Studies on a small post-glacial peat deposit in Northumberland

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STUDIES ON A SMALL POST-GLACIAL PEAT DEPOSIT IN NORTHUMBERLAND

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TRICKLEY WOOD

Introduction 1·1

There are few pollen diagrams for the Cheviot area compared with other regions of Northern England. Further information might be of help in interpreting the vegetational history of the area and the possible effect of a remnant ice cap remaining on the Cheviot after the retreat of the main glaciation.

Mesolithic and Neolithic remains indicate a large amount of activity in the area, and it seemed reasonable to hope that with a suitably chosen site it might be possible to discover something of the pattern of regional colonisation.

The Wooler area was chosen in preference to others because of topography and the slightly denser distribution of settlements of early age.

After a preliminary survey of several sites Trickley Wood was selected, as it was small and would probably show local changes more markedly than a large site. Its relationship with nearby archaeological remains was such that if anthropogenic interference had occurred it would be reflected in the pollen rain of the site.

The Preliminary Survey 1·2

The area chosen for the study is around Wooler in Northumberland. A surface Geology map of the area was first consulted and various places chosen for investigation. At each site a stratigraphical section was taken to give an idea of the build-up of the sediments found. Samples of peat were taken from near the base, usually just above the basement clay; from the top, about 10cms below the present surface; and about half way between the two. These were taken back to be prepared for pollen analysis to give an indication of the age range of the deposit in question.

The results are given below and summarised in the table.

1. Wooler Water. NT 995275 Belongs to the owner of the Milk Bar, Wooler.

The peat was noticed in the bed of the river and on the wide gravel terrace. The source was found in the bank of the river which was being eroded by the flow of the water. It was about 5 feet thick, rather fibrous at the bottom, with quite sizable pieces of wood and roots. These had a concertina-like appearance, probably due to the 10 feet or so of gravel which overlay the peat.

Rough estimate : IV to VI.

2. Middleton Hall. NT 990259 Mr. Armstrong,
Middleton Hall.

This is a shallow small deposit which looks to have developed around a spring. Not investigated further.

3. Earle. NT 990263 Mr. Dodd. seen 19.1.68.

The surface is covered with Juncus and Deschampsia flexuosa and it lies on a small plateau above the Wooler Water site. The deposit has formed in a hollow between drumlins. There was water standing in the adjoining field on the first visit. It is about 100m in diameter.

0 - 40	Crumbly peat	
40 - 75	Woody, not so firm.	? VII - VIII
75 - 100	Crumbly	
100 - 115	Birch bark	
115 - 130	Conspicuously woody	
145	Acorn (?)	
130 - 170	Slightly less woody	
170 - 275	More woody and fibrous	? VI
275 - 310	Fen peat	
310 - 350	Clay	

4. Coldmartin Loughs. c.NU 0127 The area is divided :

The Manager, Coldmartin Farm.	Mr.Strother, Fowberrymoor.	Mr.Murray, West Weetwood.
(North part)	(South part)	(surrounding moor)

The area, 700m by 300m, is in a basin on a glaciated ridge to the east of Wooler. It is covered with regenerating

Pine and Birch. There is evidence that the two pools, one to the North, and the other to the South, are being further in filled with hydroseral development.

The surface had been cut in a number of places and was now covered with fresh Sphagnum.

0 - 50	Sphagnum, Eriophorum Peat
50 - 70	More fibrous
70 - 110	Water
110 - 180	Sphagnum Eriophorum peat with Calluna wood
180 - 230	Well humified and compact
230	Sandy clay

5. Ford Moss. NT 970375 Mr. Walker, Heatherslaw, Ford.

This is a large deep basin which has been in filled. It supports both Birch and Pine - the latter in the lag zone. The surface is covered by active Sphagnum, Eriophorum, and Calluna. The peat was mainly Sphagnum with Eriophorum. D.J.B. says it is 20m deep.

6. Lilburn. NU 027235 Mr. Hall, Lilburn South Steads, Lilburn.

This deposit has formed in a hollow between drumlins and is now covered with Juncus and Deschampsia. 100m in diameter.

0 - 273	Fibrous peat
273	Small white coiled gasteropod (?) type about 1/4 - 1/2 in across. First appearance
370 - 735	Brown-buff with shells
735	Yellow-brown clay which gives way to a blue clay.

7. Kimmer Lough. NU 110175

This was looked at from a distance and appeared to be a lake about 500m long which showed signs of hydroseral development. The site would be important if work was done on the Beanley Moor Complex.

8. Trickley Wood. NU 024270 Mr. Strother, Fowberrymoor.

The site is in Trickley Wood. The Northern part is under cultivation by the Forestry Commission and some deep drainage channels have been dug from the sloping fields southwards towards the steeper scarp. The Southern part is under Birch woodland. The surface under the trees is not active now, though water does drain in from the fields (probably taken off by the Forestry Commission channels).

0 - 30	Humified with roots
30 - 70	Fibrous. Eriophorum Sphagnum Peat (?)
70 - 110	Well humified, dark.
110 - 250	Well humified, lighter, with wood.
250 - 270	Very fibrous, with Eriophorum (?)
270 - 300	Sandy colour
300 - 315	Clay
127	Charcoal band (?)

There appear to be two main types of geomorphic features which give rise to these basins in which peat develops in this area.

1. The Drumlin surrounded basin in which there is no outflow channel or outflow will only occur when a certain level of water is reached (overflow). Water drains in from the higher ground around. TYPE A.

2. Slope and scarp where the water accumulates at the base of a scarp which faces North. The slope is quite gradual and faces South. Again there does not appear to be major drainage developed, only overflow facilities. TYPE B.

SITE	O.S. REF.	TYPE	DEPTH cm	SURFACE AREA	POLLEN ANALYSIS DATA	
WOOLER WATER	NT 995275	INLIER IN GRAVEL	175cm	?	IV - VI	too early
MIDDLETON HALL	NT 990259	A	-	20m x 20m	-	
EARLE	NT 990263	A	350	100m dia.	VI - VIII	Good small site *
COLDMARTIN LOUGHS	NU 0127	A	230	700 x 300m	Not satisfactory	Water gap. Very interesting surface vegn.
FORD MOSS	NU 970375	B	? c2000	100 x 600	-	Too big
LILBURN	NU 027235	A	735	100m dia.	-	Outside area
KIMMER LOUGH	NU 110175	A	-	500m x 100m	-	Important in S. Complex
FOWBERRY MOOR (TRICKLEY WOOD)	NU 024270	B	300	500m x 150m	VIIb - VIII+	Good pollen and interesting *

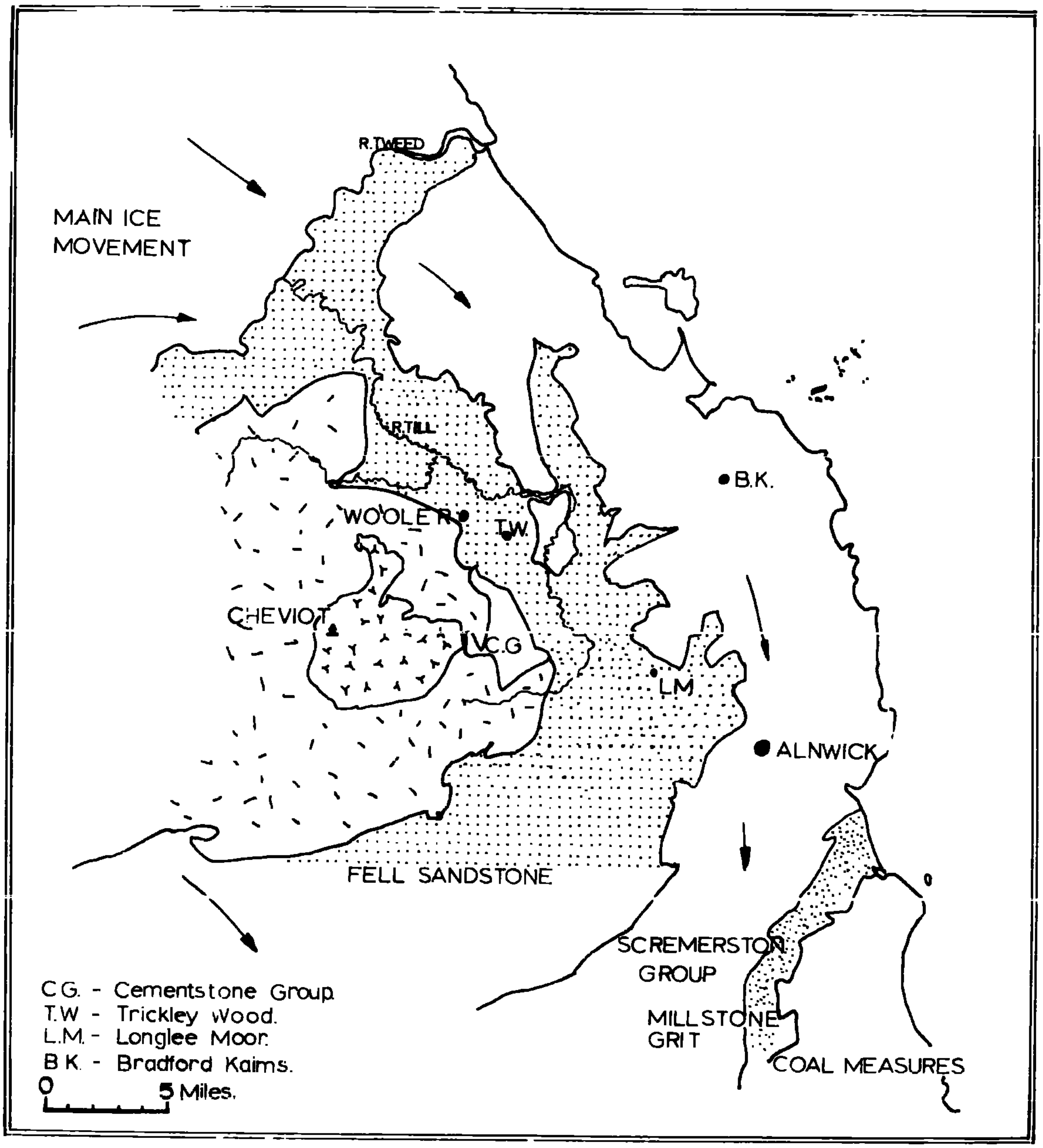

Fig.1 Geology of part of Northumberland showing Trickley Wood.

Geology 1·3

Weetwood Moor and adjacent area shown in Fig.1 are on a ridge of the Fell Sandstone. This is a coarse-grained pink rock deposited in shallow lagoons in Lower Carboniferous time. The Cheviot granite plug formed the northerly shore-line of the shallow sea in which the Carboniferous Age deposits were formed. Deltaic and swamp conditions occurred at that time on the edge of the Tynedale Geosyncline. The Fell sand-stone group contains examples of deltaic and aeolian sands as well as silt and calcareous material. Weathering of the Devonian granite of the Cheviot massif and its associated metamorphic rocks gave rise to the sand and silt. The calcareous material came from shells of fossils. Complete specimens are rare, but when found are of marine origin. Although in places this group of rocks is up to 1000ft thick, it tends to thin out towards the Cheviot and here it is only 500ft thick, the Till valley being on the Cementstone group. These shaly sandstones are intercalated with limestones of freshwater and estuarine origin.

It is probable that the Fell sandstone in this area was overlain by later deposits of Carboniferous which were then uplifted by the Hercynian movements and subsequently eroded.

Geological Sequence in this area :

Lower Carboniferous	(Limestone Series (Scremestone Coal Group (Fell Sandstone Group (Cementstone Group
Devonian Ordavician and Silurian	Cheviot Lavas

Glaciology 1·4

In the early and late stages of the last glaciation the ice cap which formed on the Cheviot massif covered this area. During the main period of activity Northumberland was swept by ice from the Southern uplands travelling southwards. The Scottish ice bificated around the Cheviot itself and passed by on either side.

The glacial erratics found in this area are all of Tweed valley origin, while further south erratics of Lake District materials show that there was a west-east movement of ice through the Tyne gap. As the ice was travelling southwards it scoured the ground surface. Where it encountered hard rocks the ice would tend to build up and overdeepen the ground upstream of the obstruction. This is the probable origin of the depression in which the peat in this study was accumulated. The hard rock outcrop being of Fell Sandstone forms the high ground to the south of the site.

Just south of the study area the local topography shows well-developed kettle moraines. These are gravelly hillocks which were deposited around stagnant ice blocks during the retreat of the glaciers. The ice blocks left behind by the main ice prevented gravels from accumulating and as they melted a hollow was left.

As the ice melted, large volumes of water began to accumulate in the valleys. It is probable that the flat-bottomed Till valley was once a glacial lake with no outlet until the water level rose high enough to flood over the ridge formed by Weetwood Moor and Horton Moor, as well as southwards along the line of the present A697. Signs of banks of at least two successive overflow channels can be seen on the end of Weetwood Moor. This channel was probably progressively deepened and now forms the outlet of the River Till to the old landlocked lake, though the flat floor of this valley probably remained wet and marshy long after the ice had melted. The River Till and Glen now flow northwards past Crookham close to the course of the preglacial rivers.

Archaeology & History 1·5

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 North Eastern 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 timbers and skins. Bones of deer, rabbits, and fish (including shell fish) have been found in 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.

It is difficult to state the exact chronology of cultures of this early period in Northumberland because of the lack of excavations at the moment. However, from very similar situations in South Scotland the evidence points to a development of the settlement pattern. This began with a timber palisaded structure. It is with this cultural development that man began to affect the vegetation. His forebears probably gathered fruits and nuts while hunting in the forest, but Mid-Stone Age man was able to cut down trees big enough to use for building.

These stockades could well have served to keep cattle in as much as marauders out. Late Stone Age man is known mainly by his custom of burial in small stone-lined chambers and long cairns (two cysts occur close to the site in question). The influence of the Beaker people spread northwards to this area, it is thought, between 2000 B.C. and 1500 B.C. Burials of this age typically contain pottery urns or food vessels.

The cairns are now round in shape and megaliths are often associated with burials. There are a number of stone circles of this age in the area whose purpose is a matter of conjecture.

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, are found in the area, so the raw materials were available for local manufacture. Bronze axeheads and adzes, as well as ornaments and weapons, have been excavated here. The finds indicate that a stable agrarian culture had developed. Among these is the imprint of barley seeds on pottery. But few convincing examples of the existence of fields survive comparable with those of the Late Bronze Age in Southern Britain. It is this culture which is accredited with the carving of the cup and ring marked stones, examples of which may be seen near Trickley Wood.

Ceramic evidence of the Iron Age is of poor quality, and probably indicates Celtic invasion around 100 B.C. in this part of Britain, though the Celts had penetrated northwards to Scarborough by 450 B.C.

The settlements had now evolved to stone structures whose remains appear as 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. Positions chosen are admittedly on spurs and promontories commanding good views over the valleys, but also they are well-drained slopes with very little thickness of drift. Also, as there is no evidence of paving within these hut circles (though there is of the courtyard outside), it may well be that these sites were chosen for their soil as much as for their military potential. The chronology of the pre-Roman stone-built settlements is made difficult by lack of datable objects. It is possible in a few cases where 'forts' are found to overlie traces of palisade structures. The Weetwood Moor and Fowberry Earthworks are similar in type to these 'forts' and thought to be more or less synchronous with them. These in turn are overlain by stone enclosures which are probably of the later Romano-British period.

Considerable effort would be required to excavate structures of the size of these forts which are similar to those of the south. However, the population, from the evidence of hut circles etc., was probably far smaller than the labour force available elsewhere, and so these earthworks represent long-term projects. This in itself tends to indicate a stable population that was prepared to defend its settlement.

The colonisation of the north-east by the Romans began about A.D.79 with their usual network of roads with staging 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 took advantage of the natural valleys of the Tyne, Tees, and Tweed.

Unfortunately, Agricola's plan for rapid colonisation and ability to enforce and collect taxes was difficult to administer in the north-east of Britain in general and the area of the Cheviot northward in particular. In fact, by the turn of the first century A.D. this latter part seems to have been abandoned completely. Conditions had so deteriorated by 122 A.D. that Hadrian came to see the problem for himself. This visit resulted in the consolidation of the Roman position south of the wall of Hadrian. The wall also provided a much stronger base for sallies against rebellious native groups than the staging posts of Agricola's road had done.

This new frontier defence system was so successful that within twenty years work was started on the Forth-Clyde wall, and so once more the Cheviot area is subjected to Roman influence.

A series of weak Emperors in Rome and poor financial arrangements led to a series of revolts among the army in Britain. These were quelled, but the troops were withdrawn from the north in 196 A.D. to fight in other parts of the Empire. The Romans soon returned to the north and in 208-211 Emperor Septimus Severus personally extended campaigns further into the Caledonians and beyond the Tay.

New economic policies dictated that each region under Roman rule should be self-supporting, and to encourage recruitment to the Roman forces, a system of land lease was introduced. Soldiers, whose sons were also serving in the army, were allotted areas of ground around the forts. Thus, in one move, Rome assured herself of an army composed of men who had a hereditary interest in the land they defended. The Roman authorities, under pressure from the Scots from Ireland, the Picts from Scotland, and Saxons from the Continent, began to pass the responsibility for local protection to the Romano-British inhabitants.

This was the final phase of the three stages of Roman influence in the area. Romanisation was most noticeable in the area of the Roman wall itself, and the outlying camps in the south of the county, especially in Redesdale, although no doubt communication of ideas penetrated northwards into the Till valley.

Main Anglian immigration occurred on the coastal plain with Bamburgh being an important centre. From here, roads passed inland towards Wooler and Yeavering, Milfield, and Kirknewton, where Anglian traces have been found. Most of these are late, so probably the main Anglian influence in the area was felt between the 7th and 8th centuries and began to tail off towards the 11th century with the influx of the Normans.

In general the settlements tend to be on the edge of the plain. Yeavering was a Royal Vill according to Bede, and recent archaeological evidence has showed traces of a large timber-built settlement with a huge hall. Paulinus preached to Edwin, King of Northumbria, close to Yeavering, so this was a place of importance in 625 A.D. The Royal Vill site at Yeavering was superseded by Milfield a few miles to the north.

Wooler was probably the crossroads of North-South and East-West traffic, and also a crossing place of Wooler Water. A cemetery here shows there to have been a settlement. How much of the area, and which part was under agriculture, is difficult to say, but probably the hill tops and higher slopes were used for pasture, while lower-lying land was subjected to crop production.

Beginning with the defeat of the Northumbrians by Malcolm II in 1018, there followed a series of Border squabbles. These raids and counter-raids, together with looting and burning, did not encourage agricultural development. The Black Death decreased an already diminished population. The wool trade and shipping on the Tyne also attracted people away to higher wages than could be found in the rural areas.

The year 1357 saw a start to the rebuilding of the castles of this area (Ford, Etal, and Chillingham) and so the inhabitants now had some protection for themselves and their movable possessions. A contemporary account describes the onset of a raid : 'So soon as there is any appearance or suspicion of war the most part of the inhabitants do withdraw themselves with their goods to other fortresses for their defence and leave the said border by the River of Till almost desolate and waste; and the war continuing long these tenants provide them of other farms. And so there is a season after the end of every such war before the frontier can be again peopled and replenished'.

This strife continued beyond the Union of Scotland and England. The Wars of the Roses provided a cause in which family feuds took the farmers yet again from their fields.

In the latter part of the 15th century under James IV and Henry VII a new phase of defensive building began. Pele towers were built in each town as a defence against thieves from either side of the border. These towers enclosed cattle as well as the people and their goods.

1513 saw the Scots taking the new castles of Ford, Etal and Chillingham, and all crops were laid waste, but the reavers of Redesdale and Tynedale were as great a threat to the inhabitants around Wooler as the Scots were.

With the death of Elizabeth, the long series of troubles died also. Revival of peace and security allowed economic expansion.

The agricultural pattern in this part of England was the Scottish 'runrig' system of infields, which were intensively manured from the farms, and outfields. These latter were temporarily reclaimed from wasteland by ploughing, sown for one year, and then left to recover before ploughing again. Stock were moved to the moorland in Spring together with the herdsman, and returned to the farm for the Winter. This practice was continued in some parts as late as 1830. The manor house and demesne structure did not apply in Northumberland; there was instead an almost tribal allegiance of peasantry to a lord who was more of a military leader of a number of vill communities than landlord of one. With a more stable political situation, these estate owners helped the spread of improved agricultural practices. Cultivation of winter fodder crops, together with greater yields from the improvement of existing and newly-won land, resulted in farming reaching its zenith from the time of the Napoleonic Wars to the 1870s.

The agricultural depression resulted in progressively larger areas of arable land being given over to permanent grass. This trend continued until recently when there has been an increase in cereal and mown grass, and more stock being carried. These fluctuations can be seen in the table of agricultural statistics below :

Acres/ 100 acres	Crop & Grass	Barley	Fodder Crops	Mown Grass	Sheep/ 1000 acres	Cattle/ 1000 acres
1875	30-40	20-30	25-30	10-15	600- 800	50-100
1937	10-20	10-20	25-30	20-25	1000-1200	150-200
1966	20-30	60-70	10-15	20-25	1000-1200	200-250

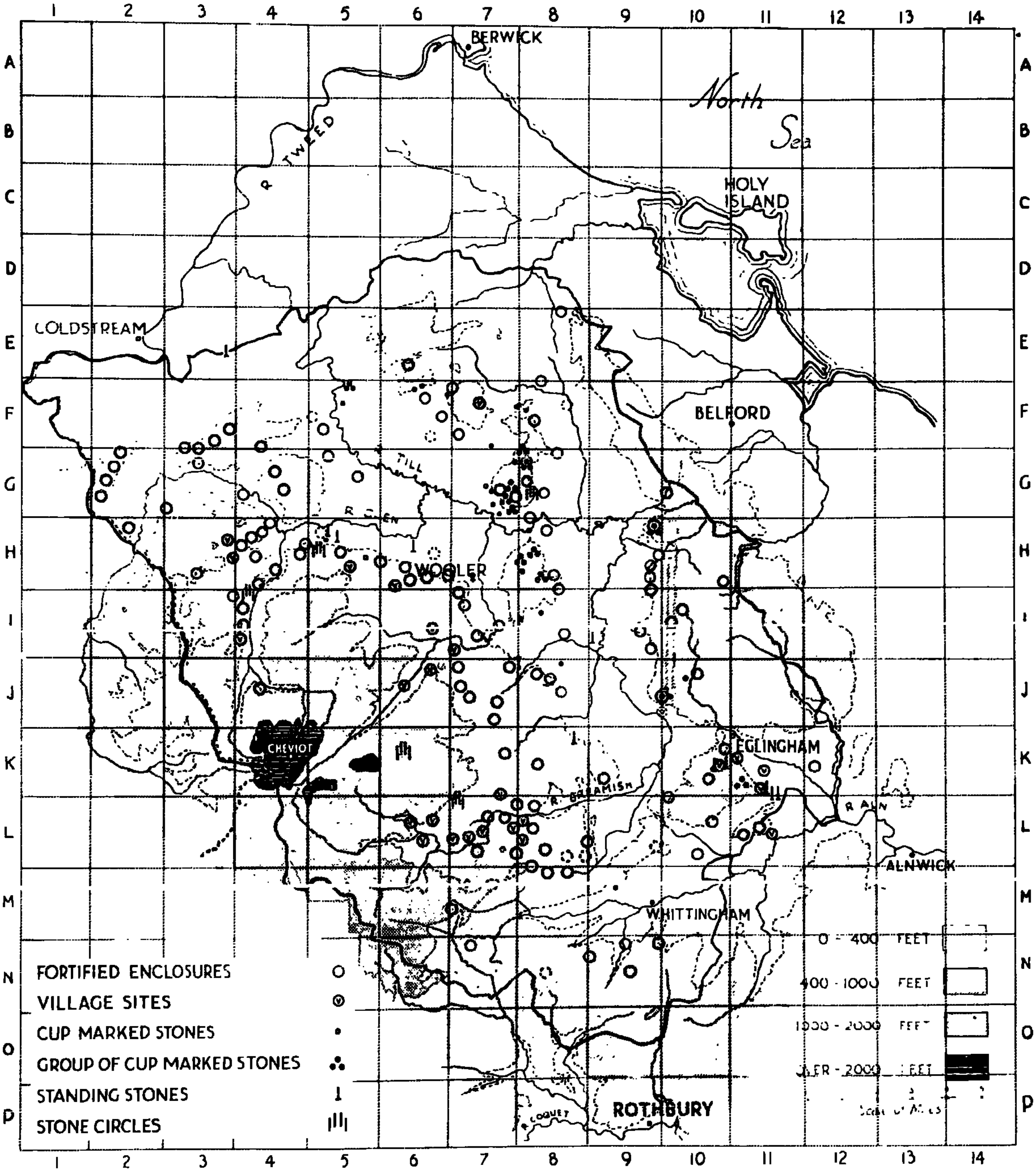

Fig.2. Stone and Bronze Age Settlement map.

Area within red square is enlarged in Fig.5.

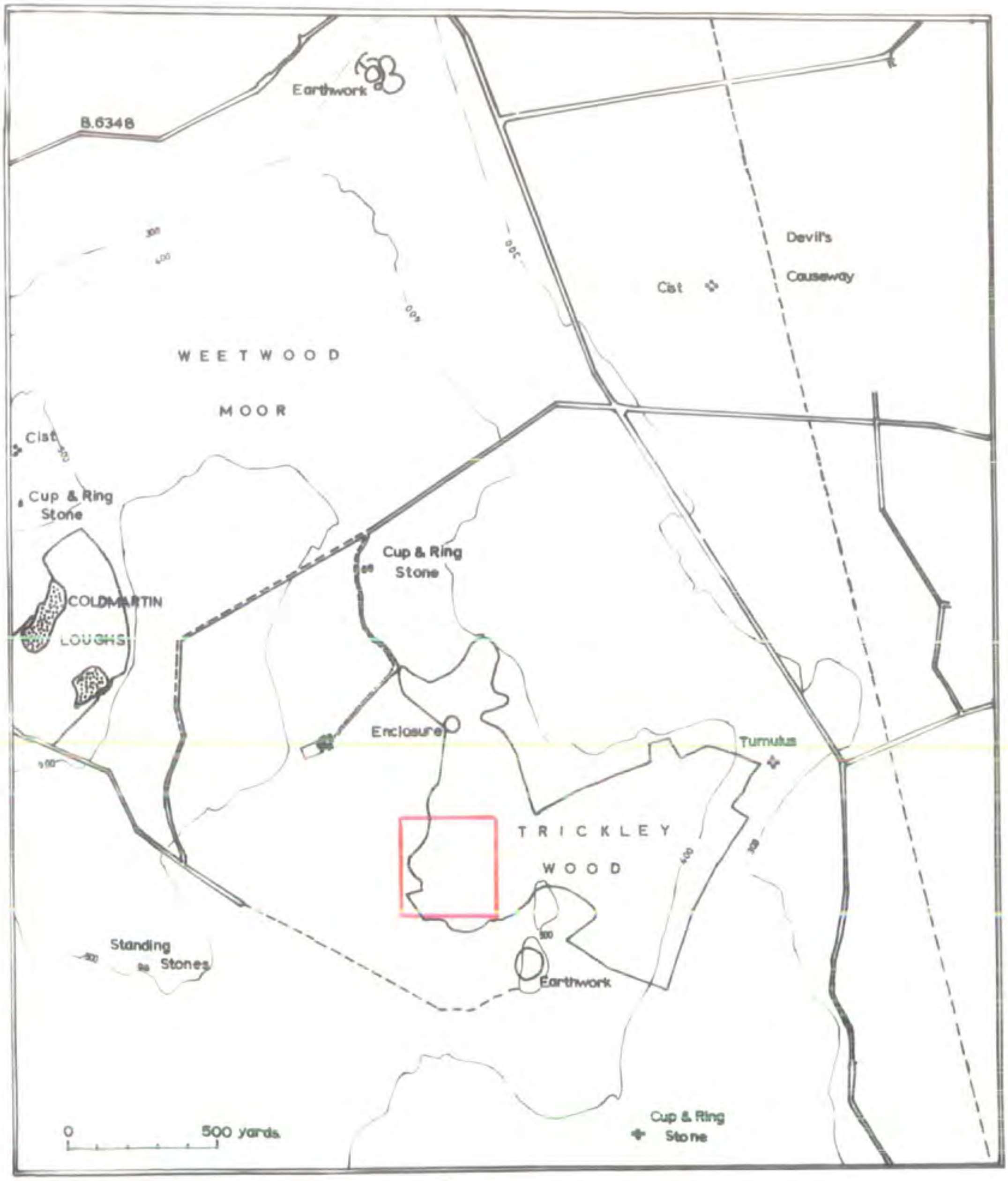

Fig. 3 The archeological remains near Trickley Wood.

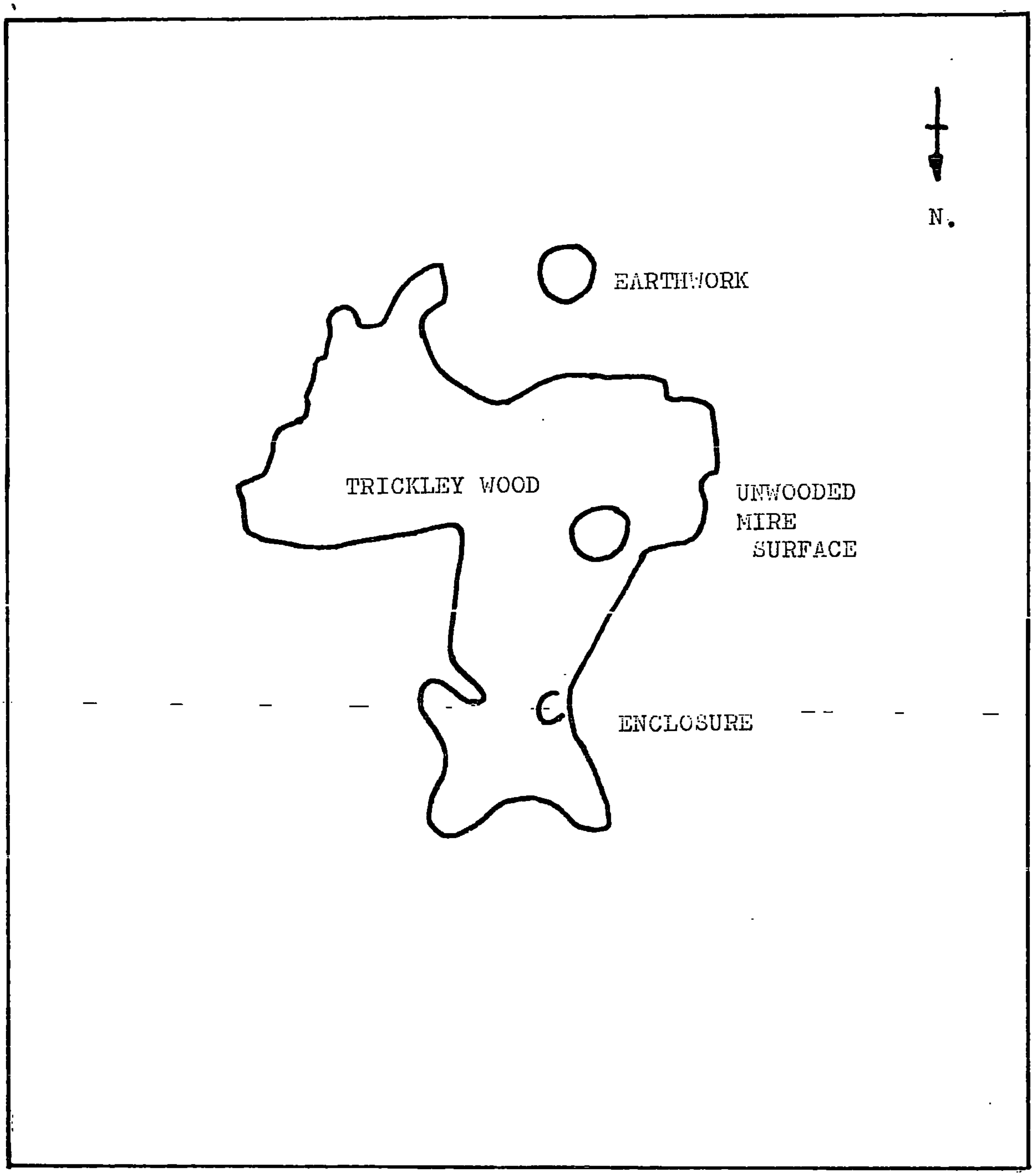
N.
EARTHWORK
TRICKLEY WOOD
UNWOODED
MIRE
SURFACE
ENCLOSURE

Fig.4. Aerial Photograph of part of Weetwood Moor.

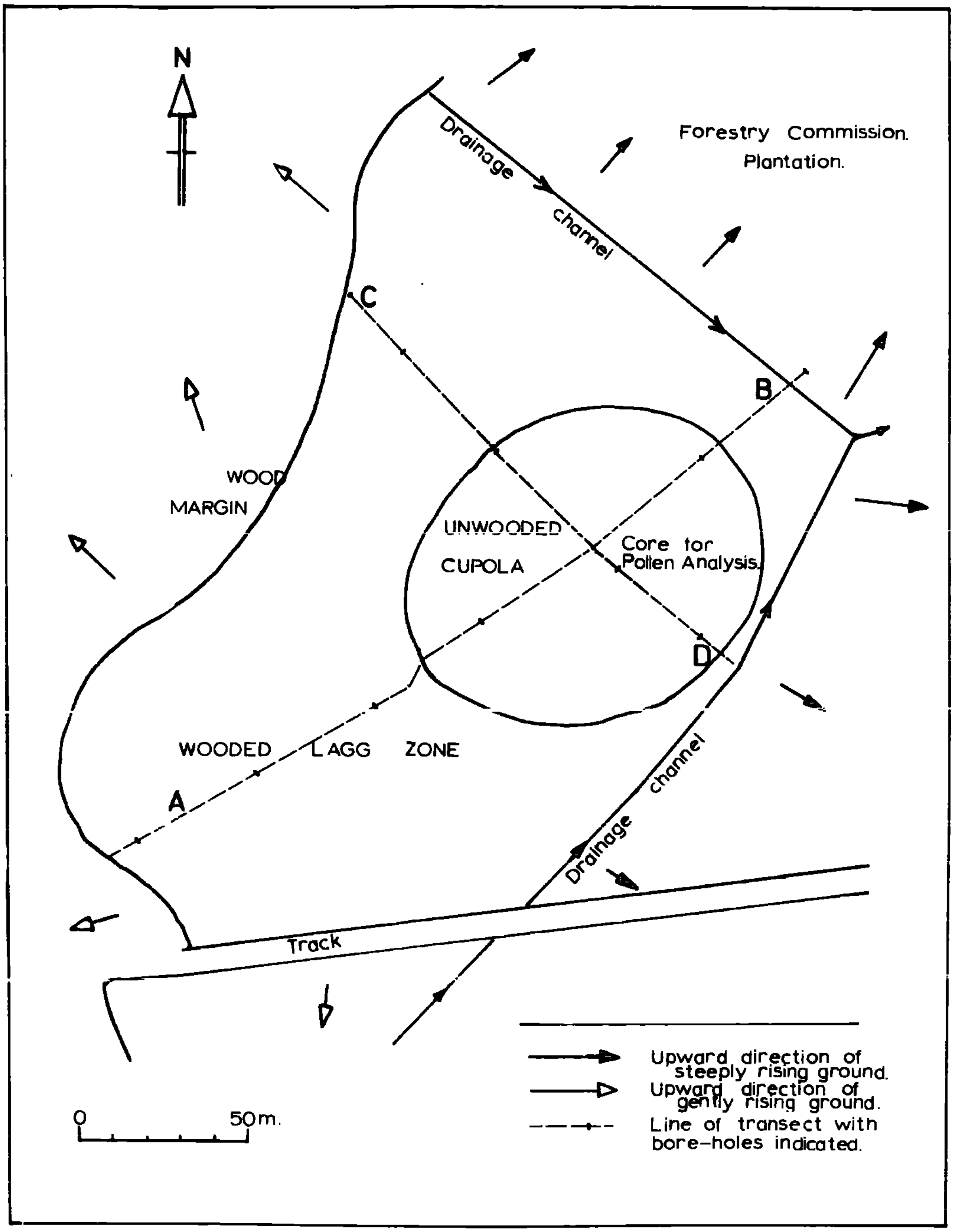

Fig 5. Sketch map of part of Trickley Wood.

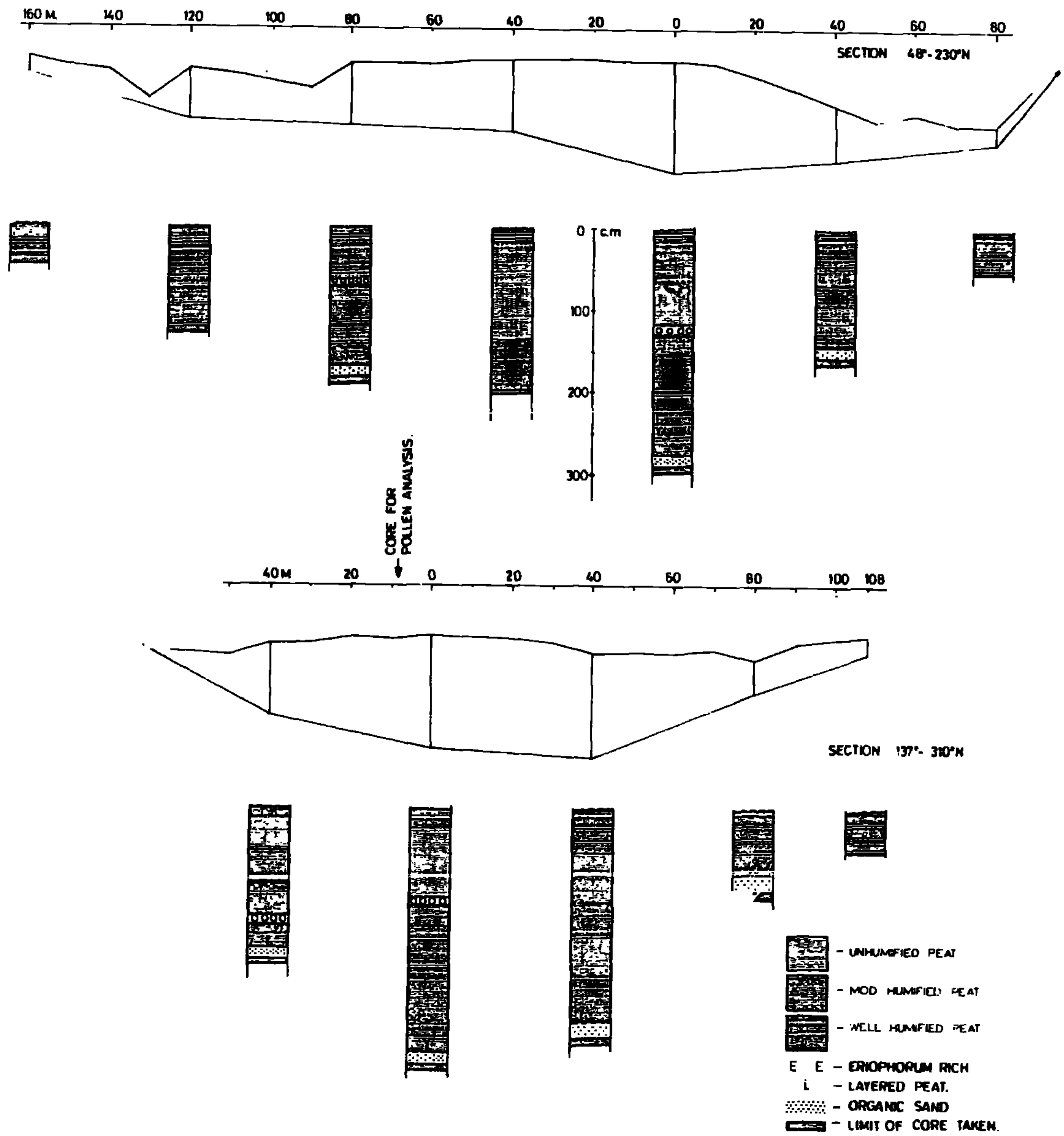

Fig 6 Stratigraphy and Sections.

1. SURVEY 2.1

The surface topography was surveyed using a Dumpy type level and staff. A central point was chosen as the datum from which four transects were laid out as shown in Fig.5. The central point was higher than the surrounding area and the mire surface firm enough to carry the level and tripod. The directions of the transects, see Fig.5, were chosen to give maximum information about the surface relations and the shape of the basement of the peat.

The transects were laid out by inserting canes every 40 metres and the level used to find the height of the ground at those places relative to the datum.

Transects A and C show slight changes in direction as it was impossible to obtain a clear line of sight through the wooded part of the site.

2. STRATIGRAPHY

A Hiller borer was used to investigate the stratigraphy along the transects. Borings were made every 40 metres along the transects used for the surface survey.

In the design of the Hiller borer there is a 7 cm screw blade, to aid penetration, below the core chamber. This tends to disturb the peat below the core just sampled. To minimise contamination and disturbance of the peat, the procedure adopted was to take 0-50 from bore hole A and 50-100 from bore hole B, a few inches away; 100-150 again from A and so on alternately until no further penetration was possible.

The results are plotted on Diagrams 3 and 4.

3. DISCUSSION

From the Diagrams, it can be seen that this peat deposit has accumulated in a shallow basin with poor drainage. The Fig.5 shows that to the south-east the ground rises sharply to about 500 feet. The ground to the east also rises but not quite so sharply or to such a height. It is through this side that a drainage gulley was excavated in the 19th century in an attempt to drain the fields which lie to the north and west of the mire. The gentle slope of the present field surface, falling to the south and east, can be seen in Diagrams 1 and 2 (Fig. 6) to continue beneath the peat until it rises towards the S.E. and E. margins. The peat surface around the edges of the fields has been disturbed as the soft peat provides the farmer with easily dug ground for the burial of dead animals. Signs of digging peat for use as a source of organic material for the soil can also be seen in one or two places. The centre of the mire is unaffected by these disturbances and no drainage cuts have been made.

From examination of the sections and the aerial photograph it can be seen that the mire surface is raised and domed, and at the present carries few trees, while the area just off the cupola carries a thick lagg zone of Betula, Pinus, [redacted], and Rhododendron.

SAMPLING METHOD FOR ANALYSIS 2.2

Difficulty was encountered when sampling in the area of the deepest part of the mire, as a water lens from 50-110cm made the unhumified peat of such a consistency that it would not remain in the borer. A point 8m from point O on the section D was chosen as being near the centre of the cupola but having least interference from the water lens.

The core of peat for analysis of macroscopic and microscopic remains was extracted with a Hiller borer with liners. The borer was scrupulously cleaned between taking each 50cm core. The method of alternate bore sampling was adopted. These cores were individually wrapped in polythene bags and sealed with tape to prevent contamination. In the laboratory they were then cut into short lengths and each length stored in 2" x 1" tubes in a freezer at 5°C until analysed.

During extraction of the liners from the borer, the wetter peat tended to compress up into one end of the liner. This occurred in the 50-100 core and to a lesser extent in the 1-50 core. The short length samples were numbered as they were extracted from the liners. Thus only 23 samples were extracted from the 50-100 core.

In some cases, especially towards the bottom of the core, difficulty was found in obtaining a clean 1cm sample; in those cases 2cm samples were taken. This was due to the peat being very soft or very fibrous.

The first and last sample in each core was discarded in case they were contaminated by peat falling from higher levels of the bore.

Sample No.	1 - 37	were	obtained	from	0 - 50
,, No.	38 - 59	,,	,,	,,	50 - 100
,, No.	60 - 91	,,	,,	,,	100 - 150
,, No.	92 - 115	,,	,,	,,	150 - 200
,, No.	116 - 144	,,	,,	,,	180 - 230

The key to the samples is given in Appendix 2.

Analysis of Macroscopic Remains 2·3

The fractions of peat filtered off after boiling with KOH during the preparation of the pollen slides (see section 3·1) were examined under a binocular magnifier. Identification of moss fragments was possible to species in some cases with the aid of keys in Watson 1963 and Procter 1955 and then reference to type material. Seeds of Carex family were traced in Brouwer & Stahlina (1955) and Beijeriuk 1947 and then compared with type material, but in most cases they are tentatively assigned to species. Lack of time prevented the preparation for identification of small pieces of wood and charcoal though characteristic bark types were recorded.

The results are given below :

DEPTH	BRYOPHYTES	SEEDS	OTHERS
230-225	Sphagnum papillosum	Scirpus sp.	monocotyledon rhizone base
	S.cuspidata	Carex c.f.dioica	
	S.subsecunda group	C.c.f.panicea	monocotyledon leaves
	Aulocomnium palustre	Eriophorum ? vaginatum	
	Hypnum cupressiforme	Betula sp.	
225-200	Sphagnum cuspidata	Carex sp.	Betula wood
	S.subsecunda group		Calluna stem

DEPTH	BRYOPHYTES	SEEDS	OTHERS
200-190	Sphagnum cuspidatum S.subsecunda group Isothecium myosuriodes	Carex spp. Betula	Betula wood Calluna stem
190-186	Sphagnum cuspidata S.squarrosum	Carex c.f.rostrata	Betula wood
186-160	Sphagnum subsecunda group S.squarrosum		Betula wood Pinus wood Monocotyledon leaves
160-100	Sphagnum plumulosum S.papillosum S.acutifolia Hypnum cupressiforme		Charcoal Betula wood ? Pinus wood
100-50	Sphagnum cuspidata S.papillosum S.subsecundum Hypnum cupressiforme	Cyperaceae	cf. Sphagnum capsules ? Pinus wood ,, bark Calluna stem cf. Betula leaf Monocotyledon rhizone stem and leaf

DEPTH	BRYOPHYTES	SEEDS	OTHERS
50-30	Sphagnum cuspidata S.papillosum S.recurvum		Pinus bark and wood cf. Sph. capsules Monocotyledon rhizone, stem and leaves
30-	Sphagnum squarrosum S.papillosum		Betula wood Calluna stem Monocotyledon rhizone, sheath base, leaves

Mire Development 2·4

This peat deposit has accumulated in a trough whose longitudinal axis runs East-West (approx.). The trough was probably eroded by glacial action. As there is no natural drainage from this hollow, it is likely that water accumulated in it. Evidence from Bore C 40 shows that there is a layer of clay underlying the deposit at this point. This thick blue clay was found in other bores not on the main transects, and is probably of glacial origin. Thus the sandstone would have been sealed, as far as water drainage was concerned, by this layer.

The dark-brown sand was not able to be obtained in an uncontaminated state for pollen analysis. The brown colour is probably organic material and would represent the early stages in the hydroseral evolution. Weathering of the sandstone cliff to the south, or outcrops of the rock to the north, is likely to have given rise to the mineral particles which were either washed or blown into the trough.

It is impossible to say with certainty what plants were present in the early stages of the succession, but it is likely that an open water state was colonised by hydrophillous plants. 230cm on the NAP diagram shows very high values for Cyperaceae, and this is borne out by the data from the macroscopic plant remains. More seeds of Carex species were found at this level than any other, e.g. Carex c.f. dioica, Carex c.f. panicea, Scirpus spps., Eriophorum vaginatum. Other traces of Monocotyledon rhizomes and leaves, together with Typha latifolia pollen indicate Carex swamp conditions. These were growing, one presumes, in conditions which became less eutrophic with the decay of previous plant material.

The peat 230-225cm contains a mixture of bryophytes which would colonise wet and fairly acid conditions. Subsequent infilling of the lake by organic material probably followed the scheme described by Weber in his 'Terrestralisation Hypothesis'. A fairly eutrophic lake becomes colonised by bottom rooting plants around the edge leading to reed swamp conditions. The mineral and oxygen status of the inflow dictates the detail of hydroseral development. In this site the inflow is mainly run off from the surrounding land surface. There is also a very small spring to the north. Death and decay of plant material leads to more oligotrophic and aseptic conditions in which breakdown bacteria cannot function. The lack of decay, or partial decay, causes a build-up of organic material giving a damp acid mat of vegetation around the margins of the pool which can be colonised by more oligotrophic mire plants. Plant debris accumulation would allow Sphagnum mosses to encroach from the edges until complete cover was obtained. From then on, accumulation will continue, unless there is a change in the climatic conditions, until the peat surface is level with the water table. After this, the texture and capillarity of the peat allows its surface to rise above that of the water table. A point is eventually reached where the capillarity fails to hold sufficient water at the surface to maintain active growth of the peat-building plants. The result of this accumulation pattern is a domed mire system.

The presence of Sphagnum subsecunda group together with S.papillosum and S.cuspidata indicates that conditions were not absolutely oligotrophic but probably suitable for development of transition mire. The slight flow mineral rich water through the mire from the spring is the likely cause of this state.

186-160cm sees an increase in the amount of wood and the first occasion when Sphagnum squarrosum is found. This Bryophyte usually occurs below trees and may be found in the Lagg zone at the moment. Together with high A.P. and Shrub frequencies, there is an indication of the development of Transition Mire Forest. Probably Betula dominated with a good deal of Corylus in clearings. Van Post found that Corylus as a shrub in closed canopy woodland flowered poorly compared with that in the open. Thus it is likely that the large amounts of Corylus pollen result from plants locally in clearings.

At about 160cm there is a change in the peat type to Fibrous Sphagnum peat with typically more hydrophyllous Sphagnum species - S.plumulosum and S.papillosum. These point to a more open Sphagnetum. This is further corroborated by no finds of S.squarrosum, though this does not necessarily mean that it was not present. There are wood fragments in this zone but not as frequently as below. The fall in Betula and Corylus pollen by large amounts also supports the idea that the Mire Forest had now decreased.

The break in peat type in some cores at this point must be noted. The abrupt change from a moderately well humified peat below to a very wet unhumified peat above can be seen in the Bores below the cupola but not in those of the Lagg area. This may mean that towards the end of VIIa the climate had ameliorated so as to cause a drying out of the surface of the cupola. When the damper conditions of VIIb occurred, the surface was once again able to continue growth.

The cause of the reversion from forest back to open Sphagnetum is probably a degeneration of climatic conditions at the beginning of the Atlantic period (VIIa). This period is generally accepted as wet and warm. The increase in rainfall also would lead to a raising of the water table in the mire basin.

Rapid moss growth resulted and weakly humified peat accumulated. This can be seen from the 100-50cm mark. Gradually the mire surface became dryer and at the 30cm depth trees begin to invade it again. This time, Pinus, as well as Betula, was involved. This can be seen from remains of old tree stumps which protrude above the present surface but are rooted at about 30cm or above. Thus, at the top of the A.P. diagram, at least part of the Pinus pollen was derived from the trees on the mire. S.squarrosum is found again, indicating shady conditions were available once more.

Present Vegetation 2·5

The majority of Trickley Wood is a Birch woodland with a pine-spruce plantation on the higher ground to the east and south. In the wood there is a raised wet area which only carries a few trees (Fig.5).

The cupola supports a rich bryophyte flora which is covered by mature Calluna vulgaris and Eriophorum vaginatum tussocks. Erica tetralix is also found. The trees are Betula pubescens, Pinus silvestris and the occasional Rhododendron bush. Few trees are more than two metres high.

Bryophytes of the surface are dominated by Sphagnum recurvum with Aulocomnium palustre and Hylocomnium splendens. Mixed with these are Hypnum cupressiforme var. ericetorum, Pseudoscleropodium purum, and Bergea rugosa. Sphagnum rubellum is found on dryer raised areas while S.papillosum colonises the wetter hollows.

The edge of the cupola is marked by a definite sharp rise from the lagg zone (see Fig.6). The margin on the west and north sides is comparatively dry and the young Betula form a dense thicket. To the east and south the ground is wetter and the trees more open.

The vegetation of the dryer areas is similar to the Betula woodland. The herb layer is dominated by grasses and Pteridium aquilinum. The main grasses are Festuca rubra, Deschampsia flexuosa, Agrostis tenuis. Raw peat separates the patches of ground flora whose main components are Luzula pilosa, Oxalis acetosella, Gallium hercynicum with occasional plants of potentilla erecta and Viola riviniana. There are a few isolated clumps of Blechnum spicant, especially near the wall on the northern margin of the wood.

In the wetter regions Vaccinium myrtillis takes the place of Calluna vulgaris on the cupola. Sphagnum rubellum, together with Pseudoscleropodium purum, Hypnum cupressiforme and Bergea rugosa, form the surface flora.

Pollen Preparation 3·1

The peat was prepared for microscopic analysis by the acetolysis method outlined by Faegri and Iverson (1964) after Erdtmann 1964.

Each peat sample was treated in the following manner :

The sample was first boiled in 10% Sodium hydroxide for about five minutes, while it was gently stirred. This enables the unsaturated organic soil colloids (humic acids) to be removed at a later stage; it also thoroughly mixes the peat in liquid.

The sample was then sieved through a 0.5mm mesh which removed the large particles which were washed and retained in labelled bottles for later examination. The filtrate was then centrifuged to concentrate fine peat fragments and pollen into a pellet. The dark supernatant, containing the humic acids, was poured away.

The pellet was broken up in distilled water and centrifuged again to ensure the removal of all colloidal matter. If the supernatant was not clear, this was repeated.

Glacial acetic acid was then used to dehydrate the pellet, and was poured away after centrifuging.

Treatment with a mixture of 10cc acetic anhydride and 1cc concentrated sulphuric acid, which was boiled for one minute in a fume cupboard, released most of the cellulose material. After centrifuging, the pellet reduced to about half its previous bulk.

Glacial acetic acid was used as a wash and after centrifuging again, the sample was neutralised with sodium hydroxide. A little Teepol was added, to cut down the tendency of grains to adhere. The sample was vigorously shaken before the final centrifuging.

The pollen was then mixed with glycerine jelly and saffranin in appropriate quantity, and a drop mounted on a 3" x 1" microscopic slide. This was labelled and stored prior to microscopic examination.

IDENTIFICATION OF POLLEN GRAINS

For the first slides, Dr. Turner confirmed the identifications made, and her help with a number of awkward grains has been invaluable throughout. For subsequent identifications, the key in Faegri and Iverson, and Erdtmann 1943 and 1965 were used in conjunction with the type collection.

Each slide was counted by traversing the slide under the microscope using X40 objective and X7 eye piece. The traverse direction was from back to front, starting at the left-hand side of the cover slip, and each traverse was 1mm to the right of the previous one. This was continued until a total of 150 grains of tree pollen or 500 grains of pollen had been counted. If the pollen concentration enabled the total to be reached without surveying the whole cover slip, the traverses were spread out to sample evenly. In one case (44cm) there were only 488 grains on the three slides prepared, and no further material for this level was available.

The number of grains of each species were totalled and expressed as a percentage of total tree pollen. From this data, Fig.7 and Fig.8 were drawn. Lines were used to signify percentage values in preference to the more widely used saw-tooth diagram, as this is a more accurate method of portrayal.

The Tree/Shrub/Herb ratio was calculated on the total pollen as in Fig.9. The ruderal and associated plants' percentages have been re-calculated because in a number of samples the A.P. was a long way short of the accepted 150 grains. Calculation using total pollen values overcomes the problem of inflated values due to low A.P. values.

From 100-0 Pine is thought to be over-represented through trees occurring around the site, and the average figure of 5% is taken to work out a second set of 'corrected' percentages shown on the diagram by the unfilled boxes. 5% was chosen because the values prior to the Pinus rise at 100cm is about 5% and also when Pinus appears to have been cut down in samples.16 & 21.

The re-calculation was done using Faegri's formula :

$$p_1 = a_p \frac{100 - r_1}{S - ar}$$

p_1 = 'corrected' percentage of species x

a_p = actual number of grains of species x in the sample

S = total A.P.

r_1 = Fixed percentage of Pinus

ar = actual number of Pinus grain in the sample

Pollen Analysis Results 3·2

The results of microscopic analysis of the peat is shown in Figs. 7 and 8 to which reference is made in this section. These have been subdivided using the criteria outlined by Godwin 1956. Reference is made to these zones in the following section, but discussion of the reasons for the subdivisions will be made during the Pollen Diagram Discussion, Section 3·3. The lowermost example shows high Betula and Cyperaceae values with Gramineae quantities which are not approached again until zone VIIb.

These high Betula values are sustained through zone VI though they gradually fall towards the beginning of zone VIIa. The Pinus pollen remains more or less constant between 5-10%. There appears to be a small peat of Ulnus at 192cm. This level of 18% is not reached again. Corylus also reaches a maximum of 58% which is not exceeded later. There is a fall in the amount of Salix pollen found, but this does recover towards the top of the diagram. The herb/tree and shrub pollen ratio rises, mainly due to an expansion of Calluna up to and over 100% of the total Arboreal Pollen. There is a gradual recession in the number of spores of Equisetum, Filicales and Sphagnum towards the top of the zone.

Falls of 30% and 35% are shown by Corylus and Betula respectively between 161 and 154cms. The lower part of zone VIIa also sees a rise in Quercus and Alnus, but both appear to rapidly decrease at 134cms. This is probably due to overrepresentation of Betula compared with other pollen types. Ulmus reaches a second peak at 118cms with 12%, followed by a downward trend towards the zone VIIb boundary. Alnus, Quercus, and Corylus, show similar patterns. The two peaks separated by a minima can be found in the Sphagna, Equisetales, Cyperaceae, and Gramineae frequencies. Plantago is present in low amounts (1-4%) throughout the zone. There is also a trend towards more frequent occurrences of single grains of herb species not found lower in the diagram.

Severe cutting back of Corylus again marks the opening of the next zone - VIIb. Pinus starts its increase at 101cms and reaches a maximum quickly at 97cms. This high and well-sustained level is probably due to trees on or close to the site. The quantities of pollen have been 'corrected' using Faegri and Iverson's formula as described in the section on Pollen Analytical Method. Betula, Quercus, and Alnus, all show minor fluctuations, but usually return to their previous levels, while Ulmus falls rarely to rise above 5%. Towards recent time, Pinus shows a period of very low percentages, but then recovers. Betula, Alnus, and Corylus, fall and do not regain previous quantities. Occasional grains of Fagus Fraxinus and Carpinus occur in this zone, but do not achieve large values. The grains of Carpinus found lower in the diagram are thought to be due to long distance transport, as are the Tilia grains. Salix, however, shows a slight but sustained recovery towards the top of the diagram. The two uppermost values are somewhat inflated due to low Arboreal Pollen totals.

The herb pollen expands very markedly above 100cms, mainly at the expense of the shrub, but also the tree pollen. Cyclic fluctuations of the grass, cereal, and ruderal species values can be seen throughout this zone. The lower two peaks are mirrored by Sphagnum, Equisetum, and Filicales quantities, while all four peaks can be seen in the Cyperaceae, the lowermost being a very high peak for the family.

The uppermost sample shows values of most herb species similar to earlier trough conditions, while Pinus and Picea values are 70% and 24% respectively. The shrub/tree and herb ratio is lower than it was at the bottom of the zone, while the tree/shrub and herb ratio is almost the same as at that point.

Pollen Diagram Discussion 3·3a

INTRODUCTION

In considering a pollen diagram, 'one must not forget for one moment that the pollen diagram represents nothing but the parts of the pollen rain that have been recovered after fossilization', Faegri and Iverson 1964. It is not possible with the techniques available at the moment to be able to say whether a pollen grain has been derived from a tree close by or some miles distant from its site of fossilization. Similarly, the occurrence of very high pollen percentages of a species can be interpreted as a large number of plants close by, while a lesser percentage could be construed as a few trees in the immediate vicinity or a larger number at a greater distance, and there is no way of telling which is correct.

Sampling from the centre of a large mire surface, some miles across, the majority of the dry land pollen (as opposed to mire species) will have had to travel some distance. Thus, a pollen spectrum obtained from this situation will give a fairly accurate portrayal of the composition of the vegetation around the edge of the mire and beyond. While with a small site like the one in question, the vegetation immediately around the site will tend to be over-represented while the regional picture will be underrated.

The problem in interpretation of these pollen diagrams lies in deciding what fractions of the pollen rain are local, extra local, or regional (Janssen 1967). Following Tauber's Model (1965) of pollen transfer, it can be seen that pollen carried high in the air, forming the 'rain out component', will be mainly of pollen derived from beyond the immediate environs of the site. The exact distance the bulk of the grains will travel depends on climatic and topographical conditions of the area. Pollen originating 'extra-locally' will be mainly found in the component carried above the tree canopy, while local pollen will be transferred through the trunk space. This later will be subjected to filtering, especially of the heavier grains, if the under-layer vegetation is thick.

Pollen Diagram Discussion 3·3b

The pollen recovered from the peat does not show a complete sequence from the retreat of the ice. The lowermost sample shows high values of herb pollen and relatively low values of shrub pollen. These figures are not approached again until the VI/VIIb boundary. Gramineae and Cyperaceae are the main contributors to the herb pollen.

The high value of Cyperaceae, together with the few Sphagnum grains which become more frequent in the succeeding zone, probably indicate the last stages of a Carex swamp. The Betula level of approaching 90% A.P. represents a local preponderance of the tree together with Corylus. Because of the relatively high percentage of grass and low Calluna values, it is thought that the Birch woodland was reasonably open with patches of Corylus. Whether this woodland with its under storey vegetation acted as a screen to nearby pollen, it is not possible to say. If Calluna was growing beyond the Birch woodland or in open patches, it may well be under-represented. However, the value is so small that this is unlikely, and it may represent a few local plants or some at a distance. The same argument applies to the Pinus, Quercus and Alnus values.

Therefore, at the bottom of the diagram, the Betula woodland can be pictured covering not only the area immediately around the Carex swamp, but also a considerable area of surrounding land. This may have contained small stands of Pinus, Ulmus

Quercus and Alnus nearby, or perhaps larger numbers at a greater distance.

ZONE VI

The opening of Zone VI sees a marked decrease in both grass and Cyperceae values together with a rise in Sphagnum. Filipendula is also found and this is considered to mark the colonisation of the reed swamp by Sphagnum species and other plants tolerant of wet, fairly acid conditions. Not too much importance should be laid on the Sphagnum values, as production of spores is somewhat haphazard. The rise of 70% is, however, thought to imply an increase in the presence of Sphagnum.

Towards the top of this zone a change can be seen in the structure of the woodland. There is a vast expansion of Corylus which is sustained until about 160cm. Coupled with this is an average of 10% fall in Betula. The fall could represent a decrease in local Betula with slightly dryer conditions around the mire, but it is more likely that the Betula woodland around was becoming more open and Corylus was forming coppices in its place. Perhaps the dryer and warmer conditions of the Boreal suited Corylus better than the Betula. Corylus is a prolific pollen producer, and so 400% does not represent a vast increase in the number of plants. Pinus values remain fairly steady, though there is a peak of 15% towards the end of the zone, perhaps signifying a slight expansion of the earlier population. The high values of Pinus reached in the North-west and Southern England are not approached here.

Through the top part of this zone there is also a rise in Calluna and a corresponding fall in Sphagnum. It may be that at this time the moorland around became clearer and Calluna plants colonised this. A more likely explanation is that the mire surface became dryer; the Calluna plants as well as Betula invaded the surface, and this may well have caused a decrease in Sphagnum spore production.

The presence of Tilia and Carpinus grains is thought to be due to long-distance transport.

Sub-division of this zone into three on the present is not feasible.

ZONE VIIa

The VI/VIIa boundary is indicated by the fall in Corylus and the rise of the components of the Mixed Oak Forest. The decrease in Betula, together with evidence already discussed in the Mire Development, is likely to mark the end of the Transition Mire Forest on the Mire surface. The rise in Quercus and Alnus shows that these trees were present locally together with Ulmus in more or less constant amounts throughout the zone.

The relatively lower values of Corylus may be due to its being shaded by the denser canopy of the Mixed Oak Forest, or that it had decreased in number. The sudden rise at 134cm suggests it was present but not flowering prolifically. The occurrence of charcoal in the peat around this time might suggest that fire had destroyed the Forest, allowing Betula to colonise, and would also account for the sudden fall in Quercus and Alnus.

The more frequent occurrences of herb pollen in small amounts might suggest the ground flora of the Mixed Oak Forest. However, Plantago, whose persistence throughout this zone must be noted, is generally thought to be a plant associated with forest clearance, pasturage and cultivation, usually in VIIb and above. These values may signify that, as there is no evidence of forest clearance, Mesolithic man may have been causing disturbance to the soil, e.g. burials.

In this zone, the Mixed Oak Forest becomes established, together with the development of the canopy plants.

ZONE VIIb-VIII

The transition between the lower and upper part of the diagram at this point is very sharp. There is also a marked change in stratigraphy from a moderately humified to a very wet and unhumified peat. This may indicate that the Mire surface dried out and erosion took place before an increased rainfall caused more peat growth. If this did not happen, there was a sudden change in the vegetation around the site. The increase in Pinus at 100cm is heralded by a slight increase in the level below. Most of the other tree species show marked changes. But Pinus tends to be over-represented when present locally, and so the increase may be due to trees on the Mire surface, or close by. This idea is supported by evidence of macro remains. The 'corrected' percentages do, however, bring the values of the other tree species back into scale with lower levels.

It is not possible to subdivide the top 100cms in VIIb and VIII by using the rise of Birch, the entry of Fagus, or the decline of Corylus. The decrease in Corylus pollen is probably due to man's interference. If, as proposed earlier, Corylus was occurring in small clearings in the woodland around the site, one of the places it is likely to have grown was on the ridge to the south. This shrub may have been easier for early man to clear than the forest trees. Corylus was certainly used by early man, and charcoal was found by Cowen and Collingwood (1948) in a Middle Bronze Age cyst at Haugh Head, Wooler. It may be, however, that a change in soil, or another ecological factor, resulted in its decrease.

Further evidence to support increased anthropogenic activity can be seen in the N.A.P. diagram. Gramineae pollen shows a gradual increase. Cereals also appear for the first time associated with a rise in Plantago and Rumex. These trends reach a peak at 84cm.

The interpretation of the subsequent cycles of agricultural and ruderal indactors have been tentatively linked to phases in the history of the locality, but with no radiocarbon dates from the site, absolute chronology is not possible. However, fairly close sampling has given data which can be assigned to cultural phases with a reasonable degree of certainty.

The earliest C_{14} date from the immediate vicinity is 2800 ± 100 from charcoal in a grave at Sandy Ford, Chatton (Jobey 1968 - in press). This may have been earlier than the grave and had fallen into it on the original excavation of the hollow, or it may be contemporary with it. Some surprise has been expressed at the earliness of this date, as man was not thought to have colonised this part of England until later. Evidence to support the date comes from an unusually long record of Plantago, indicating soil disturbance throughout the zone VIIa. As the usually accepted date of the elm decline is about 3000 B.C., the date assigned to the grave is not impossibly early.

The Cup and Ring stones (Fig.3) are dated between 2000 - 1000 B.C. and these are unusually numerous in this area. Other datable material comes from Ford, 5 miles to the north, where a Bronze Age Round Barrow is dated by C_{14} at 1670 ± 40 B.C. Bronze Age (Late, Middle and Early) Pottery, together with a Bronze Awl, have been found in a cyst close to Trickley Wood. So man's influence in the immediate locality dates certainly from 1670 B.C. and possibly predates this by as much as 1000 years.

Quern stones used in milling corn have been found in Late Pre-Roman Iron Age and Romano-British settlements, indicating sophisticated use of cereal crops. Late Iron Age settlements can be found close to Trickley Wood. The Weetwood Moor site (Fig.3) is of the type which is usually preceded by a timber palisade structure of which the post holes can be found in the lowermost layers. The Multivallate fort succeeded this about the 6th century B.C. and then on top of this the hut circles of Romano-British type occur. The number of hut circles in an enclosure is seldom more than eighteen, and this is thought to be a socio-economic unit based on an agricultural optimum yield. No evidence of field systems which were associated with similar units in Peebleshire have been found in the area. The tillage was probably in small plots worked by mattock and hoe.

The rise to the 84cm peak probably represents the development of agriculture under native and Roman influence.

The increase in spore counts is difficult to explain. The problem with Equisetum is that identification to species is not really possible from the spores. Although some structures similar to the node scales of the stems were found, they were not good enough for species identification. The increase, bearing in mind that Equisetum is a prolific spore producer, must be due to the production of a suitable habitat. The two groups of most likely species to be involved are E.palustre and E.sylvaticum, if they grew in the damp locality, or E.arvense and E.pratense on dryer, more grassy situations.

Sphagnum values have been discussed earlier, but a sudden and marked rise as is found at 100cm level can only be interpreted as a great improvement in the conditions which are conducive to spore production. Stratagraphical data shows a change to less humified peat, indicating damper conditions, and this is supported by the increase in Cyperaceae.

The grass and Calluna rise indicate that more open habitats were available. These may well have been on the ridge to the south and east where the early settlements can be found. It is probable that the Pinus would not colonise the very wet bog surface to any large extent, but it is more likely to take advantage of the cleared areas on the southern and eastern ridges. Calluna may have colonised the bog surface from this time onwards.

Following the peak at 84cm there is a fall in cereal grass and most ruderal pollen, together with a rise in A.P. This represents a closure of woodland and agriculture becoming more? widespread than before. Historically, the period after the Romans left Britain, until the Anglian culture penetrated inland, is thought to be one of degeneration, culturally and economically. It is thought that 84-80cm is a period of decreased agricultural activity which, however, later increases. ???! The Romans left Britain in 293 A.D. The Anglian influence was not felt in this area until the 6th century A.D. and there was then a period of 200-300 years during which cultural development ceased.

The next high level of A.P. pollen is the 55-50cm mark. It can be seen on the Tree/Shrub/Herb ratio that there is also a fall in the Gramineae pollen, Plantago, and Rumex pollen.

This could well be another period of poor farming practice. If this is taken to be representative of the troubled Middle Ages, it can be assumed that the peak in cereal pollen preceding it (60-70cm) is then the Anglian cultural and economic boom.

The next maxima in herb pollen at about 40cm has a build-up to it shown in all ruderal species. This is mirrored in the Corylus, Pinus and Betula curves. As these changes are synchronous on the diagram, it may be assumed that there was a widespread development of farming. The period from the 17th to 19th century was the heyday of British agriculture, followed by the Agricultural Depression in the 1870s. The fall in Sphagnum at 30cm level may represent the drying of the bog surface due to land improvement schemes instigated about 1780. The fall in Equisetum is concurrent with the decrease in Pinus. The destroying of the Pinus on or near the site at 30cm may also have destroyed the habitat of the Equisetum. The rise in Pinus later is accompanied by a rise in Equisetum. The removal of trees is so abrupt that it is concluded that they were cut down. The fall in Quercus at this time may also be due to this reason. Further evidence is to be found in the associated rise of Alnus and Corylus and Calluna which could signify colonisation of recently opened-up habitats.

The rise in Sphagnum spore numbers towards the upper samples signifies damper conditions again, possibly due to neglect of the drainage channels cut earlier. 12cm shows a further rise in the herb pollen and again a major maxima in ruderal and graminoid pollen, together with a fall in tree pollen frequencies. This could signify an agricultural revival once again.

The absence of Quercus in the uppermost sample could indicate its removal about the time of one of the Great wars. The Picea and Pinus values have increased in this level, almost certainly, because of the Forestry Commission Plantations. The decrease in cereal pollen is mainly due to a swing away from crops to increased stock production. This latter may also explain why the Gramineae, Plantago and Rumex pollen are relatively low, as so many of the surrounding fields are under permanent grass.

This is a complex zone in which Pinus dominated the immediate area; the water table in the mire was high and man's activity has shown four periods of intensive agriculture.

Relation of these results to certain other pollen diagrams 3.4

ZONE VI

The values of Ulmus throughout this zone are generally as high as those found by Bartley 1966 nearer the coast. Ulmus, Quercus and Alnus appear to expand through this zone, though Ulmus seems to become established before the Quercus and Alnus. This picture is shown in the lowland of Cumberland (Walker) as well as towards the North Sea coast. But the expansion of Quercus, with Alnus, appears to be late compared with other sites in the North. It may well be that the Betula-Corylus woodland was replaced in VIIa by Mixed Oak Forest. Godwin concludes that this expansion of Ulmus and Quercus is climatic.

Neither the Irish 'Hazel-Pine Period' nor Godwin's 'Pine-Hazel Period' term for England's zone VI are suitable for describing this and other diagrams for the North-East. Jesson's term of the 'Birch-Hazel Period' when describing zone IV in Ireland might be a more suitable description. A possible reason for the vast expansion of Corylus in the North-East at this time may be associated with its favouring Mull and fresh calcareous soils as well as a milder climate. Pinus tends to favour more sandy soils. The North-East contains large areas of Carboniferous Limestone and calcareous sands, and these would weather to give soils more suitable for Corylus than Pinus. The North Yorkshire diagrams show much higher Pinus values and this may be due to different soil conditions.

The Elm Decline

The fall in Ulmus is accompanied by a rise in Quercus but only to the levels which occurred in the Mixed Oak Forest of VIIa. Walker 1966 in the Abbot Moss diagram finds Quercus replacing cleared Ulmus. The fall in Corylus immediately below the VIIa/VIIb boundary may be an indication of forest felling in the vicinity. Morrison's 1959 interpretation of the decline being due to climatic deterioration leading to leaching of the soil cannot be supported. The climatic state at this time has been discussed earlier and it was concluded that drying of the mire had taken place prior to an apparent increased rainfall. The sporadic occurrence of heliophillous species during the decline may well support Troel Smith's Selective Utilisation Theory (Iverson 1949, Troel Smith 1960). The comparatively low Ulmus figures (a tree which tends to be under-represented) may indicate Ulmus growth at some distance from the site and possibly also accounts for the low percentage of clearance colonising species.

ZONE VIIa

This is the climatic optimum of the post-glacial (Godwin 1954). Conditions in the North certainly seem to have favoured the expansion of the Mixed Oak Forest albeit later than in other parts of the country.

Mitchell 1951 suggests that Alnus, while present in zone VI, did not really expand until the opening of VIIa. This is borne out in other diagrams from the area. Alnus is generally thought if as a plant of stream-side habit, but Dimbleby 1967 points out that it may well have occurred as a component of the Mixed Oak Forest where adequate soil moisture was available for its seed germination. If this is the case, it probably competed directly with Corylus and evidence of this can be seen at the beginning of zone VIIa and towards its close.

Zone VIIb - VIII

Ecological development in this zone is thought to be dominated firstly by climate and secondly by man. While the climate of the region may well reflect that of the country, man's influence as a factor in the ecosystem has varied in extent from place to place and time to time. Thùs general trends from other parts of Britain are found; the rise in N.A.P.; the fall in Ulmus; the expansion of Sphagnum, and the fall in Betula and Corylus. The peaks in ruderal pollen, however, tend to vary from other areas as the history of this area is not paralleled (Turner, J. 1965, Walker, D. 1966, Morrison 1951).

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SUMMARY

Trickley Wood in Northumberland contains a small raised transition mire. The investigation of the peat stratigraphy together with pollen analysis enabled a reconstruction of the development of the vegetation of the mire and the surrounding area from zone V to recent times. Being a small deposit local changes in the vegetation show up clearly. An attempt has been made to correlate these changes in the upper levels with phases in the history of the locality. A number of other diagrams from North are also compared.

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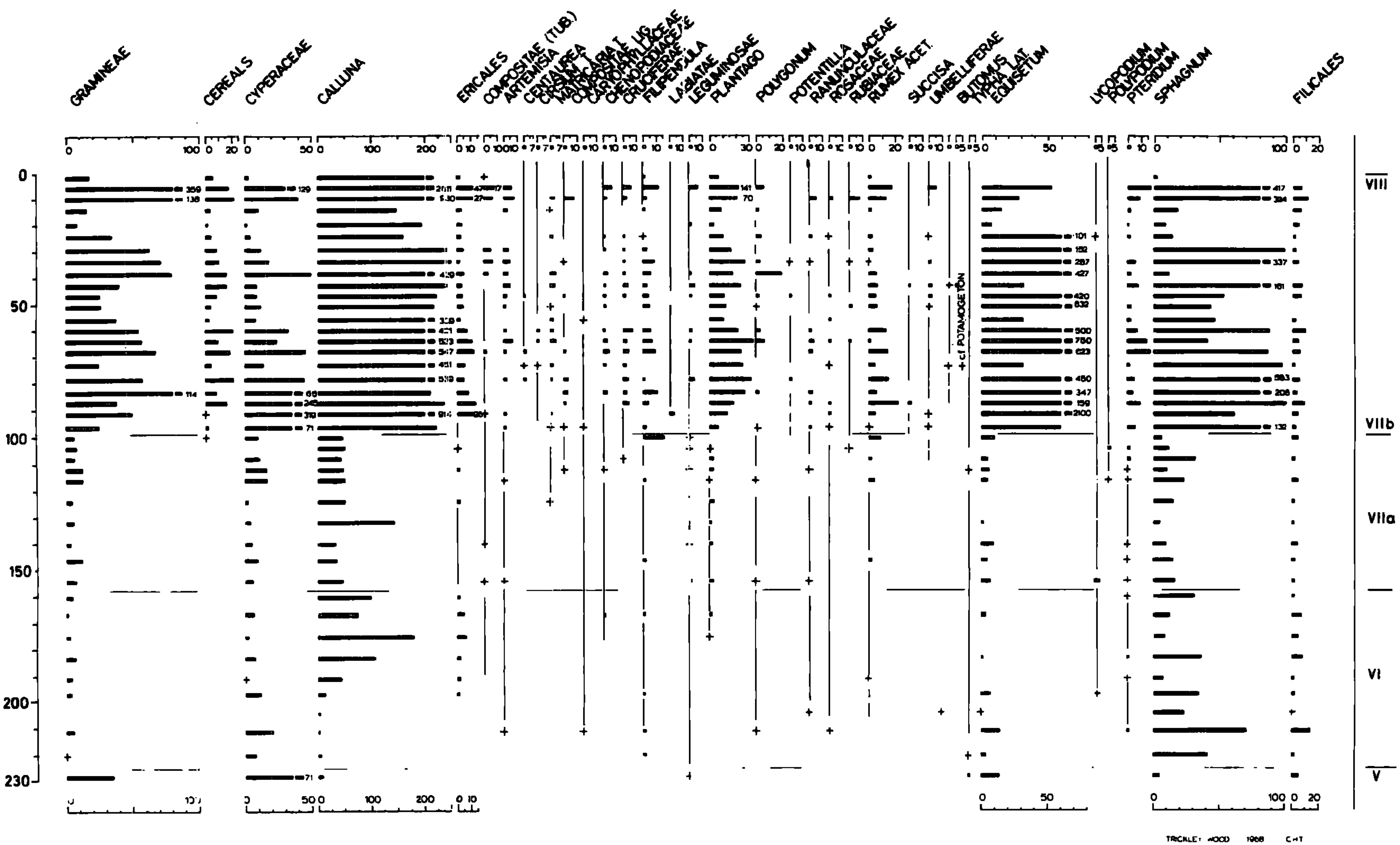

Fig 8. Herb pollen and spores expressed as percentage of total tree pollen.

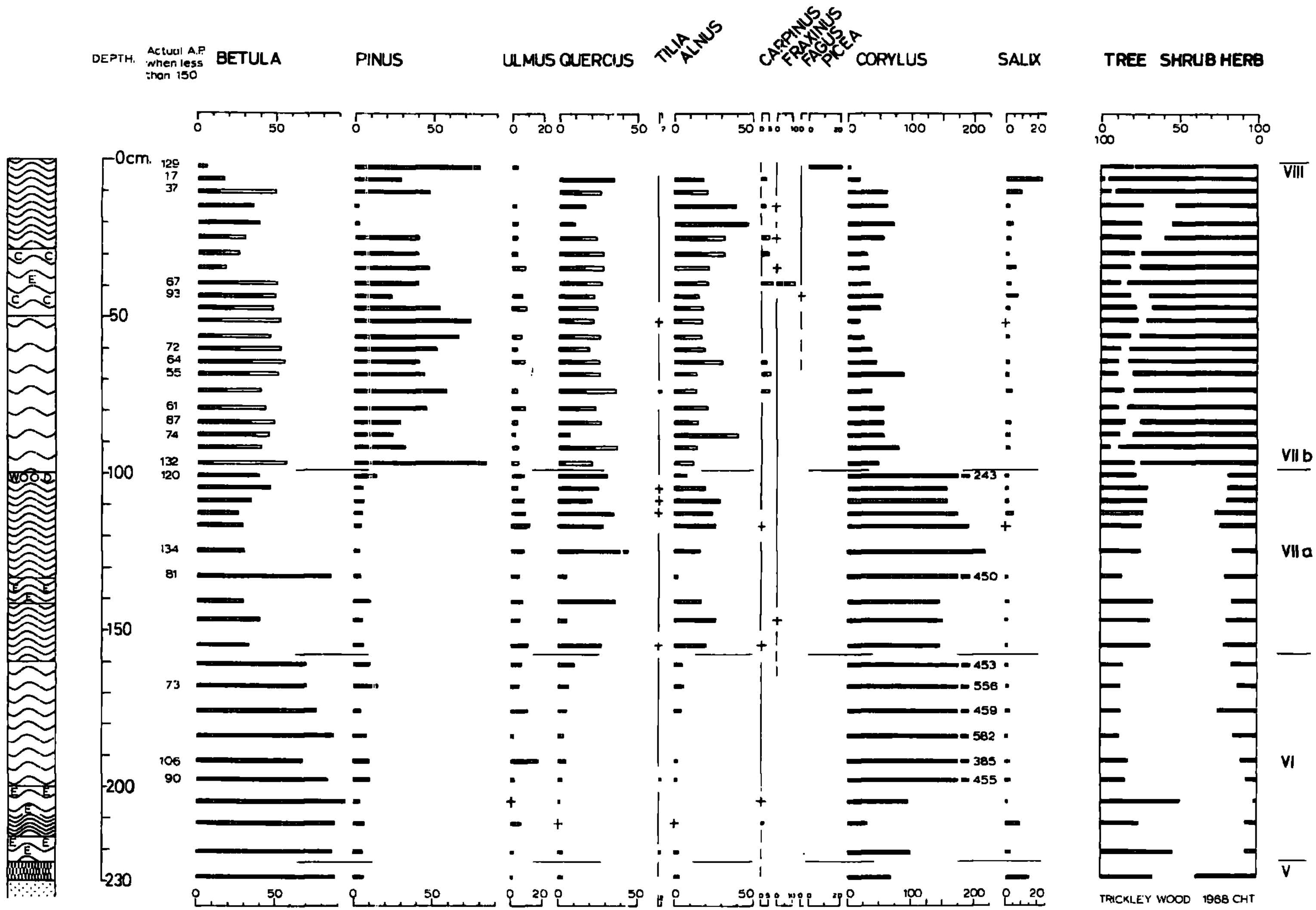

Fig. 7 Tree and shrub pollen expressed as percentage of total tree pollen; tree/ shrub/ herb ratio as percentage of total pollen.

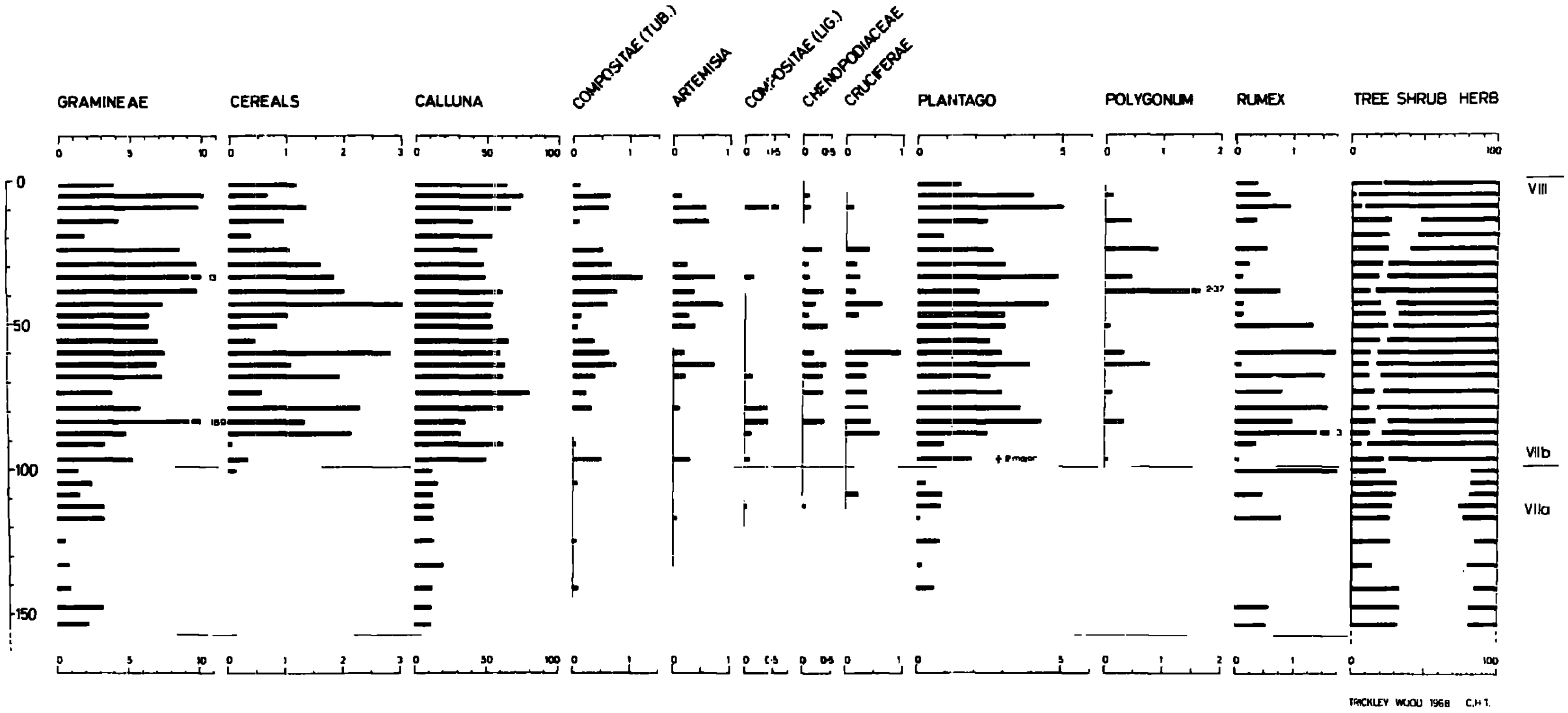

Fig.9 Certain pollen values expressed as percentage of total pollen.

APPENDIX 1. LEVELLING DATA

SECTION A

Distance from centre in metres	Height Relative to centre. Centre = 1.27m.
0	1.27
10	1.295
20	1.225
30	1.225
40	1.255
50	1.295
60	1.358
70	1.330
80	1.363
90	1.99
100	1.86
110	1.65
120	1.52
130	2.29
140	1.57
150	1.47
160	1.28
170	1.073
180	0.94

Bearing of A. 230^{o}N.

TRANSECT B

Distance from centre in metres	Height relative to centre. Centre = 1.27m
0	1.27
10	1.36
20	1.65
30	2.00
40	2.36
50	2.75
60	2.60
70	2.86
80	2.82

Bearing 48°N.

TRANSECT C

0	1.27
10	1.30
20	1.32
30	1.42
40	1.68
50	1.665
60	1.670
70	1.595
80	1.825
90	1.440
100	1.305
108	1.255

Bearing 310°N.

TRANSECT D

Distance from centre in metres	Height relative to centre. Centre = 1.27m
0	1.265
10	1.310
20	1.290
30	1.420
40	1.455
50	1.825

Bearing 137°N.

APPENDIX 2. KEY TO SAMPLE NUMBERS

Sample No.	Depth in cms	Sample No.	Depth in cms	Sample No.	Depth in cms
1	1.28	46	69.8	* 91	147
* 2	2.56	47	72.0	92	152
3	3.84	* 48	74.2	* 93	154
4	5.12	49	76.4	94	156
* 5	6.40	* 50	78.6	95	158
6	7.68	51	80.8	* 96	160
7	8.96	* 52	83.0	97	162
* 8	10.24	53	85.2	98	164
9	11.54	* 54	87.4	99	166
10	12.80	55	89.6	* 100	168
11	14.08	* 56	91.8	101	170
12	15.36	57	94	102	172
* 13	16.64	* 58	96.3	103	174
14	17.92	59	98.4	* 104	176
15	20.48	* 60	101	105	178
* 16	21.76	61	102	116 106	180
17	23.04	62	103	117 107	182
18	24.32 - 25.60	63	104	* 118 108	184
* 19	26.88	64	105	119 109	186
20	28.16	65	106	120 110	188
21	29.44	66	107	121 111	190
* 22	30.72	* 67	108	* 122 112	192
23	32.0	68	109	123 113	194
* 24	33.28	69	110	124 114	196
25	34.56	70	111	* 125 115	198-9
26	35.84	71	112	126	201
27	37.12	* 72	113	127	203
28	38.40	73	114	* 128	205
* 29	39.68	74	115	129	207
30	40.96	75	116	130	209
31	42.24	* 76	117	131	210
* 32	43.52	77	119	* 132	212
33	44.80	78	121	133	215
34	46.08	79	123	134	217
* 35	47.36	* 80	125	135	219
36	48.64	81	127	* 136	221
* 37	51.0	82	129	137	222
38	52.2	83	131	138	223
39	54.4	* 84	133	139	224
* 40	56.6	85	135	140	225
41	58.8	86	137	141	226
* 42	61.0	87	139	142	227
43	63.2	* 88	141	143	228
44	65.4	89	143	* 144	229
* 45	67.6	90	145		

* Samples taken from pollen analysis