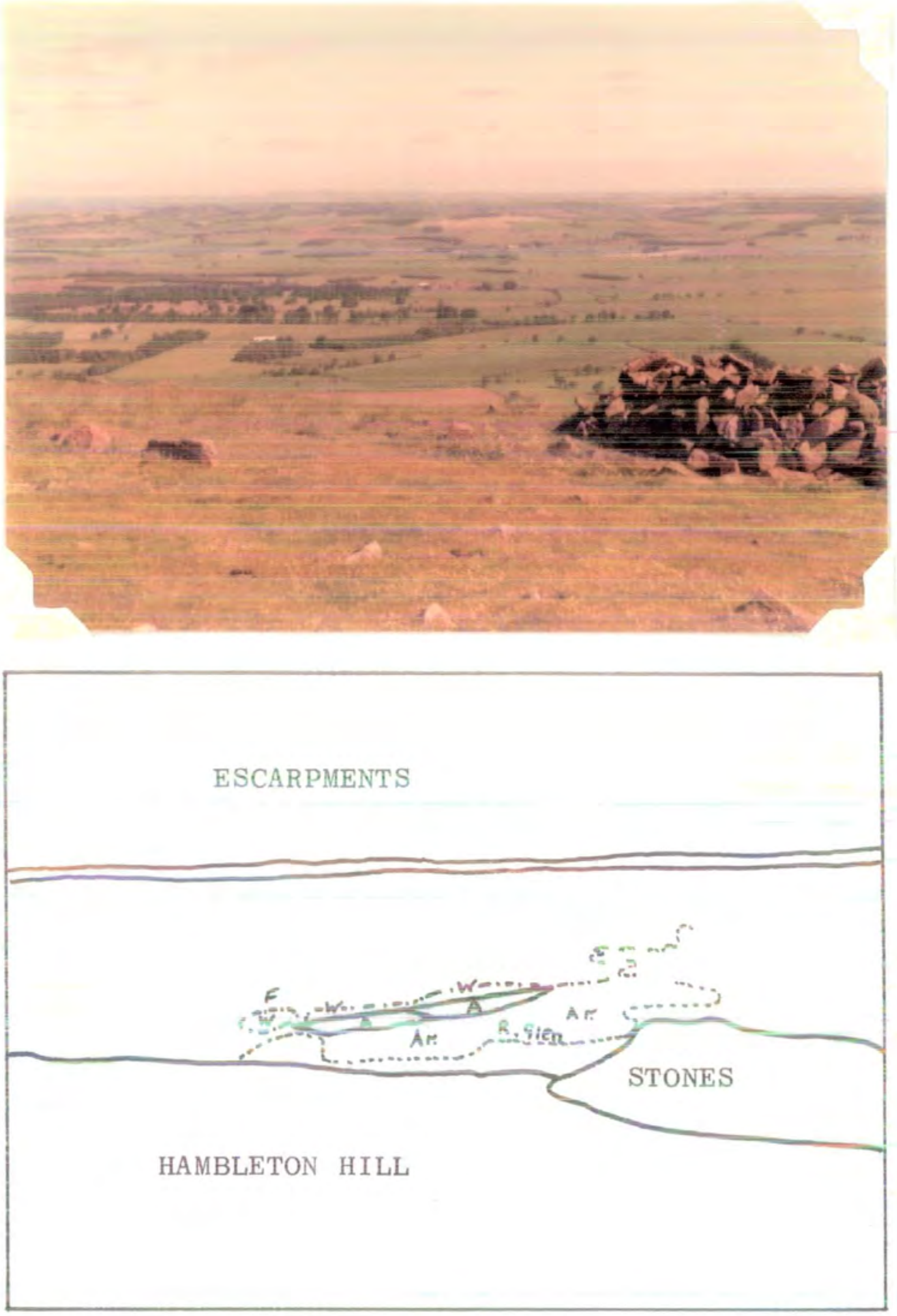

= Direction of ice flow
= Limit of 'Akeld' basin
A = Site
escarpments
r.Till
Wooler
Wooler Water
A
r. Glen
r. Tweed
Kelso
Kale Wtr.
Ek.
Oxnam Wtr.
HR
Cheviot Massif
r. Coquet
r.Aln
Rule Wtr.

FIGURE 2



F = AKELD STEADS FARM
W = WOOD AND FEN/CARR
A = SITE OF STUDY
Ar = ARABLE FIELDS

Photograph of the Akeld basin taken from the top of Hambleton Hill (OS.967284) others such as the Wooler Water and the river Glen, arise in various places on the Massif and becomes tributaries to the larger rivers. To the north-east of the hills is the broad lowland of the Merse and curving round the eastern perimeter of these hills are a series of low lying basins. These basins, one of which is the Akeld basin, are situated between the foothills of the Massif and the assemblages of pronounced escarpments a few miles to the east. These escarpments rise to 500-800 feet in the north and the basin floors are mostly below 300 feet.

Some rivers, such as the Coquet, have broken through the escarpments to reach the North Sea, others like the Till, flow northwards through the basins to join the river Tweed cutting through the foothills rather than the escarpments.

1.2 Structure and Lithology

The Cheviot Massif consists chiefly of an almost circular expanse of andesitic lavas extruded during the Lower Old Red Sandstone period. Subsequent to the volcanicity a large mass of pink augite-granite appears to have formed possibly in the former magma chamber that once fed the volcano. This granite outcrops east of the centre of the Massif.

The broad belt of low lying country partially enclosing the Cheviot Massif is composed of sedimentary strata. In the Merse these are principally Upper Old Red Sandstone overlain by rocks of cementstone group of Lower Carboniferous. The latter occur chiefly in the east. The cementstone rocks also underlie the broad basins, including the Akeld

FIGURE 3

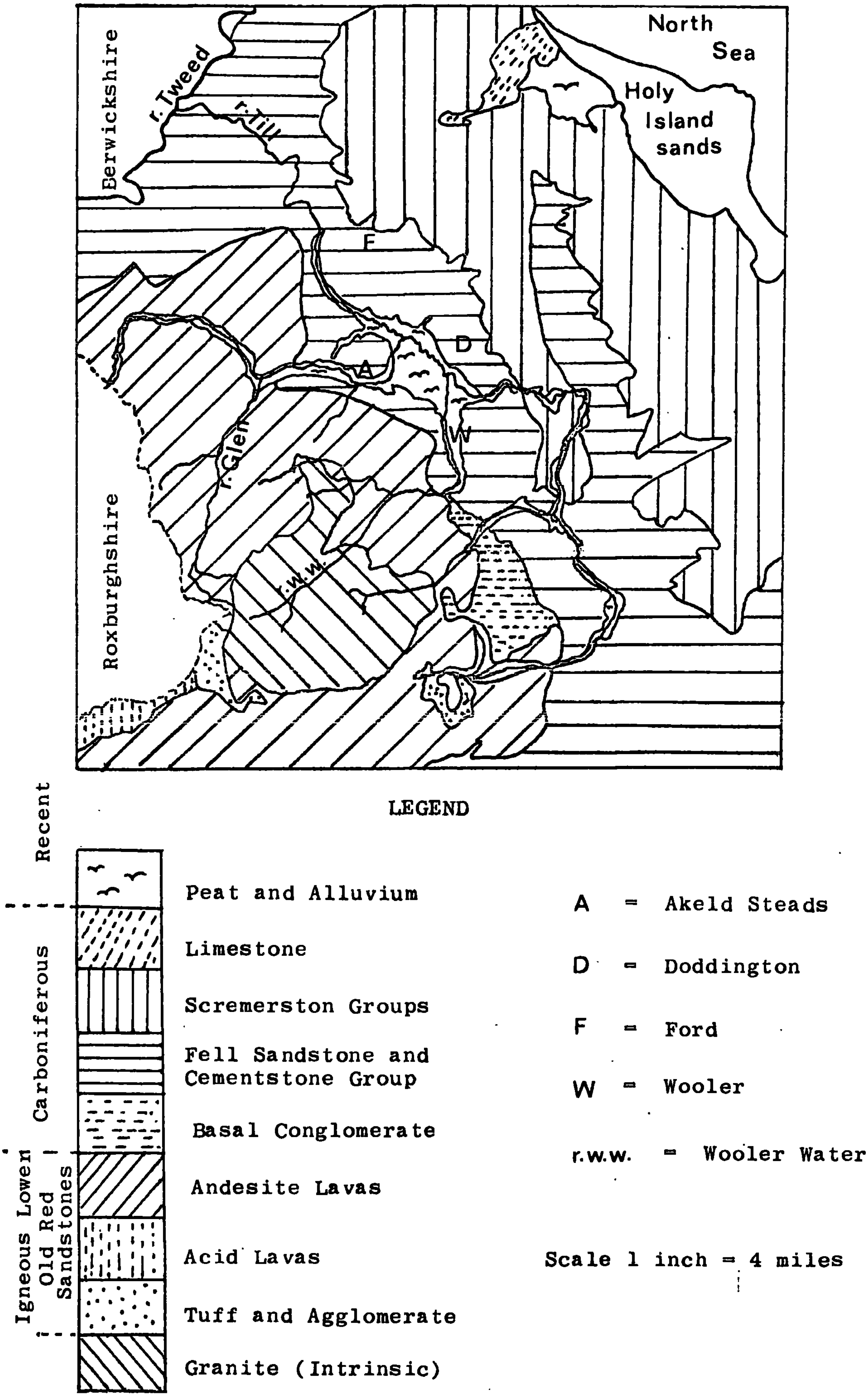
A photograph taken of the Cheviot Hills looking north-west from the top of Hambleton Hill.

Feature to note:-

1. The steep sided valley on the south side of Harehope Hill. The flat area behind it was a site of a Roman camp.
2. Akeld Hill (upper right), Harehope Hill (right) and Hambleton Hill (foreground) form part of the southern boundary of the Akeld basin.
3. Smooth grassy slopes particularly on the higher slopes. The lower areas have been overgrazed by sheep and bracken predominates (bright green).

Figure 4

GEOLOGY OF NORTH EAST ENGLAND



basin, marginal to the eastern foothills of the igneous Massif.

A wide variety of Lower Carboniferous rocks including those from the Limestone group, the Sedimentary Coal group and the Fell Sandstone group occur in the east and it is the massive sandstones of the latter group which have produced the impressive escarpments facing towards the Cheviot Massif across the basin. (Fig. 3 and 4).

1.3 Evolution of Relief and Glaciation

The structural arrangement of the area is believed to be predominantly Hercynicn in origin but the present relief was presumably fashioned during the subsequent phase of late Tertiary/early Pleistocene uplift that affected much of Europe.

Many of the major streams flow in narrow valleys the sides of which rise precipitously for 300-600 feet. Although fluvioglacial rivers probably contributed in some degree to the development of these valleys, much of their present form is preglacial. The well defined cementstone basins and the Fell Sandstone escarpments were probably etched out into relief consequent upon stream incision and slope retreat following uplift.

At the beginning of the glacial conditions it is evident that the border hills between north Tyne and Cheviots sent forth considerable streams of ice in all directions. These were checked and converged with other streams. One such stream, the Carter Ice, was barred by the great western sheet of ice from the Solway district and driven along the left bank of the Tyne. Three great sheets converged near Redesmouth and were forced eastwards along the Wansbeck and then south east towards Tynemouth. At maximum glaciation it is probable that the western ice sheet held complete sway almost as far as the coast.

On the northern side of the Cheviots ice flowing down the Tweed Valley seemed to have checked the flow of Cheviot ice in that direction and to have surmounted the outflying spurs of the hills. There is some evidence that along the coast the sheet of ice flowed southwards in the early stages of glaciation due to the pressure of the North Sea ice. This effect is recognisable for about 14 miles inland and might have just affected the study area (Fig. 1). As a result of this Tweed and local ice was thrust up the valley of the Till but was barred near Hedgeley by the Cheviot ice. The Cheviots were partially enveloped by two major streams of glacier ice from the west. The ice flowed round the north-east and south flanks of the Massif and converged in the vicinity of North Charlton. Subsequently the North ice mass was caused to flow in a southerly direction over the territary east of Thrunton causing the distal extremety of the western ice mass to swing round in a similar direction. The reason for this change in movement of the north Tweed ice mass is not certain but it is possible that the deflection was caused by the North Sea ice as first envisaged by Geikie (1876).

However, since there is some doubt as to the extent of Scandinavian ice and its influence on the flow of British glaciers it is thought that the change might have been caused by the joint Highland/Southern Upland ice flowing out into the North Sea basins and which was assumed to be extensive enough to force the Tweed glacier to flow in the southerly direction down the east coast of Northumberland.

There is no doubt, therefore, that the area of study was influenced by glaciation from the earliest part of the last glacial period. Furthermore, it was an area of ice conflict, where the west (Solway), north, (Highland) and east (North Sea) ice sheets met resulting in a high pressure belt of ice being forced to flow down the coast of Northumberland.

As the ice receded the basins and valleys behind it filled with water forming shallow lakes. Therefore it is envisaged that the whole area of the basin, from the foothills of the Massif to the escarpments was under water forming one such shallow lake at the beginning of the post glacial period. (Clapperton 1967). The lake probably persisted until the early Boreal period when, due to succession and the dry climate, it gave way to Fen/Carr type of habitat and later, at the end of Boreal, to a dry habitat. However, there is some stratigraphical evidence to show that the lake might have been recreated for a short period at least during the early Atlantic period.

1.4 Archaeology and History

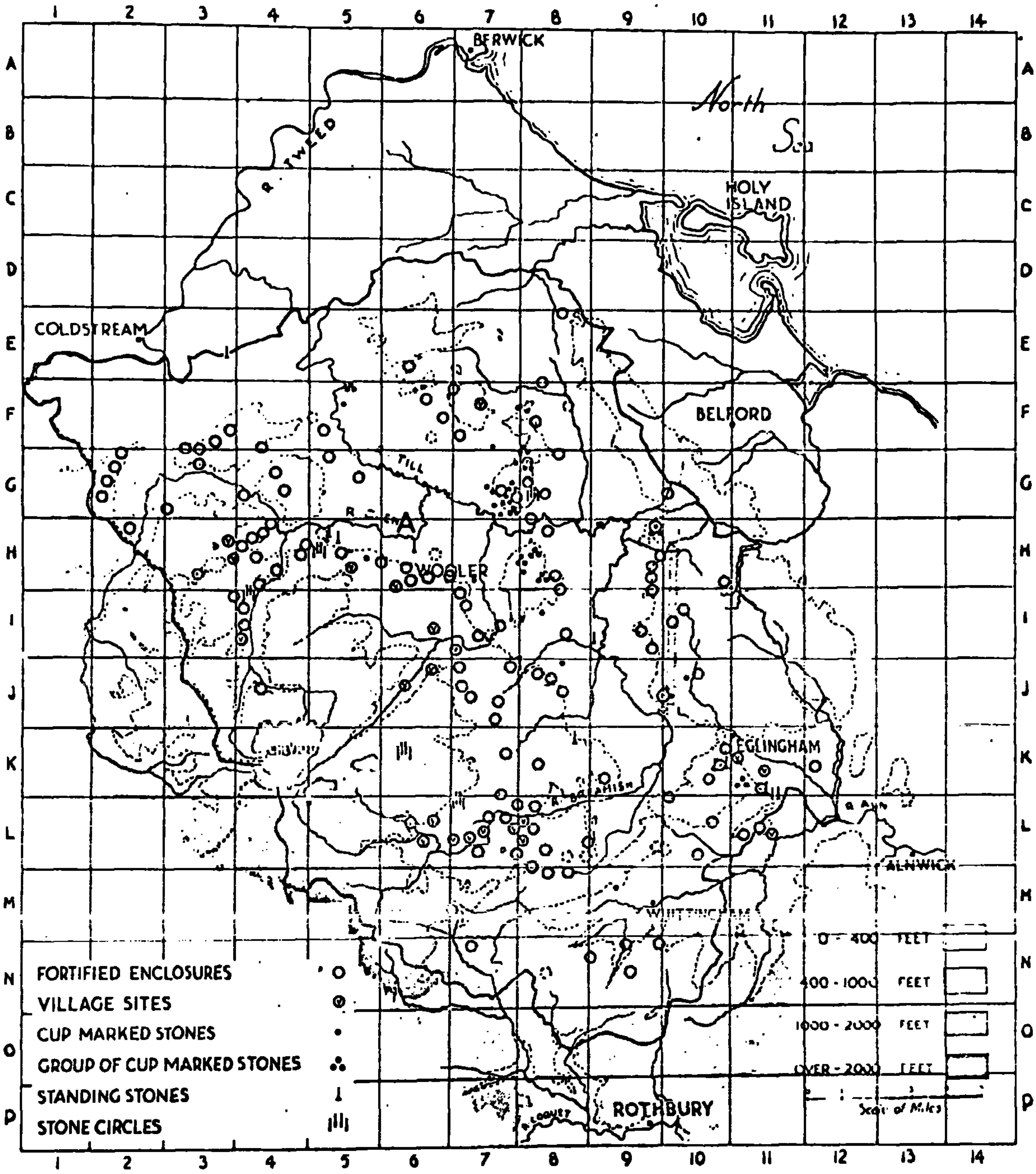
Following the retreat of the ice and the amelioration of the climate man began to move northwards from the southern part of Britain and the Continent. It is generally thought that colonisation of this part of Northern England occurred comparatively late. The probable lines of immigration were from the south along the Pennines, along the Tyne Valley from the west and eastwards from the Dumfries - Selkirk area.

The earliest inhabitants are thought to have been hunters living in temporary shelters of timber and skins. Bones of deer, rabbits and fish (including shell fish) have been found in the middens associated with these people, although signs of their habitation have long since disappeared. Small flint scrapers, flakes and axeheads of various origins indicate the presence of these early settlers.

Evidence particularly from south Scotland points to the development of settlement patterns which might have taken place in the area. This settlement pattern began with timber palisaded structures and it is with this cultural development that man began to affect the vegetation. For it was not until man was able to clear large enough areas of land for cultivation that a stable agrarian culture could develop. Neolithic man is known mainly by his custom of burial in small stone-lined chambers and long cairns. Two such cysts have been found near Wetwood Moor about three miles from the site.

The influence of the Beaker people spread northwards to this area, it is thought between 2000 BC and 1,500 BC. Burials of this age typically contain pottery urns or food vessels. The cairns are round in shape and megaliths are often associated with the burials. There are a number of stone circles of the age in the area although their purpose is unknown. (Fig. 5). The introduction of bronze and copper items to Northumberland seems to have been over the Cheviots from the well-developed Galloway centre. Copper ore as well as native gold was found in the area so the raw

FIGURE 5



MAP OF NORTH EAST ENGLAND (TAKEN FROM A DISSERTATION BY C. H. TURNER) TO SHOW:-

1. STONE AND BRONZEAGE SETTLEMENTS.
2. SITE OF STUDY 'A' AT H6.

materials were available for local manufacture. Bronze axeheads and adzes as well as ornaments and weapons have been excavated. The finds indicate that a stable agrarian culture had developed. However few convincing examples of the existence of fields survive comparable to those of late Bronze age in southern Britain although imprints of barley seeds have been found on pottery of that time. It is this culture that is accredited with the carving of the cup and ring marked stones, examples of which may be seen in the area (Fig. 5).

Ceramic evidence of the Iron age is of poor quality and probably indicates Celtic invasion around 100 BC in this part of Britain, though the Celts had penetrated northwards to Scarborough by 450 BC. The settlements had by now evolved to stone structures whose remains appear in rings. With the coming of the Celts there probably was a tendency to concentrate these huts within protective walls. It is debatable whether the many hill forts were actually places of defence at this time. Although the positions chosen are on spurs and promantories commanding good views over the valleys these sites are on well drained slopes with very little thickness of drift and thus ideal for agriculture. It is possible that some of these forts overlie palisade structures of earlier times.

The colonisation of the north-east by the Romans began about AD 79 with their usual network of roads with standing camps. Typically these ran where they could give maximum communication and control with minimum effort. Thus the northward routes lay between the dales and the coastal part of the country. East-west communication was via the valleys of the Tyne, Tees and Tweed. The Roman influence subsided somewhat until 122 AD when Hadrian visited the area. As a result of this visit the wall was built and the Roman influence returned to the Cheviot area once more. The Roman troops were withdrawn from the area in 196 AD to fight elsewhere but returned in 208 AD. However due to the new economic policies the land passed out of Roman hands into the Romano - British inhabitants.

Although Romanisation was greatest near the wall and in camps such as Redesdale ideas must have penetrated into the Till valley area.

The Anglian immigration occurred on the coastal plain with Bamburgh being an important centre. From here roads passed inland towards Yeavering, Millfield, Kirknewton and Wooler where Anglican traces have been found. This main influence was probably felt between 7th and 8th centuries and began to tail off with the influx of Normans.

Wooler was probably the cross roads of the north-south and east-west traffic and also a crossing place for Wooler Water. A cemetry here shows that there was a settlement.

How much of the area was used is difficult to say but probable the hill tops and higher slopes were used as pasture while lower-lying land was cultivated for crop production.

Beginning with the defeat of the Northumbrians in 1018 AD there followed a series of border squabbles which continued until the 16th century. This resulted in more land being turned over to pasture. The agricultural pattern in this part of England was the Scottish 'runrig' system of infields which were intensively manured from farms and outfields. These latter were temporarily reclaimed by ploughing, sown for one year and then left to recover. This sytem was practised until the 1830s. when the agricultural depression saw the fields turned over to pasture once more. Since 1937 the low land has been subjected to modern agricultural practices whilst the hills and higher slopes are still used as pasture.

1.5 Site description

As discussed in Section 1.1 the Akeld basin is the most northerly of the low lying basins curving round the eastern perimeter of the Massif. This basin is drained by the river Till which enters it at the south eastern extremity having broken through the ridge of the foothills of the Massif. The river continues to flow westward for a mile or so and then turns north-eastwards to flow diagonally across the basin. It leaves the area via a gap in the Massif foothills at the northern end of the basin and joins the river Tweed some five miles further north.

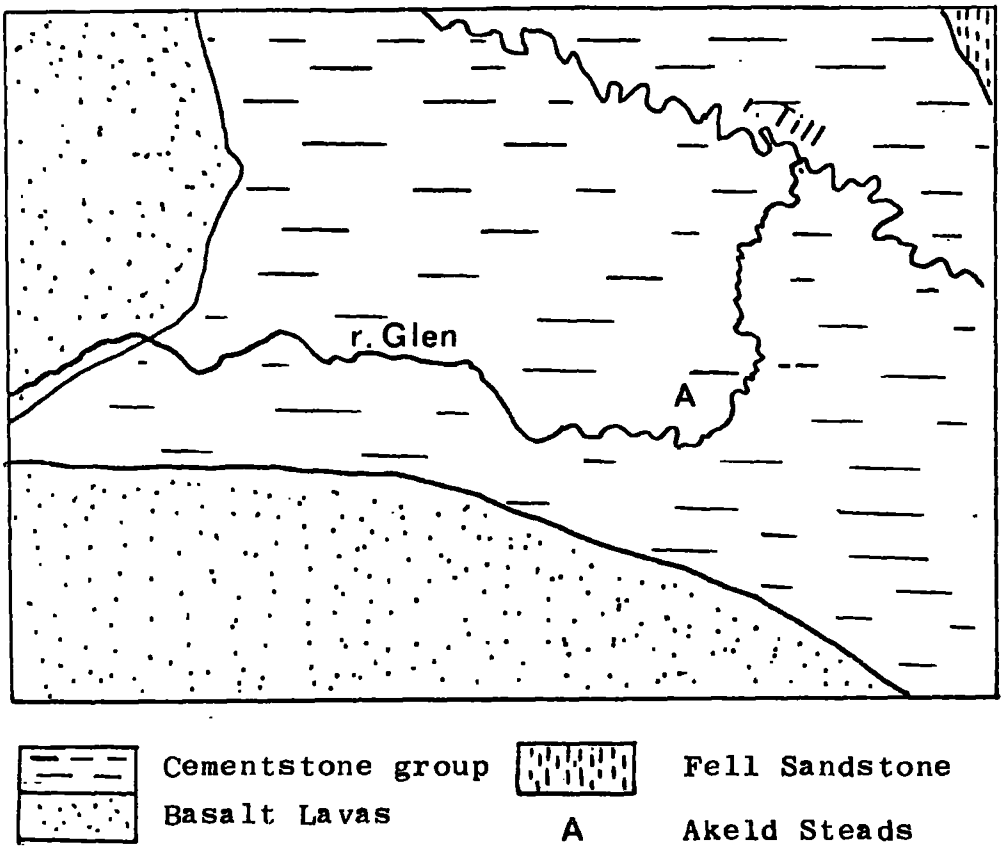
Two tributaries join the Till as it flows through the Akeld basin. The Wooler Water enters the basin from the south and joins the Till before it turns north-westward. The second river, the Glen, emerges from the western foothills of the Massif and flows eastwards. Half way across the basin it turns northwards, following a terrace (demarcated by the 150 foot contour line on the OS 1 inch map) and joins the

Figure 4a

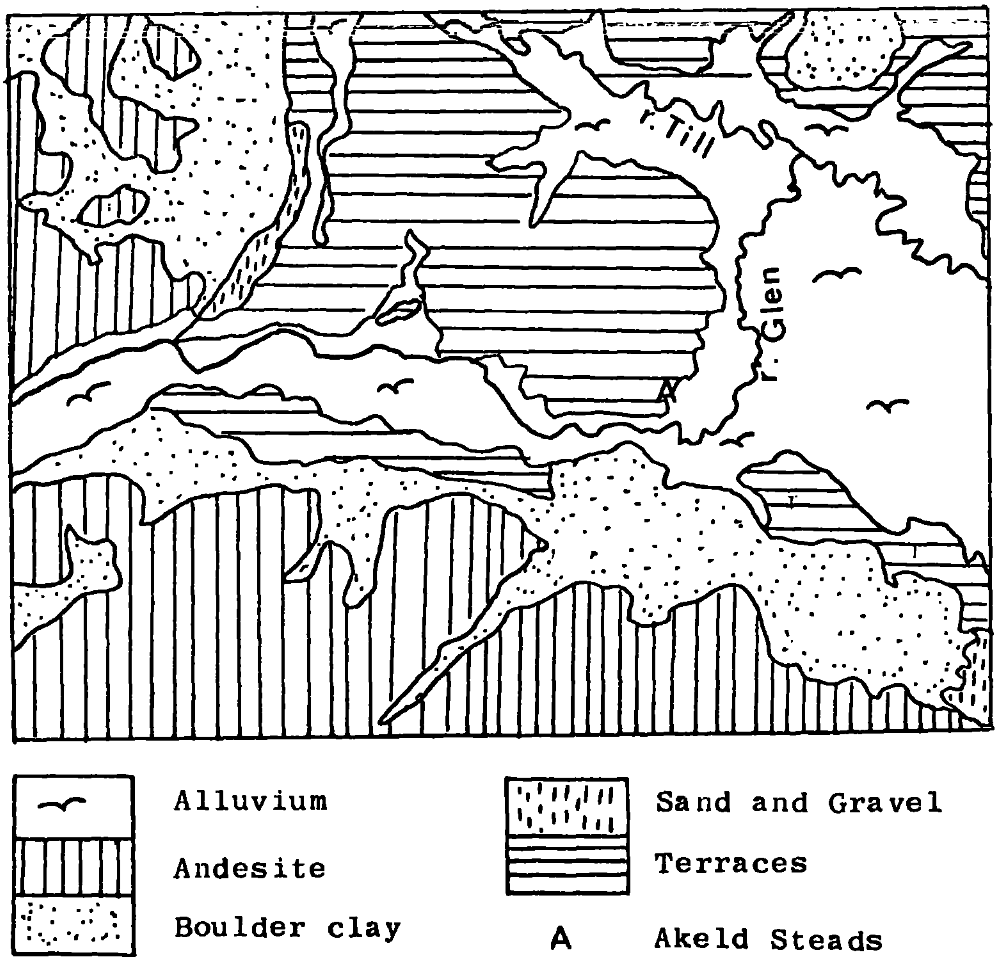
Site Geology

Scale 1 inch = 1 mile

1. SOLID GEOLOGY



2. DRIFT GEOLOGY



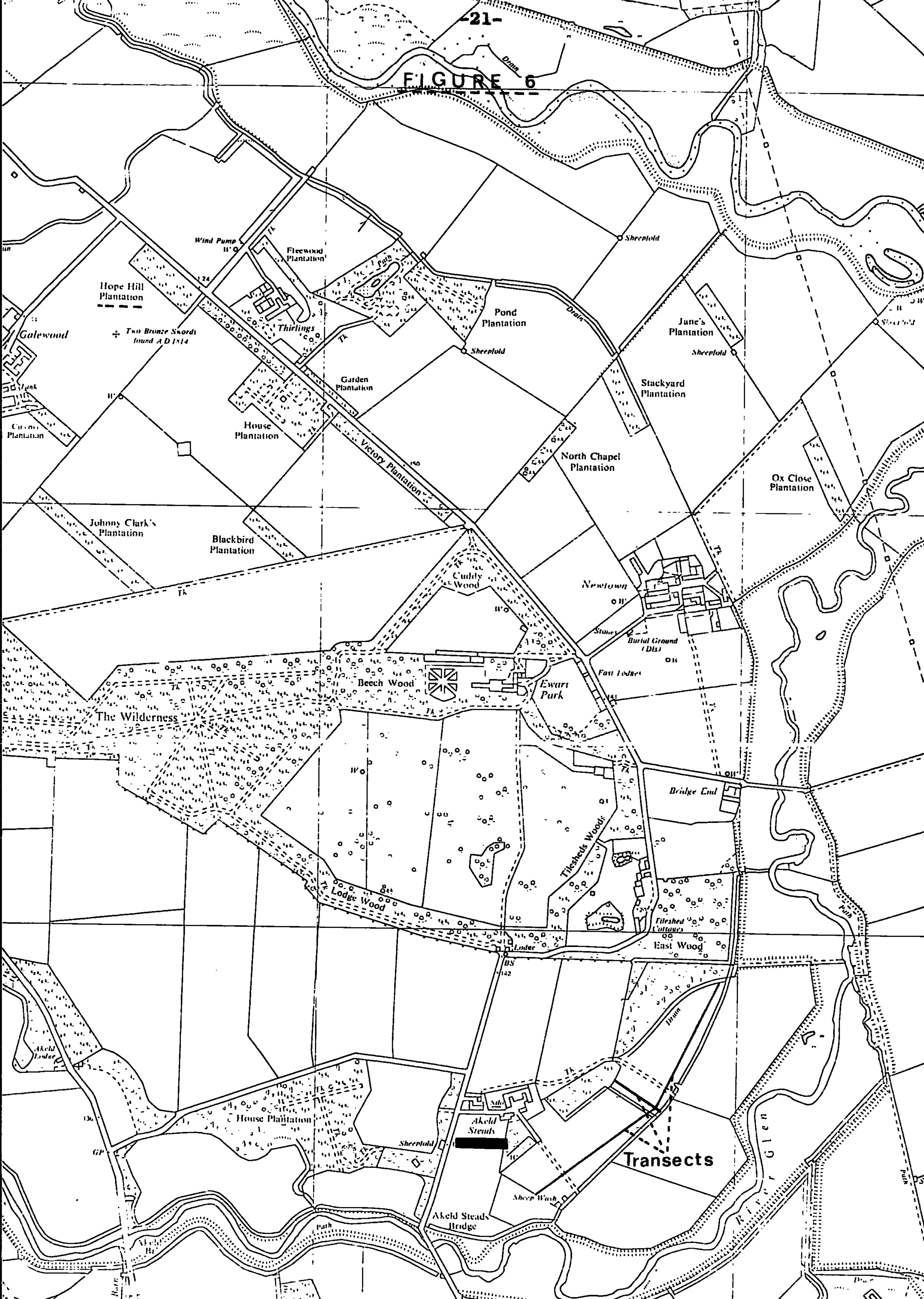
river Till about a mile and a half further north from the turn. (Fig. 4a)

On the inside of that bend about half a mile from the river and on the terrace stands Akeld Steads farm. Between the farm and just below it is the site of study (Fig. 6). The site consists of two fields aligned south-west to north-east. This constitutes one of the lowest areas of the basin have been designated as wet pasture. To the north and north west is a small conifer and mixed deciduous plantation, and a small pond with a Fen/Carr around it which extends into a field north east of the site. Beyond this field and behind the Fen/Carr is the higher ground of the terrace. To the west are some pasture fields but to the east leading to the banks of the river and on slightly higher ground are some arable fields.

The site is not flooded because the river flows in a deep channel and the water level is below the level of the site. However in spring the water is probably above the level of the site but the site does not become flooded because of the high banks of the river particularly next to the arable fields, the flood plain on the other side and the sluice gates protecting the drainage ditches which surround and cross the wet land pasture.

The geology of the site is somewhat complex. The basin is underlain by cementstone rocks which themselves rest on rocks of the Old Red Sandstone period. Erosional material from the volcanic Massif and sandstones from the escarpments were deposited on the cementstone before the glacial period.

FIGURE 6


Drain
Wind Pump
Fleewood Plantation
Path
Sheepfold
Hope Hill Plantation
Galewood
Two Bronze Swords found A D 1814
Thirlings
Pond Plantation
Drain
June's Plantation
Sheepfold
Sheepfold
Garden Plantation
Stackyard Plantation
House Plantation
Victory Plantation
North Chapel Plantation
Ox Close Plantation
Johnny Clark's Plantation
Blackbird Plantation
Tk
Cuddy Wood
Newtown
Burial Ground (Dis)
East Lodges
Beech Wood
Ewart Park
The Wilderness
Bridge End
Tileshed Woods
Lodge Wood
Tileshed Cottages
East Wood
Lodge
BS
142
Drain
Akeld Lodge
House Plantation
Akeld Steads
Sheepfold
Transects
Sheep Wash
Akeld Steads Bridge
Path
River Glen
Path

Subsequently these were modified and added to during the last glacial period. Further deposits, originating from the Massif and escarpments have been laid down in the early post glacial period when the area constituted a shallow lake. Thus the immediate layer of material underlying the mass of peat consists of sand and clay with some glacial drift.

CHAPTER 2

STRATIGRAPHY

2.1 Introduction

In order to determine the best position to obtain the core for pollen analysis and to gain an impression of the site during the period of peat formation, transects were laid across the site and the organic deposit examined throughout its depth at several points along these transects. The cores were taken using a Russian borer and a screw auger was used to check for the bottom of the deposit when evidence for this was not clear in the deposits brought up using the Russian sampler. The surface topography was surveyed using a Dumpy type level and staff.

The results are shown in Figures 8 and 11 and details tabulated in appendix 1.

2.2 The south 49° East transect

The transect, stations A-N, was laid in the most easterly of the two fields. The 13th post (23.1 metres from the dividing fence) was taken to mark the first station, A and the rest of the transect was laid almost parallel to the drainage ditch running in the south westerly direction. Canes were placed every 10 metres and the transect was levelled (Fig. 7). Cores were taken every 40 metres at stations B, F, and N. The first sample was taken at B in order to avoid contamination due to the drainage ditch. The shallowest deposit was found near the wood at station B and the deepest at the other end of the transect at N. (Fig. 8). The other samples being intermediate in depth. The bottom of the deposit thus resembled a gentle slope of a pond or lake margin.

FIGURE 7

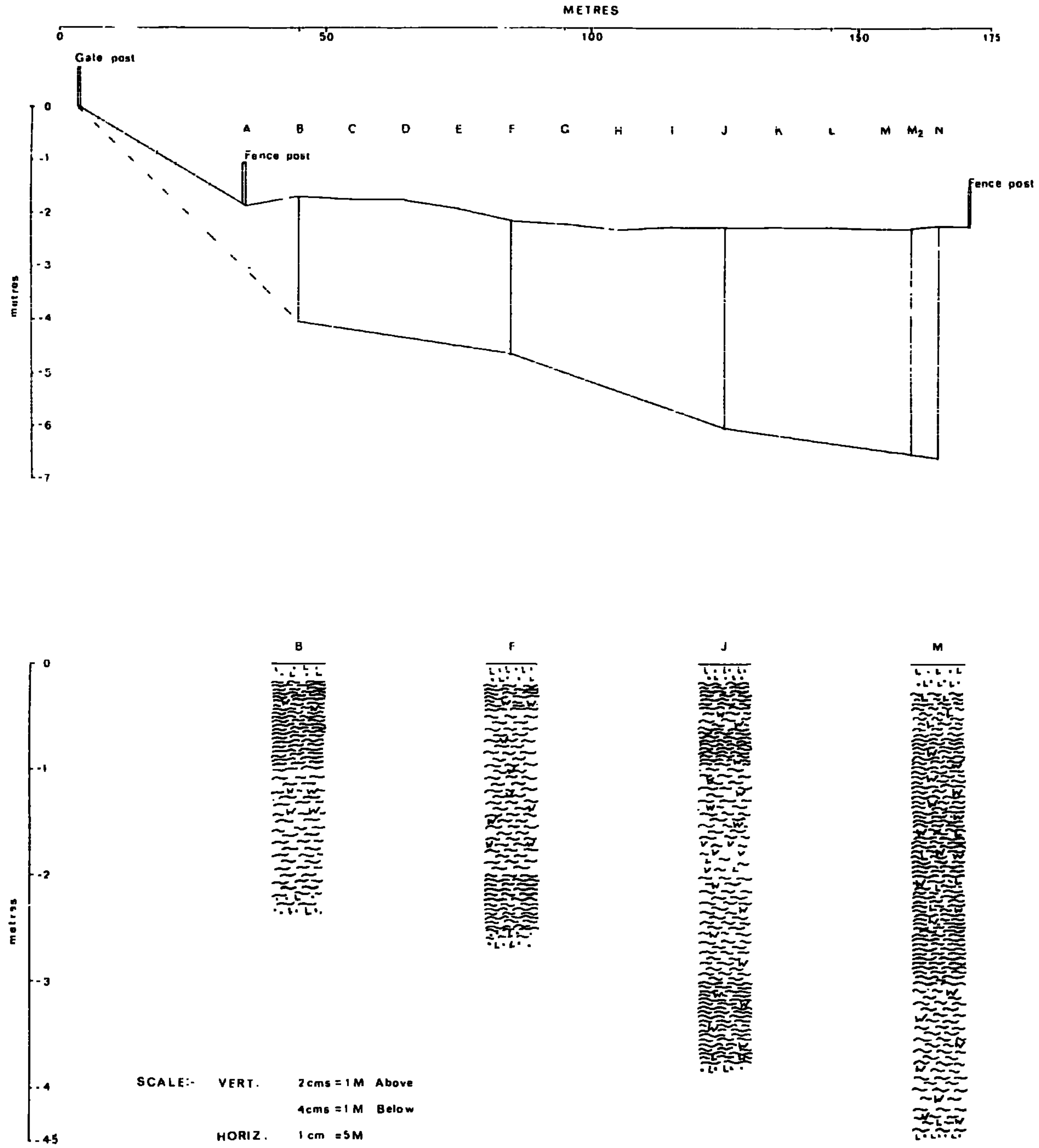
Photograph taken from station "A" on the South East transect to show.

1. The AN transect with the staff at station M_2.
2. The arable field beyond the fence and drainage ditch (centre, left to right)
3. The tree (centre right) marks the south corner of the north-east field and the junction of two drainage ditches.
4. The site of the river demarcated by the trees in the background.

FIGURE 8

THE SOUTH-EAST TRANSECT

STRATIGRAPHY



It was not possible to sample beyond station N (130 m) as this was the boundary of this field and the field beyond was under cultivation.

The samples for pollen analysis were taken from a point intermediate between M and N at M_2 to gain maximum depth and avoid contamination of the deposit along the transect.No uniformity of texture could be seen at corresponding levels, however vegetational content of the deposit was similar. The deposit consisted predominantly of sedge peat with a few remains of Phragmites in deeper deposits. Wood is evident to various degrees throughout the profiles and in some instances (180 cms at N and M) the deposit consisted almost entirely of wood.

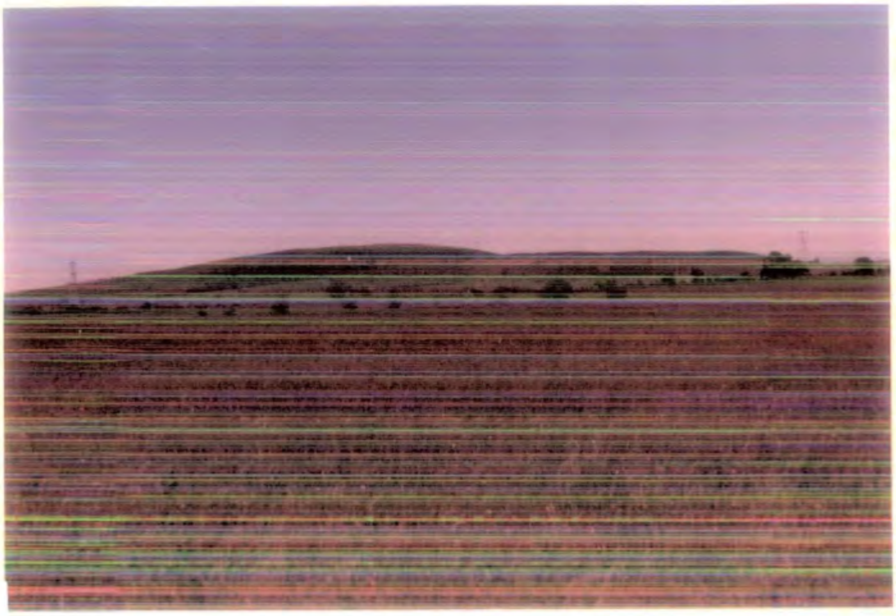
Clay is more evident in the deeper deposits perhaps because the water drained into these lower areas forming standing water where the clay could settle and the major bands of clay were at 200 cms in M and M_2 (Figs. 8 and 11).

The deposit lay on grey clay and sand which contained small angular chips of volcanic rock and in one instance some pebbles were brought up. These coarse deposits are of glacial origin laid down at the end of the last glacial period as the glacier receded from the area.

2.3 The south-west and north-east transects.

As station M_2 was one of the deepest points on the A-N transect and also the point at which the core was taken for pollen analysis it was decided to construct the other transects through that point. However it was not possible to construct a transect at right angles to the A-N transect

FIGURE 9



Photograph of site looking east to show:-

1. The area of the north east transect.

2. Doddington Hills.

3. The near row of hawthorn bushes demarcating the drainage ditch.

4. The line of trees in the background on the banks of the river Glen.

and sample both fields because of the shape of the fields and therefore two separate transects were laid from M_2. One transect was laid at 80° to the A-N transect and at a bearing north 41° east from M_2 and the other at 70° and west 29° south from M_2 (Figures 9-11). In this way it was possible to avoid the drainage ditches and the cultivated fields and sample the entire length of the study site.

The surface of the site slopes towards the north east and the river which lies beyond the Fen/Carr (Section 1.5).

2.3.1. The North-east transect.

The depth of the deposit is fairly uniform and the deepest parts are at M_2 and 200 m north east of M_2 (Fig. 11).

The profile shows some uniformity in vegetation type and clay deposition, however the decomposition and distribution of wood varies from profile to profile. However the wood deposit at 180 cm found in the A-N transect and identified as birch at M_2, is evident here but deeper deposits of wood are also present. Charcoal was found at a depth of 113 cm at station 50 in N.E. of M_2, 99 cms and 200 cm at 100 m N.E. and 50 cms at 300 m. N.E. of M_2.

2.3.2. The South-west transect.

This transect (Fig. 11) produced an unexpected result and one not indicated by preliminary investigations. A deposit of 520 cms was discovered at 100 metres S.W. of M_2 in the westerly field. This deposit shallowed rapidly to 200 cm in the next 50 metres and decreased more slowly to 90 cm in the remaining 200 metres of the transect.

The depression discovered may have been formed during

FIGURE 10

A photograph of the site looking at Akeld Mill and south west.

Features to note:-

1. The slope leading to Akeld Hill forming the edge of the basin.
2. The line of trees (middle left to right) at the bottom of the slope demarcating the river Glen.
3. The area of wet pasture beyond the drainage ditch demarcated by the hawthorn bushes (middle to right).

the last glacial period. There is evidence that the Cheviot ice coming down the Glen Valley was forced to turn south by the Tweed ice flowing up the Till Valley, (Fig. 1) and the pressures thus set up may have caused the depression. A similar depression, caused by the same forces has been described by C. H. Turner (1968).

The deposit in the profiles is somewhat varied and little pattern can be seen. However, the wood deposit conforms to the N.E. transect.

The deepest deposit shows a marked difference from the other cores from 420 cm onwards. The deposit consists almost entirely of Sphagnum not evident anywhere else and wood is absent at this depth. Charcoal is found at the depth of 73 cms 200 m S.W. of M_2.

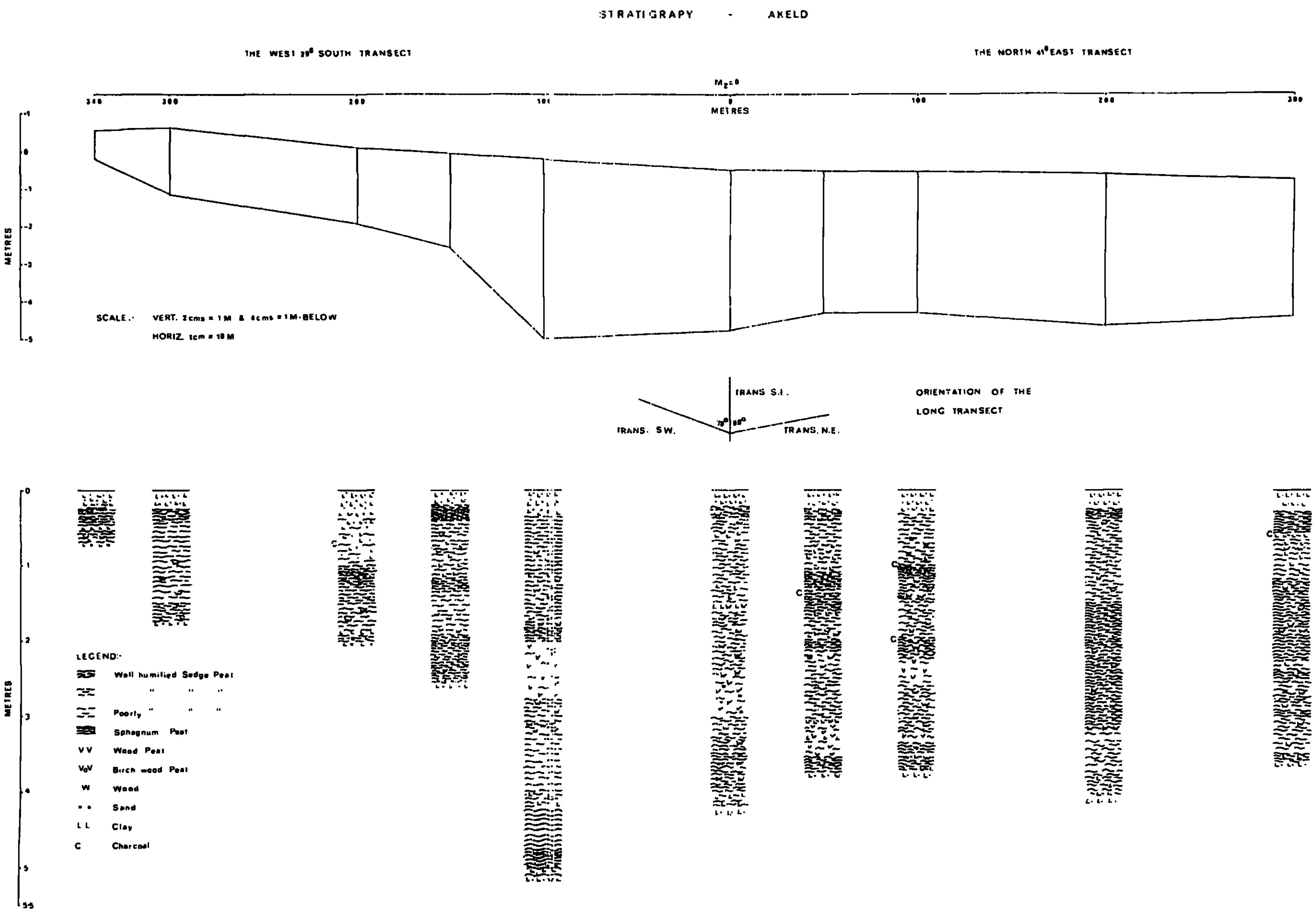
2.4 Conclusion

The overall stratigraphy indicates a dynamic mosaic of hydrological habitats persisting throughout the period of peat growth.

As the area drained and succession took place water persisted in the depressions, like the one found on the transect, as shallow pools of open water and later rafts of vegetation formed over these pools. These rafts were unable to support tree growth, probably due to a lens of water beneath, as indicated by the lack of wood in the deposit in the deepest area. One such pool still persists (in the Fen/Carr) to the north of the site.

The clay deposits indicate that the area was flooded several times during the period of deposition. The thick clay deposit at 180 cm coincides with the beginning of the

FIGURE 11



STRATIGRAPY - AKELD

Atlantic period and the abundance of Alnus. This evidence would suggest that the early post-glacial lake that had dried up during the Boreal period had been temporarily recreated during this period.

This necessarily led to considerable changes in vegetation as well as differential rates of deposit peat growth and deposition under different hydrological habitats. This is reflected in the varied decompositional state of the peat in the different profiles examined.

Thus the flora of the site was typical of the period examined but the distribution depicted the differing hydrological habitats of the site.

CHAPTER 3.

POLLEN DIAGRAM

3.1 Preliminary Work

Whilst investigating the depth of the peat, samples of the deposit from various depths were collected to discover the age of the deposit and to determine whether pollen was present. Some doubt about the latter was expressed as it had been noted by Clapperton (1963) that the peat exposed by the Wooler Water some 2 miles away had been almost completely devoid of pollen.

On examination of the present deposit pollen was found in all samples, however, the frequency and preservation diminished with depth and with the occurrence of clay. It was also discovered that the samples examined contained varying amounts of inorganic matter and, therefore, a method for its removal had to be incorporated into the process of pollen slide preparation.

The bottom of the deposit was found to be pre-*Alnus* rise and correspond to either zone V or VI of Godwin's diagram for England and Wales (1940). As these zones are dated pre-Neolithic the deposit was old enough to yield some interesting information about the immigration of the early man into the area and therefore the construction of a complete pollen diagram of the deposit was undertaken.

3.2 Collection of Samples.

Peat cores were taken with the Russian sampler which gives a very clean core. Two bores were made and the successive 50 cms of deposit extracted from alternate holes in order to avoid contamination and compaction of the upper 15 cms of the following core by the tip of the borer.

Cores were carefully placed in labelled protective plastic liners of 5 cms diameter and these in turn were wrapped in a polythene bag to avoid desiccation and for ease of transport. The deepest deposit was extracted from both of the bores in order to check that the bottom had been reached rather than just an obstruction met. However, it was realised that the bottom of the deposit was some 15 cms below that extracted, this being the length of the tip of the borer. Although the remaining peat was extracted using a screw augar the deposit was too contaminated for pollen analysis.

The peat was transported to the pollen extraction laboratory where it was sectioned into 5 cms lengths. The top one centimetre of each 5 cms block was cut off, thus giving 1 cm samples of core every 5 cms throughout the depth of the deposit. The outer layers of the 1 cm blocks were trimmed off to remove any contamination, leaving a 1 cm cube of deposit which was placed in labelled, air light specimen tube. The remaining 4 cms blocks were replaced into the plastic liners, wrapped in polythene bags and stored in case other sections were required.

Care was taken to clean the instruments used for cutting and handling the deposit after each cut was made in order to avoid any contamination from different depths of the deposit.

3.3 Preparation of slides

The material for pollen analysis was prepared by the standard method of Faegri and Iverson (1964) for removing the extraneous organic matter. However, since the deposit contained variable amounts of inorganic material in almost all samples a process to remove this material had to be incorporated into the method.

Details of Method

3.3.1. Treatment with sodium Hydroxide

This deflocculates the deposit and removes the 'humic acid' at the same time.

Half of the peat from the specimen tube was transferred to a boiling tube and 20 mls of 10% NaOH was added. The tube and contents were heated in a boiling water bath for 30 minutes. The contents was then poured through a fine metal sieve and the filtrate washed and centrifuged repeatedly until the supernatant was clear. Macrofossils were washed and retained.

3.3.2. Removal of inorganic matter

If the remains looked whitish and felt gritty then silica had to be dissolved out in order to make the pollen grains and in particular the pores more distinguishable. All samples were treated. The method chosen to remove the silica was by means of hot hydrofluoric acid and one sample could be dealt with in 15 minutes. The method was as follows:

(i) After deflocculation with NaOH the residue was washed centrifuged and transferred to a nickel crucible using minimal amounts of 10% HCl.

(ii) 2-3 mls of 40% hydrofluoric acid was added and the mixture boiled for 2-3 minutes.

(iii) This mixture was then transferred into a plastic centrifuge tube using 10 mls of 10% HCl and centrifuged.

(iv) The resultant residue was transferred to a 15 cc glass centrifuge tube using 10% HCl and heated to remove colloidal SiO_2 and silicofluorides. After 2-3 mins. it was centrifuged while still hot and the supernatant discarded.

(v) The residue was washed with distilled water before the next process.

3.3.3. Acetolysis

This process removes cellulose of the still remaining organic matter, also exine features come out more distinctive than before. The method was as follows:

(i) After deflocculation and HF treatment the residue was washed, dehydrated with 4-5 mls of glacial acetic acid and centrifuged.

(ii) The residue was heated in a boiling water bath for 1 min with a mixture of 10 mls acetic anhydride and 1 ml concentrated sulphuric acid, centrifuged and washed with distilled water containing a few drops of glacial acetic acid.

(iii) The resultant residue was washed once more with distilled water but containing a few drops of NaOH and detergent. This mixture was shaken vigorously before centrifugation.

This process completed the treatment of the deposit and the resultant residue containing mostly pollen grains and spores was then mounted on microscope slides using glycerine jelly mixed with safranin.

3.4. Pollen Analysis.

A binocular Vickers microscope with integrated lighting and vernier stage was used and most identification and counting was done with x 8 eyepiece and a x 40 objective giving a total magnification of x 320. Difficult grains were examined under x 100 oil immersion lens (total x 800). In order to count the pollen grains on the slide, traverses across the slide were made every 1½ fields of view. This distance was chosen to avoid any overlap and to achieve maximum coverage of the slide. In this way over 30 traverses could be made per slide.

A standard method of counting was employed and each count was terminated when either, 150 tree pollen grains (excluding Corylus) or a total of 500 land pollen grains excluding aquatic, Pteridophyte and Bryophyte pollen and spores had been counted. Only specimens that could be identified with high degree of certainty were included, even if some grains were present in part only.

The actual pollen identification was facilitated by the pollen type collection in the Department of Botany and Keys of Faegri and Iverson (1964). Furthermore, when in doubt, the position of the pollen grains in question were noted and second opinion was sought as to their identity.

An overall total of more than 11,000 grains was counted on 49 slides and these represented 29 levels. The ratio of slides counted to levels represented is somewhat higher than expected due to the scarcity of pollen grains and poor preservation in the deeper parts of the deposit and in the areas of clay deposition.

Of the 29 levels shown 17 are represented by counts of

FIGURE 12

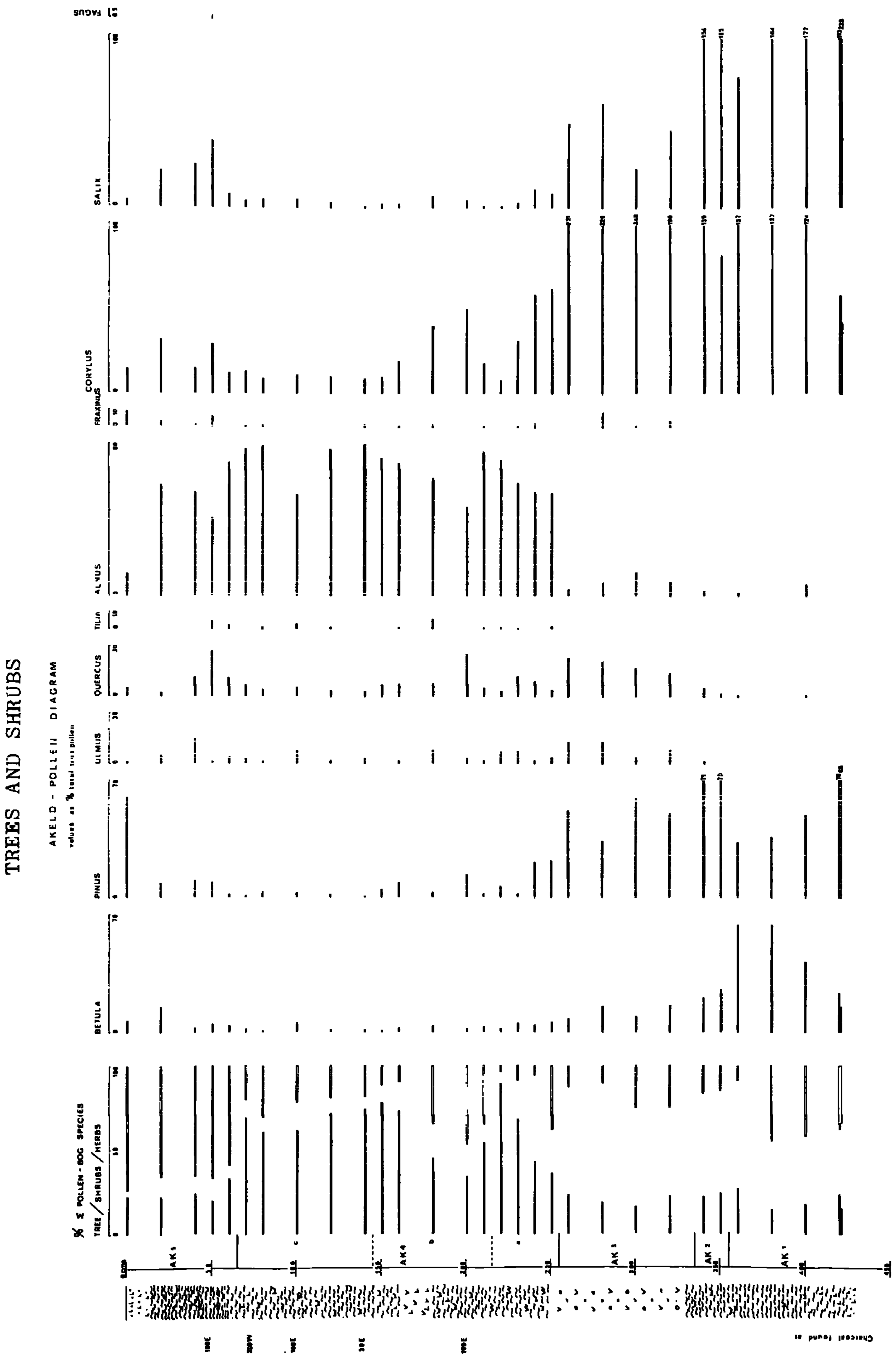
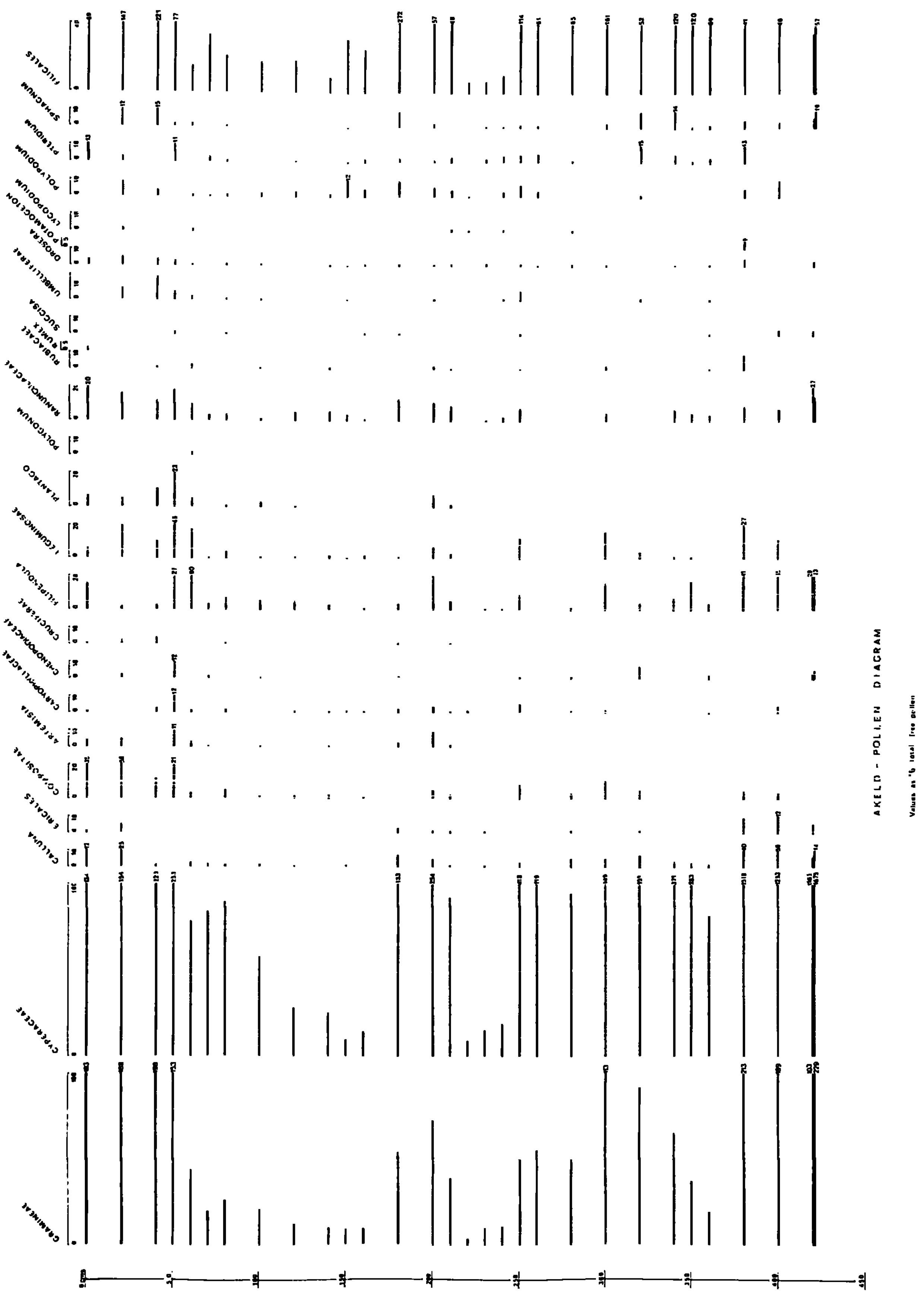

TREES AND SHRUBS
AKELD - POLLEN DIAGRAM
values as % total tree pollen
% Σ POLLEN - BOG SPECIES
TREE / SHRUBS / HERBS
BETULA
PINUS
ULMUS
QUERCUS
TILIA
ALNUS
FRAXINUS
CORYLUS
SALIX
FAGUS
AK 5
AK 4
AK 3
AK 2
AK 1
a
b
c
0 cm
50
100
150
200
250
300
350
400
450
200W
100E
30E
Charcoal found at

FIGURE 13

HERBS AND SPORES



AKELD - POLLEN DIAGRAM

Values as % total tree pollen

500 pollen grains often using 2-3 and on one occasion 4 slides to achieve this number. This proved extremely time consuming as a complete day was often required to count the 500 pollen grains for one sample.

The complete pollen diagram is presented in figures 12 (trees and shrubs) and 13 (herbs and spores).

3.5 Zonation and interpretation of Pollen Diagram

The pollen zones into which the diagram can easily be divided do not clearly correspond to the scheme proposed by Godwin (1940) for England and Wales and therefore, for ease of description, discussion and comparison it has been decided to divide the diagram into local pollen assemblage zones. These zones represent the successive, distinct areas of the pollen diagram which exhibit similar pollen spectra and as such, reflect a similar type of vegetation.

Five clear assemblages are recognised and each is prefixed by AK (AKELD) and numbered from oldest to youngest as they appear in the diagram.

The zones are listed below showing their depth and characteristic vegetation.

Zone AK1	355-421 cms	*Corylus*, *Salix*, *Betula*, Herbs.
Zone AK2	335-355 cms	*Corylus*, *Salix*, *Pinus*.
Zone AK3	255-335 cms	*Corylus*, *Pinus*, *Quercus*, *Ulmus*.
Zone AK4	65-255 cms	*Alnus*
Zone AK5	0- 65 cms	Herbs

Zone AK1 and AK2

3.5.1 Zone AK1

The early and mid parts of this zone are characterised by high herb pollen frequencies (40%). However these give way to high shrub pollen frequencies (60%) at the end of the period. Tree pollen is low (15%) and in the early stages is represented by two genera only, Betula (14%) and Pinus (86%). The frequencies however, change throughout the period, that of Pinus declining to 33% and that of Betula rising to 64% by 360 cm, when they are joined for the first time by those of Quercus and Alnus. The early record of Quercus (1 grain) at 400 cms may be attributed to long distance transport since it is unlikely that it had migrated into the area by this time, however the presence of Alnus (7%) at the same level is too high to be regarded as long distance transport. Its presence, at such an early stage in this area is probably due to the local condition providing suitable wet habitats for its growth. These habitats had been created by the shallow lake that occupied the basin during the early parts of the post glacial period. The herb pollen taxa recorded include Calluna, Ericales, Ranunculaceae, Leguminosae and Filipendula. These occur in substantial amounts at first but decline by the end of the zone. The same fate is shared by Graminae and Cyperaceae curves, which decline from 200 to 20% and 1000% to 80% respectively.

Spores are represented by Polypodium, Filicales and Sphagnum, the former two showing a slight increase and the latter a fall.

The pollen frequencies indicate that the vegetation of the area resembled that in much of the rest of North England during this period. The period recorded began with an open woodland of birch, pine and hazel on the hills and in the valleys surrounding the lake which occupied the basin. (With amelioration of climate). The birch slowly replaced the pine and the hazel spread to invade the herbaceous communities and to form an understorey to the trees. Infact there has always been some controversy as to whether the hazel grew as an under shrub below the woodland canopy or in pure hazel woods. In this case there is no doubt that it was growing in the open, because as the herbs declined there was no corresponding increase in trees, but the hazel frequencies increased by 30%.

By the end of the period the only herbaceous communities remaining were probably those in the marginal areas of the lake and on the steep sided valleys, both unsuitable for tree growth. Most of the open wet areas near the lake must have dried up considerably by the end of this period as shown by the fall in the Cyperaceae (1000% to 80%), Salix and wet land herbs. However the remaining carr still supported a considerable amount of willows (24%) and the few alder that had managed to reach the area by then.

3.5.2 Zone AK2

The main character of the AK2 zone is the increase in Pinus (33%-73%), an almost corresponding decrease in Betula (64%-35%) and the high level of shrubs. The thermophilous trees began to migrate into the area and Quercus and Alnus became established by the end of this period. However Ulmus had not yet arrived. The record of 1 grain at 350 cms may by attributed to long distance transport.

There are indications in the increase in Fen species such as Cyperaceae, Salix and Filipendula and the decrease in bog species such as Calluna and Ericales that the area may have become slightly wetter than it had been. However the general picture of the region does not change, as the area was still covered by a woodland of pine, hazel and birch with the addition of little oak 7%. The herb communities, although a little more extensive, due to the expansion of wet lands were still confined to the lake margins and areas unsuitable for most trees. The wet-lands, however are ideal habitats for Salix and thus its frequency doubled at the beginning of this period.

In trying to compare this diagram with others from the area it has been noticed that zone AK1 and AK2 taken together correspond to zone V on other diagrams and that is why they are being considered together. They closely resemble zone V at Flixton (Yorks) and form an almost perfect match with zone V Embleton's Bog (Northumberland), the latter bog being only 13 miles east of the present site. The main features of similarity are the Betula and Pinus curves and the high values of Corylus. The rise in Corylus has been used by Goodwin (1940) to establish the IV/V zone boundary.

Since there are no radiocarbon dates available for this site, it is hoped that by making comparisons with other diagrams from the area it will be possible to establish some dates for the present site. The sites used for comparison are Neasham Fen (Co. Durham), Scaleby Moss and Din Moss both in Northumberland which are the nearest dated deposits to the present site. In fact Din Moss lies only 10 miles west of

Akeld, although Scaleby Moss lies 53 miles south-west.

Chambers has dated the Corylus rise at Neasham Fen (Co. Durham) to 9,082±90 radiocarbon years BP. This closely resembles the date of 8,809±192 radiocarbon years BP for the top of the same zone at Scaleby Moss (Godwin Walker and Willis 1957).

The most striking feature of the diagram at this level is the appearance of Quercus before Ulmus the reversal of what is normally found both in this area and indeed in the rest of the country. However, a close inspection of several diagrams has revealed a similar trend at Embleton's Bog (Northumberland) and Blelham basin cores B and D in the Lake District although these were not commented upon by their authors. Also the simultaneous appearance of both trees has been recorded at a few other sites including Blelham basin core A in the Lake District, Langlee Moor in Northumberland and Seathwaite Tarn in North Lancashire but not from further south. Therefore, it seems that Quercus managed to establish itself in some localities of Northern England before Ulmus did, although the latter may have been present in small amounts.

The other feature worth noting is the relative abundance of Salix and the diversity of herbs found in this area as compared with other sites. These features, however, are local and may be attributed to the vast amounts of marginal land that must have existed due to the presence of the lake in the basin, and repeated floodings. These areas were unsuitable for trees but ideal for willows and herbacious communities.

3.5.3 Zone AK3

The opening of this zone sees a rise in *Quercus* and *Ulmus* pollen frequencies. These continue to rise throughout the zone to reach frequencies of 23% and 14% respectively. *Pinus* and *Betula* frequencies decline slightly but *Corylus* rises to its maximum of384% at 300 cms. *Alnus* is present in low frequencies and *Fraxinus* pollen is recorded for the first time. *Salix* frequency oscillate about a 40% mean.

This zone, as the previous one is dominated by shrub pollen (60%) most of which is *Corylus* which presumably is still growing as a tree. The tree and herb pollen frequencies represent only 35% of the vegetation at their maximum with the tree frequencies being more prevalent throughout as the herb frequencies have declined since the last zone.The herbs include Calluna, Ericales, *Filipendula*, Leguminosae, Compositae, also Caryophyllaceae, Chemopodiaceae and Ranunculaceae, Filicales maintain a high level throughout the zone and *Sphagnum* and *Polypodium* are present. Graminae show a slight rise and then decline, but Cyperaceae maintain high pollen frequencies throughout (over 100%).

The vegetation of this zone was very similar to that of the previous one. The area was still shrouded in dense woodland, however there was a higher frequency of oaks and elms among the birches, pines and hazels. In the wet lands alder had become well established among the still abundant willows. The herb communities had been reduced somewhat as compared with the last zone probably due to recession of the lake and the rapid succession that must have taken place throughout the wet lands influenced by the warm, dry climate of the Boreal period.

In trying to cimpare this zone with similar ones on other diagrams the *Quercus* and *Ulmus* rise and the decline of *Betula* are diagnostic. These are the features used at Embleton Bog to establish the V/VI transection zone, and this boundary has been dated 8,809±122 radiocarbon years B.P. at Scaleby Moss (Northumberland). This date corresponds well with 8,684 140 radiocarbon year B.P. at Din Moss (Roxburghshire) for the *Quercus* rise and *Corylus* maximum which represent the mid point of zone AK3. Furthermore the higher frequency of *Quercus* than *Ulmus* and the *Pinus* peak shown at the end of the zone have been dated 7,670±150 radiocarbon years B.P. at Din Moss and represent the VI/VII boundary on the present diagram. However, this may not be the true boundary as the sharp transition between the zones suggest that a part of the deposit is missing. This missing deposit may be of late Boreal and/or early Atlantic origin. The absence of the late Boreal peat may be accounted for by the drier conditions prevailing at that time which would cause the mire surface to dry out and erosion to take place before the increased rainfall of the Atlantic renewed peat growth. This feature has also been found at Wetwood Moor, a site 3 miles away at the south western extremity of the basin (C. H. Turner 1968).

From the description above it is clear that the AK3 zone corresponds with zone VI, or at least most of it, on other diagrams from England and Wales. This period lasted for over a thousand years (8,809±122 B.P. - 2,670±150 B.P.) and is represented by 80 cm of the present peat deposit (255-355 cm).

3.5.4 Zone AK4

The beginning of this period is marked by a dramatic increase in Alnus pollen frequencies (4% - 62%) and reaching a maximum of 140 cms and a decline in Corylus (220% to 63% to 9%). Whilst Betula, Quercus, Ulmus, and Salix pollen frequencies also show a phase of decline, Tilia appears for the first time at the beginning of this zone and is recorded throughout this period. The zone as a whole shows higher tree pollen frequencies than before reaching a maximum of 89% at 220 cms. Although uniform in many respects this zone can be subdivided into three subzones on the basis of tree-herb pollen frequency ratios. These subzones are considered below.

3.5.4.1 Subzone AK4a

This subzone represents the initial rise in the total tree pollen frequencies that reach a maximum (89% at 220 cms) at the end of the period. There are also substantial increases in herb pollen frequencies at the beginning of this subzone but these may be local and due to the expansion of wetland communities during the early Atlantic period. However these communities must have undergone rapid succession as they are soon replaced by shrubs and later by trees (predominantly Alder).

The vegetation of the area had changed somewhat from the end of the last period. Quercatum mixum and Corylus communities had been replaced by Alnus dominated woodlands with a little oak, elm, birch, pine and hazel still present, probably occupying the drier south facing slopes. The hazel may have been more abundant than the pollen frequencies indicate but now in the role of an understorey shrub when its pollen production is severely curtailed.

When comparing this diagram with others it is evident that subzone 4a corresponds with at least part of the Godwin's VIIa zone for England and Wales (1940). It is the latter part of the VIIa zone that is represented and, therefore, it is evident that not only is the late Boreal deposit missing (section 3.5.3) but also the early Atlantic deposit is not present. This lack of peat deposition in the early Atlantic was probably due to local hydrological conditions. As the site is one of the lowest areas of the basin and near a river, it was undoubtedly subjected to severe flooding and probably formed part of the river flood plain during the early Atlantic period. (Indeed, as mentioned earlier, were it not for the high banks of the river and the sluice gates the area would be subjected to periodic flooding at the present time). The water depth and/or the rate of flow must have been such as to prevent peat growth and sedimentation from taking place. However, subsequently these limiting factors subsided and peat growth began once more, also clay deposition is evident and increases throughout the profile.

It is not possible to date the beginning of the 4a subzone by comparing it with the VI/VIIa dates elsewhere because of the gap in the peat formation. All that can be said is that the beginning of this subzone post-dates the

VI/VIIa transition zone which has been dated 7,360±140 radiocarbon years B.P. at Din Moss Northumberland.

The 4a subzone ends with the elm decline usually taken to indicate the VIIa/VIIb boundary and dated to 5,441±70 radiocarbon years B.P. at Din Moss. Although the elm decline is not a clear feature of this diagram, the general tree decline, which is taken to coincide with the former event, is very marked. This tree decline, which seems fairly synchronous throughout the country at about 5,000 B.P. and dated 5,505±120 and 5,335±120 radiocarbon years B.P. in the Fens compares well with the date of the elm decline for Din Moss.

Therefore the transition between subzones AK4a and AK4b is taken to represent the onset of the VIIb zone (Godwin 1940) at about 5,400 B.P.

The cause of the elm decline is uncertain but as it coincides with the general tree decline at the beginning of the sub-Boreal period, it could have been climatic. However, Pennington (1970) states - "Whatever may ultimately prove to have been the climatic character of the centuries on either side of 3000 B.C., the very regular association between the elm decline and presence of Plantago lanciolata is strong ebidence that man's activities played some part in the vegetational change".

In this diagram Plantago lanciolata is first recorded at the beginning of the next subzone.

3.5.4.2 Subzones AK4b AK4c

These two subzones show remarkable similarities and therefore, they are considered together. The beginning of each subzone is marked by a decrease in tree pollen frequencies and corresponding rise in herb, including grass, pollen frequencies and a reverse of these features is seen towards the end of the subzones.

All the herbs in these subzones have been recorded before with two noticable exceptions of Plantago and Artemisia. Plantago appears at the beginning of the 4b subzone but disappears again when the herb pollen frequencies decrease. It reappears in subzone 4c with the increase in herb pollen, and continues to be represented to the present time. Artemisia also appears at the beginning of the 4b subzone, however it does not disappear but is recorded throughout the rest of the diagram. Both Plantago and Artemisia peaks coincide with the highest herb frequencies recorded in each subzone.

The presence of these two herbs and lower tree pollen frequencies are normally associated with the influence of Man (Pennington 1970) and, therefore, the two subzones are taken to represent successive periods of land clearances by Man. It is thought that at this time Man probably used the land as pasture and for crop growing. For the latter the land was cleared by chopping down the trees and burning the remains. Crops were planted for several years until the soil was exhausted then Man moved on leaving the land to recover. The animals were probably allowed to roam within the forests. These animals would have destroyed the understorey shrubs and prevented regeneration of the forest by eating the young seedlings. This would have led to further degeneration of the forest.

Further evidence for Man's presence in this area and at this time comes from stratigraphical records (Figures 8 and 11). Charcoal has been found in the deposit at levels corresponding to the clearances within the subzones and also inorganic material began to be deposited in substanial amounts on the site. This inorganic deposition implies an alteration in drainage pattern and accelerated erosion which could be caused by major deforestation, especially of the upland areas.

Although Man must have temporarily moved from the locality of the site at the end of subzone 4b, which is recorded as an increase in the tree pollen frequencies from 34.5% to 78.1% at 200 cms and 150 cms respectively, he undoubtedly persisted in the basin. The evidence for the latter is shown by the tree pollen frequencies which do not attain the previous maximum of 88.8% recorded prior to the early clearance.

Following this initial forest recovery there was another period of tree decline, which implies the second influx of Man into the area. However this decline was less extensive as the total tree and shrub pollen frequencies do not fall below 60%.

Certain of the vegetational changes of zone AK4 were not entirely due to Man. For example, the large amount of Salix (60%) and Cyperaceae (418%) in subzone 4a, the rise in Cyperaceae from 92% to 253.9% in subzone 4b and also the corresponding increases in all herbs at these times were probably due to the local hydrological conditions of the site and indeed of the whole basin. It is envisaged (section 1.3 and 2.3) that the early post-glacial lake may have been recreated in the early Atlantic period and then rapid succession took place. The site itself must have persisted as a Fen/Carr with open pools for a long period of time as succession may have been arrested due to the periodical flooding.

The increase in clay content of the deposit at 210 cms to 140 cms is associated with these hydrological conditions.

Dating subzones 4b and 4c is extremely difficult in the absence of radiocarbon dates from the site as the vegetation, represented by the pollen spectrum, has become extremely local due to the interaction of the atipical hydrology of the area and the influence of Man.

3.5.5 Zone AK5

The beginning of this zone is marked by the decrease in total tree pollen frequencies and the increase in herb and grass frequencies just as in the previous two subzones. However, the main difference is that Betula, Corylus, Salix and Pinus frequencies rise slightly as the Alnus frequencies fall. This may indicate the transition from the sub Boreal to the sub Atlantic climate.

The change in tree pollen frequencies may not altogether be climatic. The increase in Artemesia and Plantago frequencies would suggest that Man had began to use the area once more. As the tree pollen frequencies (20%) are the lowest recorded since the Boreal period Man's activity must have been more intense than ever before. Further evidence of this comes from the peaks in Artemesia and Plantago 50cm, which coincide with this low tree pollen frequency.

The onset of this period indicates the third influx of Man into the area and thus the vegetation changed once more from a forest to an open woodland, pasture and cultivated land.

Although the beginning of this zone may correspond to the original Godwin (1940) VIII zone it is felt that such a division may not be justifiable and indeed the validity of such a division is not certain.

West (1969) states:- "In Neolithic and Post Neolithic times, zone VIIb onwards, there developed much diversity of vegetation. Deforestation was accompanied by a rapid spread of weeds and ruderals , a decrease in the woodland flora and development of scrub, and widespread cultivation resulted in the introduction of alien crop plants and alien weeds. Temporary and extensive clearances have been distinguished by respectively low and high frequencies of grasses. Pastoral activities have been distinguished from arable, the former showing high frequencies of Plantago and Pteridium pollen and the latter with marked frequencies of Artemisia, Compositae, Rumer, Chenopodiaceae and Ranunculaceae pollen.

As Man had become the dominant factor in the vegetational change he obliterated any changes which might have arisen from climatic and edaphic factors. This anthropogenic influence on vegetation is evident on the diagram and therefor no further division distinguishing zone VIIIhas been made.

In the absence of radiocarbon dates for this site it is difficult to correlate the tree periods of tree decline, recorded on the diagram with the different cultures of Prehistoric and Historic Man. However, using archaeological data, an attempt has been made to associate these periods of forest clearance with cultures of Man known to have existed in the area.

There is considerable archaeological evidence to support the view that Man was present in the area from Prehistoric times (Section 1.4). As such he affected the vegetation to a greater or lesser degree and some of these effects are recorded in the changing pollen rain of that period. Even before Man began to clear and cultivate the land extensively, he farmed animals, used natural clearing for cultivation and built shelters and stockades of wood. Such activities would undoubtedly have caused a local effect on the vegetation but not large enough to be recorded as a change in the pollen spectrum.

The three periods of major tree decline recorded on the diagram must have represented considerable activity in the area and are thought to represent the Neolithic and Early Bronze age, the Iron age and the Anglo-saxon periods.

The evidence for Neolithic and Bronge age Man is overwhelming (section 1.4 Figure 5) and thus Man must have been present in considerable numbers. It is not surprising therefore that his agricultural practices and industry (copper smelting being one of them) had such a catastrophic effect on the forest of the area (the tree pollen frequency fell from 88.8% to 34.1%). This tree decline was dated about 5,000 B.P. and coincides with the known dates for the Neolithic period.

The recovery of the forst in the area, as shown by the tree pollen frequencies rising to 78.1% shows that Man must have abandoned the area, or at least greatly reduced his activities, for a considerable period of time. The reason for this is unknown.

The second period of tree decline coincides with the Iron age 'hill forts' that overlook the basin. However, this tree decline was of a lesser magnitude, than the previous one (the tree pollen frequencies do not fall below 60%) which would suggest that the land was not used to such an extent as it was during the Neolithic times. It is probable that during the Roman period, which followed, people had come into this area to seek refuge from their captors, as is exemplified by their refusal to pay taxes to the Romans and the Romans' difficulties in controlling the area. This would suggest that the population of the area was small and the region forested to some degree.

The onset of the third and final forest decline follows the dark ages and coincides with the Anglian influence of the 7th and 8th centuries. This was followed by the Saxon culture and dwellings of that period have been found near the site (Sec. 1.4). As the tree pollen frequency falls to 19.9% at 50 cm and is the lowest recorded since the Boreal period the land must have been used to a greater degree than ever before.

A slight rise in tree pollen frequency to 24.5% at 40 cms is seen and this may be attributed to the unrest in the area following the defeat of the Northumbrians (section

1.4). However after this period a small decline in the tree pollen frequencies is seen once more (21.7% at 20 cms) probably indicating the renewed agricultural activities of the 16th Century.

The pollen spectrum at the surface does not markedly differ from that at 20 cms. The two main differences are seen in the higher percentage of wet land vegetation at 20 cm and the higher percentage of pine at the surface. These differences are local, the former indicating that the site had not been drained at that time and the latter is due to the pine plantation to the north of the site. Therefore, the vegetation of the area has not altered considerably since the deposit at 20 cms was formed and thus the deposit may be taken to be recent (16th Century).

However, peat growth must have ceased about this time as the transition zone from the clay soil above to the peat below takes place from 15 to 23 cms.

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Appendix 1

TABLE 1

LEVELLING DATA FOR LINE TRANSECT PROFILE

THE SOUTH-EAST TRANSECT

Station	Distance from 13th Fence Post in Metres	Height Relative to the Base of the N.E. Gate Post in Metres
Post	-30.9	0
A	0	-1.86
B	10	-1.71
C	20	-1.75
D	30	-1.76
E	40	-1.91
F	50	-2.14
G	60	-2.21
H	70	-2.31
I	80	-2.25
J	90	-2.25
K	100	-2.26
L	110	-2.28
M	120	-2.31
M_2	125	-2.32
N	130	-2.26

<u>BEARING</u> south 49°east

<u>ADDITIONAL DATA</u>

Terrace 40m beyond gate post + 1.27 m
Terrace 75m " " post + 3.35 m
(TOP OF THE SLOPE)

Appendix 1

Stratigraphy - Description of cores for the A-N transect.

Depth cms	Core at B
0 - 18	Sandy clay soil, mid grey-brown, fresh roots.
18 - 24	Transition zone.
24 - 28	Diffuse layer of black peat.
28 - 100	Wood-sedge peat (probably some *Phragmites*)
100 - 230	Poorly decomposed sedge peat with wood.
230 - 232	Increasing amount of clay.
	Core at F
0 - 21	Sand-clay soil.
21 - 26	Dark diffuse layer of peat.
26 - 42	Well humified sedge peat.
42 - 231	Slightly humified peat + wood.
231 - 250	More humified, darker peat.
250 - 260	Increasing amount of clay.
	Core at J.
0 - 18	Peaty clay soil evidence of glaying.
18 - 42	Dark brown well humified peat + wood.
42 - 59	Less humified wood.
59 - 72	Dark brown diffuse layer of peat well humified.
72 - 100	Humified peat + wood.
100 - 165	Less humified + wood.
165 - 185	Wood-sedge peat.
185 - 200	Plus some clay.
200 - 300	Poorly humified peat + wood.
300 - 365	Humified peat + wood.
365 - 375	Plus increasing amounts of clay.

Stratigraphy - Description of cores for the A-N transect.

Depth cms	Core at N
0 - 31	Clay-sand
31 - 42	Increasing amounts of peat.
42 - 71	Sedge peat + clay
71 - 150	Sedge wood peat well humified.
150 - 200	Peat + wood + large amounts of clay.
200 - 250	Decrease in clay.
250 - 300	Sedge wood peat, well humified.
300 - 400	Sedge peat + wood poorly humified
400 - 422	+ clay.
422 - 436	Some peat and wood in the clay.

	Core at M_2
0 - 15	Clay - humus soil.
15 - 23	Transition zone.
23 - 45	Humified sedge peat + some wood.
45 - 59	Diffuse layer of black peat + wood.
59 - 63	As above but more humified + clay.
63 - 74	Clay + some peat and wood.
74 - 120	Dark brown peat with some wood.
120 - 162	As above some clay.
162 - 180	Clay with wood.
180 - 194	Peat + clay + wood.
194 - 250	Sedge peat with increasing amount of wood.
250 - 298	Wood peat (birch)
298 - 330	Dark brown sedge peat + wood.
330 - 400	More compact.
400 - 422	As above with increasing amount of clay.

Appendix 1

TABLE 2

LEVELLING DATA FOR LINE TRANSECT PROFILE

SW-NE (LONG) TRANSECT

Station	Distance from Station M_2 on S.E. Transect in Metres.	Height in Relation to N.E. Gate Post in Metres.
M_2	0	-2.32
1E	50	-2.35
2E	100	-2.42
4E	300	-2.64
1W	100	-1.98
2W	150	-1.89
3W	200	-1.80
4W	300	-1.24
5W	340	-1.34

BEARINGS

1E - 4E North 31° East from Station M_2

1W - 5W South 61° West from Station M_2

Appendix 1

Stratigraphy - description of cores for the N. E. transect.

Depth cms	Core at 50 metres N.E. of M_2
0 - 23	Clay-sand soil.
23 - 26	Transition zone.
26 - 40	Dark brown well humified peat.
40 - 72	Less well humified peat.
(50 - 62)	Diffuse layer of dark peat.
72 - 113	Sedge peat + some clay.
90	Maximum clay.
113 - 164	More compact, humified peat.
139	Charcoal.
165 - 166	Some clay.
166 - 200	Sedge wood peat, less humified.
190 - 192	As above + clay.
200 - 212	Compact peat well humified no wood.
212 - 300	Sedge peat, humified with little wood at first.
300 - 327	As above.
316 - 317	Band of clay.
324 - 350	Wood peat with some sedge peat + clay
350 - 375	Well humified peat.
375 - 385	Increasing amounts of clay.

Appendix 1

Stratigraphy - description of cores for the N. E. transect.

Depth cms	Core at 100 metres N.E. of M_2
0 - 22	Clay soil.
22 - 34	Transition.
34 - 60	Poorly humified, blackish peat.
60 - 100	Poorly humified brown, sedge peat plus some wood.
	Little clay.
	Charcoal.
100 - 133	Brown, sedge peat + wood, humified.
133 - 150	Increasing amount of wood.
150 - 195	Poorly humified, light brown peat very little wood.
195 - 200	Dark band - charcoal.
200 - 250	Sedge peat very little wood.
	Large piece of wood.
250 - 338	Humified peat plus wood.
310 - 315	Wood.
338 - 350	Sedge peat, very little wood.
350 - 373	Increasing amount of clay, sedge peat.

Appendix 1

Stratigraphy - description of cores for the N. E. transect.

Depth cms	Core at 200 metres N. E. of M_2
0 - 21	Clay soil.
21 - 25	Transition.
25 - 35	Brown well humified peat.
35 - 56	Less humified peat - sedge.
56 - 61	Darker peat.
61 - 66	A little clay in the peat.
66 - 90	Humified sedge peat.
90 - 100	Poorly humified sedge peat and wood.
100 - 142	Humified peat + wood.
142 - 166	Poorly humified sedge peat.
166 - 195	Well humified light brown peat.
195 - 200	A little clay in the peat.
200 - 345	Light brown quite well humified peat + wood.
320	Large piece of wood
345 - 400	Poorly humified light brown peat.
400 -	Poorly humified peat increasing amounts of clay.

Appendix 1

Stratigraphy - description of cores for the N.E. transect.

Depth cms	Core at 300 metres N. E. of M_2
0 - 23	Clay soil.
23 - 31	Transition.
31 - 58	Dark well humified peat.
50,58	Charcoal.
58 - 68	Clay with little peat.
68 - 122	Increasing amounts of peat poorly humified.
83	Wood.
122 - 173	Humified sedge peat.
173 - 190	Increasing amounts of wood peat well humified.
190 - 234	Compact, well humified peat, very little wood.
234 - 246	Light brown well humified peat.
246 - 250	Some clay in the peat.
250 - 267	Well humified sedge peat.
267 - 294	Little less humified.
294 - 350	Well humified peat + wood.
350 - 360	Dark brown well humified peat with increasing amounts of clay.

Appendix 1

Stratigraphy - description of cores for the S. W. transect.

Depth cms	Core at 100 metres S.W. of M_2
0 - 31	Clay soil.
31 - 36	Transition.
36 - 72	Poorly humified black peat.
72 - 108	Light brown poorly humified sedge peat + wood.
108 - 122	Considerable amount of clay in the peat.
122 - 177	Light brown humified sedge peat + some wood.
177	Large piece of wood.
177 - 181	A little clay in the peat.
181 - 200	Slightly more humified peat.
200 - 270	Wood peat with a little sedge peat.
270 - 310	Sedge-wood peat + less humified
310 - 325	Wood peat poorly humified.
325 - 350	Sedge peat poorly humified.
350 - 423	Brown sedge peat well humified.
423 - 480	Poorly humified sphagnum peat.
480 - 520	Increasing amounts of clay in the Sphagnum peat.

Appendix 1

Stratigraphy - description of cores for the S.W. transect.

Depth cms	Core at 150 metres S.W. of M_2
0 - 22	Clay soil.
22 - 28	Transition.
28 - 35	Well humified sedge peat, some clay.
35 - 84	Poorly humified sedge peat + wood.
83 - 110	Poorly humified sedge peat + clay.
110 - 121	Clay wood-sedge peat.
121 - 145	Humified sedge peat.
145 - 158	Poorly humified sedge peat.
158 - 193	Poorly humified sedge peat + wood.
193 - 244	Brown fairly well humified + wood.
244 - 255	Well humified sedge peat with increasing amounts of clay.

Appendix 1

Stratigraphy - Description of cores for the S.W. transect.

Depth cms	Core at 200 metres S.W. of M_2
0 - 21	Clay soil.
21 - 31	Transition.
31 - 35	Band of clay.
35 - 50	Peaty soil.
50 - 84	Clay soil with bands of black peat.
73	Charcoal.
84 - 105	Mostly clay increasing amounts of peat.
105 - 108	Black peat poorly humified.
108 - 125	Large piece of wood + diffuse peat.
125 - 187	Sedge peat poorly humified + wood.
187 - 189	Band of clay.
189 - 195	Decreasing amounts of clay.
195 - 199	Band of woody peat.
199 - 200	Sand.

Appendix 1

Stratigraphy - Description of cores for the S.W. transect.

Depth cms	Core at 300 metres S.W. of M_2
0 - 20	Clay soil.
20 - 23	Transition.
23 - 50	Well humified sedge peat + wood.
50 - 150	Humified sedge peat + wood.
150 - 175	More diffuse well humified sedge peat.
175 - 178	Increasing amounts of clay.
	Core at 340 metres S.W. of M_2
0 - 18	Clay soil.
18 - 21	Transition.
21 - 49	Well humified sedge peat.
49 - 50	Band of clay.
50 - 66	Less humified peat some clay.
66 - 70	Increasing amounts of clay + wood.
70 - 82	Grey clay.
82 - 90	Small pieces of angular rock + clay.
90 - 100	A little clay, sand and wood.

Appendix 2

TABLE 1

POLLEN COUNTS FOR AKELD DIAGRAM. TREES AND SHRUBS

NUMBER OF POLLEN GRAINS

			Trees								Shrubs			
Depth cms	Travs	Slides	B	P	U	Q	T	A	Fr (Fa)	Tree Total	C	S	Shrub Total	Total
0	21	1	6	46	1	4	0	10	10	77	11	3	14	91
20	13	1	9	5	3	1	0	39	2	59	19	13	32	91
40	24	1	2	8	12	9	0	48	0	79	12	20	32	111
50	29	1	3	6	0	18	3	30	(2)	66	19	26	45	111
60	21	1	5	2	5	14	2	104	0	132	16	11	27	159
70	18	1	3	2	4	10	0	130	1	150	19	5	24	174
80	13	1	1	6	2	6	1	133	1	150	13	7	20	170
100	19	1	8	5	12	31	4	90	0	150	31	8	39	189
120	17	1	2	3	3	5	+	130	4	150	14	4	18	168
140	14	1	2	1	5	5	0	135	2	150	13	1	14	164
150	21	1	1	8	11	4	0	123	3	150	15	4	19	169
160	26	1	3	14	2	11	1	118	1	150	29	5	34	184
180	51	2	4	4	10	9	7	84	2	120	48	8	56	176
200	26	1	2	13	3	23	2	48	0	91	45	4	49	140
210	33	1	4	4	3	17	1	130	1	150	27	2	29	179
220	3	1	3	10	10	4	1	122	0	150	12	+	12	162
230	23	1	8	3	10	18	1	109	1	150	47	4	51	201
240	37	2	6	31	3	14	0	93	3	150	88	90	178	328
250	62	3	4	16	3	3	2	44	0	72	45	6	51	123
260	38	2	7	48	12	21	0	4	0	92	203	45	248	340
280	44	2	12	26	10	16	0	6	7	77	253	48	301	378
300	61	2	6	38	3	11	0	9	0	64	223	15	238	302
320	77	3	13	41	7	11	0	7	3	82	156	38	194	276
340	54	2	12	43	+	3	0	0	2	59	82	91	173	232
350	56	2	16	46	+	1	0	0	0	63	52	104	156	219
360	77	3	71	37	0	1	0	2	0	111	174	86	260	371
380	42	2	14	8	0	0	0	0	0	22	28	36	64	86
400	119	4	11	13	0	0	0	2	0	26	32	36	64	90
420	47	2	7	24	0	0	0	0	0	31	18	35	53	84
421	34	2	3	18	0	0	0	0	0	21	9	50	59	80

Appendix 2

TABLE 2

POLLEN COUNTS FOR AKELD DIAGRAM. TREES AND SHRUBS AS % TOTAL TREE COUNT EXCLUDING CORYLUS

Depth	TREE POLLEN						SHRUBS		
cms	B	P	H	Q	T	A	Fr (Fa)	C	S
0	7.8	59.2	1.3	5.2	0	13	13	14.3	3.9
20	15.3	8.5	5.1	1.7	0	66.1	3.4	32.2	22
40	2.5	10.1	15.2	11.4	0	60.8	0	15.2	25.3
50	4.6	9.1	0	27.3	4.6	45.6	5.1(3)	28.8	39.4
60	3.8	1.5	3.8	10.6	1.5	78.8	0	12.1	8.3
70	2.0	1.3	2.7	6.7	0	86.7	0.7	12.7	3.3
80	0.6	4.0	1.3	4.0	0.6	88.7	0.6	8.7	4.7
100	5.3	3.3	8.0	20.7	2.7	60.0	0	20.7	5.3
120	1.3	2.0	2.0	3.3	+	86.7	2.7(1)	9.3	2.7
140	1.3	0.6	3.3	3.3	0	90.0	1.3	8.6	0.6
150	0.6	5.3	0.6	7.3	2.7	82.0	2.0	9.8	2.7
160	2.0	9.3	1.3	7.3	0.6	78.7	0.6	19.3	3.3
180	3.3	3.3	8.3	7.5	5.8	70.1	1.7	40.0	6.6
200	2.2	14.3	3.3	25.3	2.2	52.7	0	49.5	4.4
210	2.7	2.7	2.0	4.7	0.7	86.7	0.7	18.0	1.3
220	2.0	6.7	6.7	2.7	0.7	81.2	0	8.0	0
230	5.3	2.0	6.7	12.0	0.7	66.7	0.7	31.3	2.7
240	4.0	20.7	2.0	9.3	0	62.0	2.0	58.2	60.0
250	5.6	22.2	4.2	4.2	2.8	61.1	0	62.5	8.3
260	7.6	52.2	13.0	22.8	0	4.4		220.6	48.9
280	15.6	33.8	13.0	20.8	0	7.8	9.0	328.6	62.3
300	9.4	59.4	4.7	17.2	0	14.0	0	348.4	23.4
320	15.9	50.0	8.5	13.4	0	8.5	3.7	190.2	46.3
340	20.3	71.2	+	5.1	0	0	3.4	139.0	154
350	25.4	73.0	0	1.6	0	0	0	82.5	161.1
360	64.0	33.3	0	0.9	0	1.8	0	156.7	77.4
380	63.6	36.4	0	0	0	0	0	127.3	163.6
400	42.3	50.0	0	0	0	7.3	0	123.7	177
420	22.6	77.5	0	0	0	0	0	58.1	12.9
421	14.3	85.7	0	0	0	0	0	42.8	238.1

Appendix 2

TABLE 3

POLLEN COUNTS FOR AKELD POLLEN DIAGRAM. TREE/SHRUB/ HERB RATIOS AS % TOTAL POLLEN AND % TOTAL POLLEN MINUS BOG SPECIES (CALLUNA, ERICALES & CYPERACEAE).

Depth	% Total Pollen			% Tot. Pollen - Bog Spp.		
cms	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs
0	15.4	2.8	81.8	21.6	3.9	74.5
20	11.8	6.4	81.8	21.7	11.8	66.5
40	15.8	6.4	77.8	24.5	9.9	65.6
50	18.2	9.0	77.8	19.9	13.5	66.6
60	26.4	5.4	68.2	33.5	6.9	59.6
70	43.4	6.9	49.7	68.8	11.0	20.2
80	39.3	5.2	55.5	61.0	8.1	30.9
100	45.0	11.7	43.3	61.7	16.1	22.2
120	59.8	7.2	33.0	71.8	8.6	19.6
140	62.8	5.8	31.4	74.3	6.9	18.8
150	72.1	9.1	18.8	78.1	9.9	12.0
160	66.4	15.0	18.6	73.2	16.6	10.2
180	24.0	11.2	64.8	44.4	20.8	34.8
200	18.2	9.8	72.0	34.5	18.6	46.9
210	36.0	7.0	57.0	54.5	10.5	35.0
220	82.4	6.6	11.0	88.8	7.1	4.1
230	61.2	20.8	18.0	68.2	23.2	8.6
240	39.5	47.0	13.5	42.9	50.9	6.2
250	14.4	10.2	75.4	36.5	25.9	37.6
260	18.4	49.6	32.0	23.5	63.4	13.1
280	15.4	60.2	24.4	18.3	71.3	10.4
300	12.8	47.6	39.6	15.8	58.8	25.4
320	16.4	38.8	44.8	22.2	52.6	25.2
340	11.8	34.6	53.6	21.2	62.0	16.8
350	12.6	31.2	56.2	24.6	60.6	14.8
360	22.2	52.0	25.8	27.2	63.9	8.9
380	4.4	12.8	82.8	14.1	41.3	44.5
400	5.2	12.8	82.0	16.7	41.0	42.3
420	6.2	10.6	83.2	23.0	39.3	37.7
421	4.2	11.8	84.0	14.9	41.8	43.3

Appendix 2

TABLE 4

POLLEN COUNTS FOR THE AKELD DIAGRAM HERBS AND SPORES

Depth cms	Gr	Cy	C	E	Co(t)	A	Co(L)	Ca	Ch	Cr	F	Le	Pl	Po	Ra	Ru	Rx	S	U	D	Total	Pot	Ly	Pol	Pt	Sp	Fi	Total
							Herbs																	Spores				
0	183	134	9	1	11	3	16	1	0	1	12	5	5	0	23	0	2	0	0	3	409	-	-	-	10	-	53	63
20	111	210	15	3	23	3	11	-	1	1	1	11	3	-	9	-	-	-	4	3	409	-	1	5	2	7	87	102
40	156	176	1	-	8	-	1	2	-	3	2	8	8	-	9	1	-	-	11	3	389	-	-	3	-	12	175	190
50	101	167	-	-	8	7	6	8	8	-	18	32	15	-	12	-	-	2	3	2	389	-	-	-	7	2	51	60
60	58	103	3	-	4	4	-	2	-	-	119	22	6	2	13	3	-	-	3	1	341	-	2	1	-	3	19	25
70	30	126	2	-	-	1	-	-	2	-	5	1	-	-	5	-	-	-	-	-	172	-	-	1	4	-	50	55
80	39	134	2	-	4	-	2	3	-	1	11	6	1	-	6	-	-	1	1	1	212	-	-	2	1	1	31	35
100	31	87	3	-	2	1	-	-	1	-	8	2	4	-	2	2	-	0	1	+	144	-	-	3	-	-	26	29
120	18	42	1	-	2	-	-	2	-	-	8	2	1	-	8	-	-	-	-	-	83	-	-	4	1	-	27	32
140	15	37	-	-	2	1	1	1	-	-	4	3	-	-	9	-	-	-	-	1	75	-	-	3	-	-	14	17
150	12	15	1	-	-	-	-	1	-	-	-	1	-	-	5	-	-	-	1	1	39	-	-	12	1	1	46	60
160	14	21	-	-	1	-	-	1	-	-	1	1	-	-	+	-	-	1	-	1	42	-	-	7	3	-	37	47
180	65	219	8	3	-	2	-	2	1	1	4	1	-	-	16	-	-	1	-	1	324	-	-	11	2	10	326	349
200	66	231	4	1	3	8	1	3	-	-	18	6	6	-	10	-	-	-	1	1	360	-	-	5	1	2	52	60
210	59	138	2	2	1	2	2	1	-	1	8	4	2	-	13	1	-	-	-	2	238	-	1	6	5	-	72	84
220	6	13	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	20	-	1	1	-	-	11	13
230	15	23	1	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	2	44	-	-	-	2	1	11	14
240	16	29	-	-	-	-	-	-	-	-	1	-	-	-	4	-	-	-	1	-	51	-	1	4	6	1	16	28
250	36	301	2	-	4	-	2	4	1	-	7	9	-	-	5	-	-	1	4	1	377	-	-	5	3	2	82	92
260	50	109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	160	-	-	3	5	2	56	66
280	38	73	4	1	2	-	-	1	1	-	1	-	-	-	-	-	-	-	-	1	122	-	1	-	1	-	50	52
300	72	92	3	-	7	-	-	1	-	-	10	10	-	-	3	1	-	-	-	+	198	-	-	-	-	2	103	105
320	75	124	6	1	4	-	-	-	6	-	3	-	-	-	3	-	-	-	1	-	224	-	-	1	12	8	43	64
340	38	219	2	-	-	-	-	-	-	-	4	1	-	-	4	-	-	-	-	+	268	-	-	3	-	8	71	82
350	23	241	2	-	-	-	-	-	-	-	11	1	-	-	3	-	-	-	-	-	281	-	-	-	1	1	76	78
360	21	91	2	-	-	-	-	1	2	-	4	-	-	-	4	1	-	1	1	1	129	-	-	-	3	2	77	82
380	47	334	9	2	1	-	-	1	-	-	9	6	-	-	2	2	-	-	-	1	414	-	-	1	3	2	9	15
400	49	326	15	3	1	-	-	-	1	-	9	3	-	-	2	-	-	1	-	-	410	-	-	4	-	1	12	17
420	32	361	2	2	-	-	-	-	1	-	9	-	-	-	7	-	-	1	-	1	416	-	-	-	-	2	11	13
421	48	356	3	-	-	-	-	-	1	-	9	-	-	-	3	-	-	-	-	+	420	-	-	-	-	4	12	16

Appendix 2

TABLE 5

POLLEN COUNTS FOR THE AKELD DIAGRAM. HERBS AND SPORES AS % TOTAL TREE POLLEN EXCLUDING CORYLUS

HERBS

Depth cms	Gr	Cy	C	E	Co(t)	Ar	Co(L)	Ca	Ch	Cr	F	Le	Pl	Po	Ra	Ru	Rx	S	U	D	Total
0	237	174	11.7	1.3	14.3	3.9	20.8	1.3	-	1.3	15.6	6.5	6.5	-	29.9	-	2.6	-	-	3.9	530.6
20	188.1	355.9	25.4	5.1	39	5.1	18.6	-	1.7	1.7	1.7	18.6	5.1	-	15.9	-	-	-	6.8	5.1	693.2
40	197.5	222.9	1.3	-	10.1	-	1.3	2.5	-	3.8	2.5	10.1	10.2	-	11.4	1.3	-	-	13.9	3.8	492.4
50	153	253	-	-	12.1	10.6	9.1	12.1	12.1	-	27.3	48.5	32.1	-	18.2	-	-	3	4.6	3	589.4
60	43.9	78	2.3	-	3.0	3.0	-	1.5	-	-	90.2	16.7	4.5	1.5	9.9	2.3	-	-	2.3	0.8	258.3
70	20	84	1.3	-	-	0.7	-	-	1.3	-	3.3	0.7	-	-	3.3	-	-	-	-	-	114.6
80	26	89.3	1.3	-	2.7	-	1.3	2	-	0.6	7.3	4	0.6	-	4	-	-	0.6	0.6	0.6	141.3
100	20.7	58	2	-	1.3	0.6	-	-	0.6	-	5.3	1.3	2.6	-	1.3	1.3	-	-	0.6	+	96
120	12	28	0.6	-	1.3	-	-	1.3	-	-	5.3	1.3	0.6	-	5.3	-	-	-	-	-	43.7
140	10	24.7	-	-	1.3	0.6	0.6	0.6	-	-	2.7	2	-	-	6	0.6	-	-	-	0.6	50
150	8	10	0.6	-	-	-	-	1.3	-	-	-	0.6	-	-	3.9	-	-	-	0.6	0.6	26
160	9.2	14	-	-	0.6	-	-	0.6	-	-	0.6	1.3	-	-	+	-	-	0.6	-	0.6	28
180	54	182.5	6.7	2.5	-	1.7	-	1.7	0.8	0.8	3.3	0.8	-	-	13.3	-	-	0.8	-	0.8	270
200	72.5	253.9	4.4	1.1	3.3	8.8	1.1	3.3	-	-	19.8	6.6	6.6	-	1.1	2.2	-	-	1.1	1.1	395.6
210	39.3	92	1.3	1.3	0.7	1.3	1.3	0.7	-	0.7	5.3	2.7	1.3	-	8.7	0.7	-	-	-	1.3	158.6
220	4	8.7	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	13.4
230	10	15.3	0.7	0.7	-	-	-	-	-	-	0.7	-	-	-	0.7	-	-	-	-	1.3	30.1
240	10.6	19.3	-	-	-	-	-	-	-	-	0.7	-	-	-	2.7	-	-	-	0.7	-	34.0
250	50	418.1	2.8	-	5.6	-	2.8	5.6	1.4	-	9.7	12.5	-	-	6.9	-	-	1.4	5.6	1.4	523.8
260	54.4	118.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	174
280	49.4	94.8	5.2	1.3	2.6	-	-	1.3	1.3	-	1.3	-	-	-	-	-	-	-	-	1.3	158.5
300	112.5	148.8	4.7	-	10.9	-	-	1.6	-	-	15.6	15.6	-	-	4.7	1.6	-	-	-	+	309.4
320	91.5	151.2	7.3	1.2	4.9	-	-	-	7.3	-	3.7	-	-	-	3.7	-	-	-	1.2	-	272
340	64.4	371.2	3.4	-	-	-	-	-	-	-	6.8	1.7	-	-	6.8	-	-	-	-	-	454.3
350	36.5	382.5	3.2	-	-	-	-	-	-	-	17.5	1.6	-	-	4.8	-	-	-	-	-	446.1
360	18.9	82	1.8	-	-	-	-	0.9	1.8	-	3.6	-	-	-	3.6	-	-	0.9	0.9	0.9	115.3
380	213.6	1518.2	40.9	9.1	4.5	-	-	4.5	-	--	40.9	27.2	-	-	9.1	9.1	-	-	-	4.5	1881.6
400	188.5	1253	57.7	11.5	3.9	-	-	-	3.9	-	34.6	11.5	-	-	7.7	-	-	3.9	-	-	1572.3
420	103.5	1164.5	6.4	6.4	-	-	-	-	3.2	-	29	-	-	-	22.5	-	-	3.2	-	3.2	1341.9
421	228.6	1695.2	14.3	+	-	-	-	-	4.7	-	42.9	-	-	-	14.2	-	-	-	-	-	1999.9

Appendix 2

TABLE 5 (con.)

POLLEN COUNTS FOR THE AKELD DIAGRAM. HERBS AND SPORES AS % TOTAL TREE POLLEN EXCLUDING CORYLUS

SPORES

Depth cms	Pot	Ly	Pol	Pt	Sp	Fi	Total
0	-	-	-	13	-	68.8	81.8
20	-	1.7	8.5	3.4	11.9	14.7	40.2
40	-	-	3.8	-	15.2	221.5	240.5
50	-	-	-	10.6	3.0	77.3	90.9
60	-	1.5	0.8	-	2.3	14.4	18.9
70	-	-	0.7	2.7	-	33.3	36.7
80	-	-	1.3	0.6	0.6	20.7	23.3
100	-	-	2	-	-	17.3	19.3
120	-	-	2.7	0.6	-	18	21.3
140	-	-	2	-	-	9.3	11.3
150	-	-	8	0.6	0.6	30.7	40
160	-	-	4.7	2	-	24.7	31.3
180	-	-	9.2	1.7	8.6	271	282.5
200	-	-	5.5	1.1	2.2	57.1	66
210	-	1.3	4	3.3	-	48	56.6
220	-	0.7	0.7	-	-	7.3	8.7
230	-	-	-	1.3	0.7	7.3	9.3
240	-	0.7	2.7	4	0.7	10.6	18.7
250	-	-	6.9	4.2	2.8	114	127.3
260	-	-	3.3	5.4	2.2	60.7	71.6
280	-	1.3	-	1.3	-	64.9	67.5
300	-	-	-	-	2	161	163
320	-	-	1.2	14.6	9.8	52.4	78
340	-	-	-	5.1	13.6	120	138.7
350	-	-	-	1.6	1.6	121	124.2
360	-	-	-	2.7	1.8	69.4	73.9
380	9.0	-	4.5	13.6	4.5	40.9	72.5
400	-	-	15.4	-	3.9	46.1	65.4
420	-	-	-	-	6.4	35.5	41.9
421	-	-	-	-	19.1	57.1	76.2

ABBREVIATIONS USED IN TABLES

B	Betula
P	Pinus
U	Ulmus
Q	Quercus
T	Tilia
A	Alnus
Fa	Fagus
Fr	Fraxinus
C	Corylus
S	Salix
G	Gramineae
Cy	Cyperaceae
C	Calluna
E	Ericales
Co(t)	Compositae (tub.)
Ar	Artemisia
Co(L)	Compositae (Lig.)
Ca	Caryophyllaceae
Ch	Chenopodiaceae
Cr	Cruciferae
F	Filipendula
Le	Leguminosae
Pot	Potamogeton
Pl	Plantago
Po	Polygonum
Ra	Ranunculaceae
Ru	Rubiacaee
Rx	Rumex
S	Succisa
U	Umbelliferae
D	Drosera
Ly	Lycopodium
Pol	Polypodium
Pt	Pteridium
Sp	Sphagnum
Fi	Filicales