UNIVERSITY OF SOUTHAMPTON

Faculty of Science

Department of Geography

LATE HOLOCENE PALAEOECOLOGY AND ENVIRONMENTAL ARCHAEOLOGY OF SIX LOWLAND LAKES AND BOGS IN NORTH SHROPSHIRE

A Thesis submitted for the degree of

DOCTOR OF PHILOSOPHY

by

SIMON NICHOLAS TWIGGER

1988

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF SCIENCE

GEOGRAPHY

Doctor of Philosophy

LATE HOLOCENE PALAEOECOLOGY AND ENVIRONMENTAL ARCHAEOLOGY OF SIX LOWLAND LAKES AND BOGS IN NORTH SHROPSHIRE

by Simon Nicholas Twigger

The pollen spectra from four lakes and two peat bogs in lowland north Shropshire show that in the Neolithic and earlier Bronze Age periods human impact on the woodlands of the area was localised and mainly slight. Impact increased in the later Bronze Age and during the Iron Age wide areas were denuded of woodland. Land abandonment led to woodland regeneration over much of the area at the end of the Iron Age although some clearings remained in use; woodland clearance was renewed in the mid Roman period. Evidence for Anglo-Saxon farming is seen and wider areas of pasture appear to have been created in later historic times.

Inter- and intra-site comparisons of the pollen spectra are made. Inter-site contrasts in the pollen spectra suggest that the dominant pollen source areas at the smaller sites were very restricted. There are also indications that relatively localised pollen sources were important at the larger sites. Numerical zonation of the pollen spectra shows that the most significant change in the pollen content of the lake sediments occurred in the later Bronze Age; mineral magnetic analyses point to intensified soil erosion during the later Bronze Age and early Iron Age. Theoretical models relating basin size to pollen source area are reviewed in the light of the results of this study: multiple-coring is confirmed as a productive strategy in palaeoecology.

CONTENTS

CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

CHAPTER TWO: THE STUDY AREA

CHAPTER THREE: THE NEOLITHIC AND EARLIER BRONZE AGE PERIODS

CHAPTER FOUR: THE TRANSITION FROM THE EARLIER TO THE LATER BRONZE AGE

CHAPTER FIVE: LATER BRONZE AGE AND IRON AGE VEGETATION CLEARANCES

LIST OF FIGURES

LIST OF PLATES

Plates 1 - 3 used with the permission of Cartographic Services Ltd., Southampton. Plate 13 used with the permission of the Curator in Aerial Photography, University of Cambridge.

Acknowledgements

I am indebted to my supervisor Dr Keith Barber for his advice and encouragement throughout the course of my studentship.

I am also grateful to Gary Moys, Bill Mansfield, Chris Haslam, Barry Pyke and David Anderson and to Adrian Bayley and the staff of Preston Montford Field Centre for their invaluable co-operation and assistance during fieldwork; Chris also carried out identifications of plant macrofossils.

Gratitude is also due to the landowners for allowing frequent access to the study sites and for their local knowledge.

I am grateful to Professor F. Oldfield, Department of Geography, University of Liverpool for arranging for mineral magnetic measurements to be made on sediment samples and to Gill Yates for preparation and analysis of the samples. I wish to thank Dr. J.P. Smith, Wolverhampton Polytechnic, for permission to refer directly to his unpublished Ph.D. thesis.

Thanks are owed to N.E.R.C. for the provision of the studentship and to Dr. D.D. Harkness, N.E.R.C. Radiocarbon Laboratory, for the prompt analysis of peat and sediment samples. Photographic material was prepared and printed by Mr. A.C. Polley, Cartographic Unit, Department of Geography, University of Southampton. Typing of the thesis was carried out by Mrs. S. M. Shaw.

CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

1.1 Aims

When the palaeoecology of a lake, or peat moss is to be investigated it is usual for a single core-sample to be taken, typically from the central zone of the site under study. In the case of pollen analysis, if a number of cores are available from several sites in a given area, regional or sub-regional pollen zonation - schemes can be proposed (Birks & Berglund, 1979). For a forested area, Berglund (1986) suggests that a site of 25 - 100 ha in area will represent a pollen source area of c. 10 - 30km radius; for deforested landscapes, a number of smaller basins would be needed (Berglund 1986). As basin size is reduced, however, the pollen source area becomes more restricted (Tauber 1965, 1967a, 1967b; Berglund 1973; Jacobson and Bradshaw 1981; Prentice 1985). Thus, as vegetational patterns diversify following forest clearance, an increasingly large number of small basins must necessarily be analysed before the vegetation of an area can be satisfactorily reconstructed. To a certain extent, the pollen source area of a site can expand if woodland is cleared from around that site (Tauber 1965, 33; 1967b, 139), and so smaller basins can become more representative of a wider area. If any attempt is to be made to relate vegetational changes inferred from a given pollen profile to developments in the local archaeological record, the actual area represented by the pollen profile must be accurately estimated (cf Jacobson and Bradshaw 1981). The aim of this study is to examine the palynological record from several sites in the same area, at a time when the vegetation was being cleared by man, and to attempt to relate the palynological record to known archaeological developments. At two of the study sites, one lake and one moss, two cores have been taken for analysis, to examine the degree of intra-site pollen profile replicability. Detailed inter-site comparisions involving all six sites were planned at the start of the project with the intention of examining the extent to which inter-site similarities or differences could be detected. Theoretically, the extent of the dominant pollen source areas at the sites should vary, since the sites themselves vary in size. Observed similarities or differences in the pollen spectra will be discussed in relation to expected similarities or differences (*cf* Tauber 1965, 1977; Jacobson and Bradshaw 1981; Prentice 1985), in this way it is intended that the project will act as a palaeoecological test of the validity of theoretical models relating basin size to pollen source area (1.3.3)

1.2 Approach

1.2.1 Site selection

The great number of lakes and mosses present on the Shropshire-Cheshire Plain of north west England provide an excellent opportunity to examine questions of pollen profile replicability and representativity. An ecological background to these sites is provided by Sinker (1962) and Reynolds (1979); the contemporary vegetation of the County of Shropshire is fully described by Sinker et al (1985). It is possible to carry out a multiple-core palynological study in this area which involves several sites, of varying size and character, which could, theoretically, have some pollen source areas in common (Tauber 1965, Berglund 1973, Prentice 1985).

Six sites have been selected for analysis; four small lakes, locally referred to as meres, and two peat mosses; these sites are described more fully in Chapter 2.

Figure 2 shows the location, size, and proximity of the study sites. Two cores have been taken for analysis from both Berth Pool and Boreatton Moss and single, central cores have been taken from Birchgrove Pool, Marton Pool, Fenemere and New Pool. These sites were selected because of their proximity to one another (Plates 1 - 3) and the relative proximity of the four lakes and Boreatton Moss to The Berth (Plate 6) a small hillock of fluvioglacial sand and gravel which has Iron Age fortifications (Gelling and Stanford 1965). Previously published work (1.3) suggests that potentially inter- and intra-site contrasts in pollen spectra could occur between these sites.

This site selection represents an opportunity to critically examine the accuracy of models of pollen dispersal and source area (1.3). Actual inter- and intra-site similarities and contrasts can be discussed with reference to expected similarities or contrasts. Multi-site studies have previously been undertaken in several areas. In a recent study in North America Bradshaw and Webb (1985) examined over 300 surface pollen samples from lake sediments, wetland basins and moss polsters; tree inventory data were collected and the use of pollen frequency correction coefficients was reviewed in

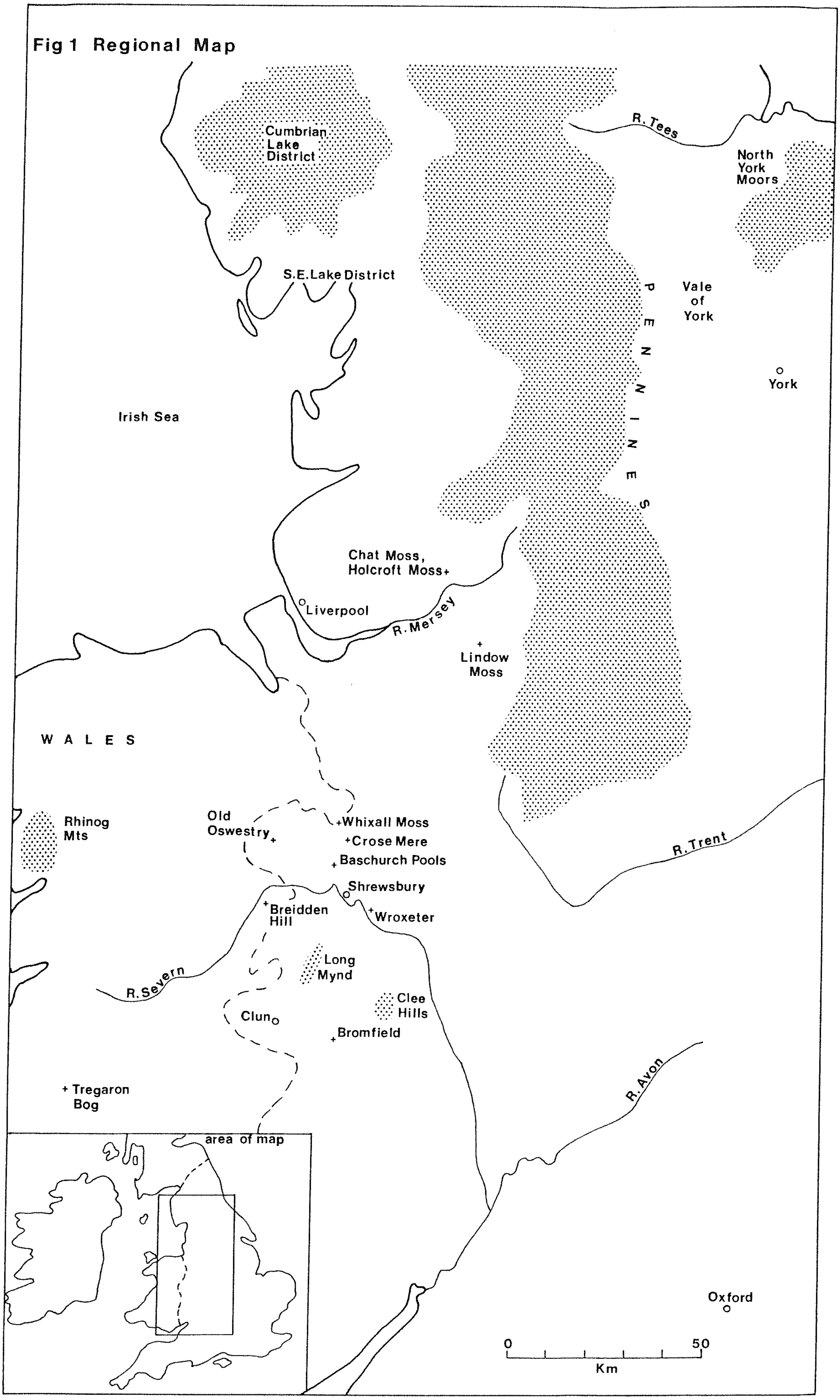
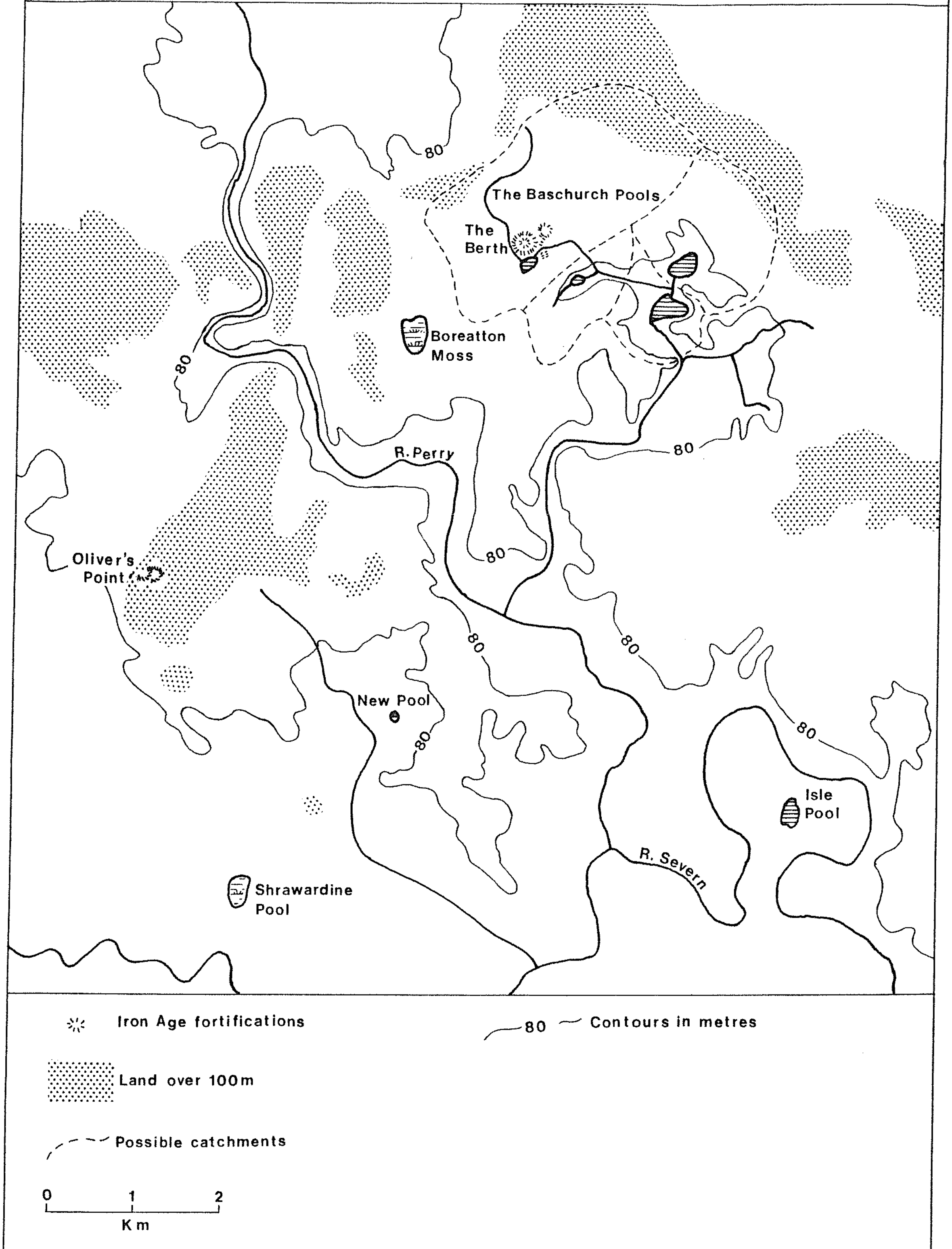


Fig 1 Regional Map
Cumbrian Lake District
R. Tees
North York Moors
S.E. Lake District
PENNINES
Vale of York
York
Irish Sea
Chat Moss, Holcroft Moss+
Liverpool
R. Mersey
Lindow Moss
WALES
Rhinog Mts
Old Oswestry
Whixall Moss
Crose Mere
Baschurch Pools
Shrewsbury
R. Trent
Breidden Hill
Wroxeter
Long Mynd
R. Severn
Clee Hills
Clun
Bromfield
R. Avon
Tregaron Bog
area of map
Oxford
0
50
Km

Fig 2 The Study Area



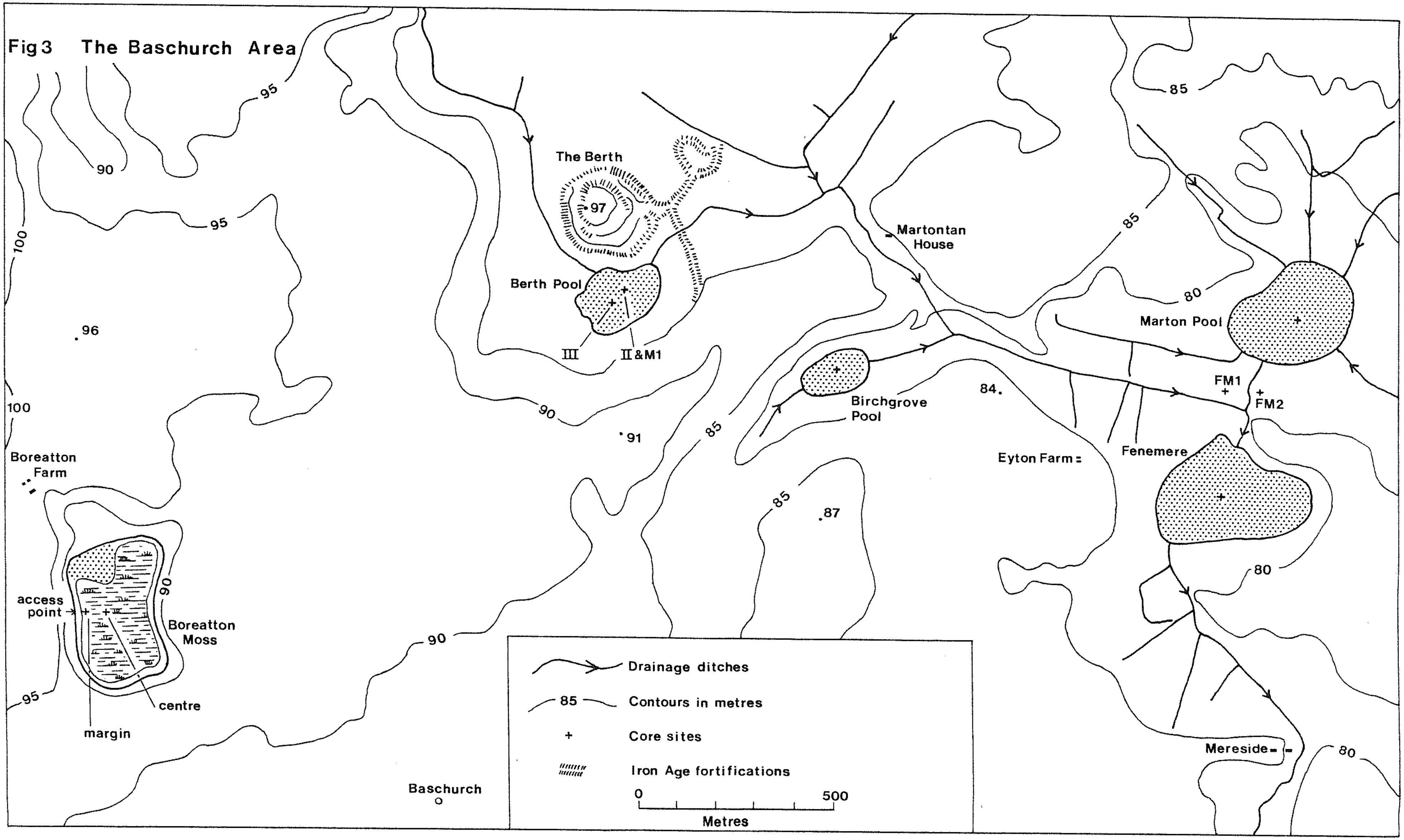


Fig 3 The Baschurch Area

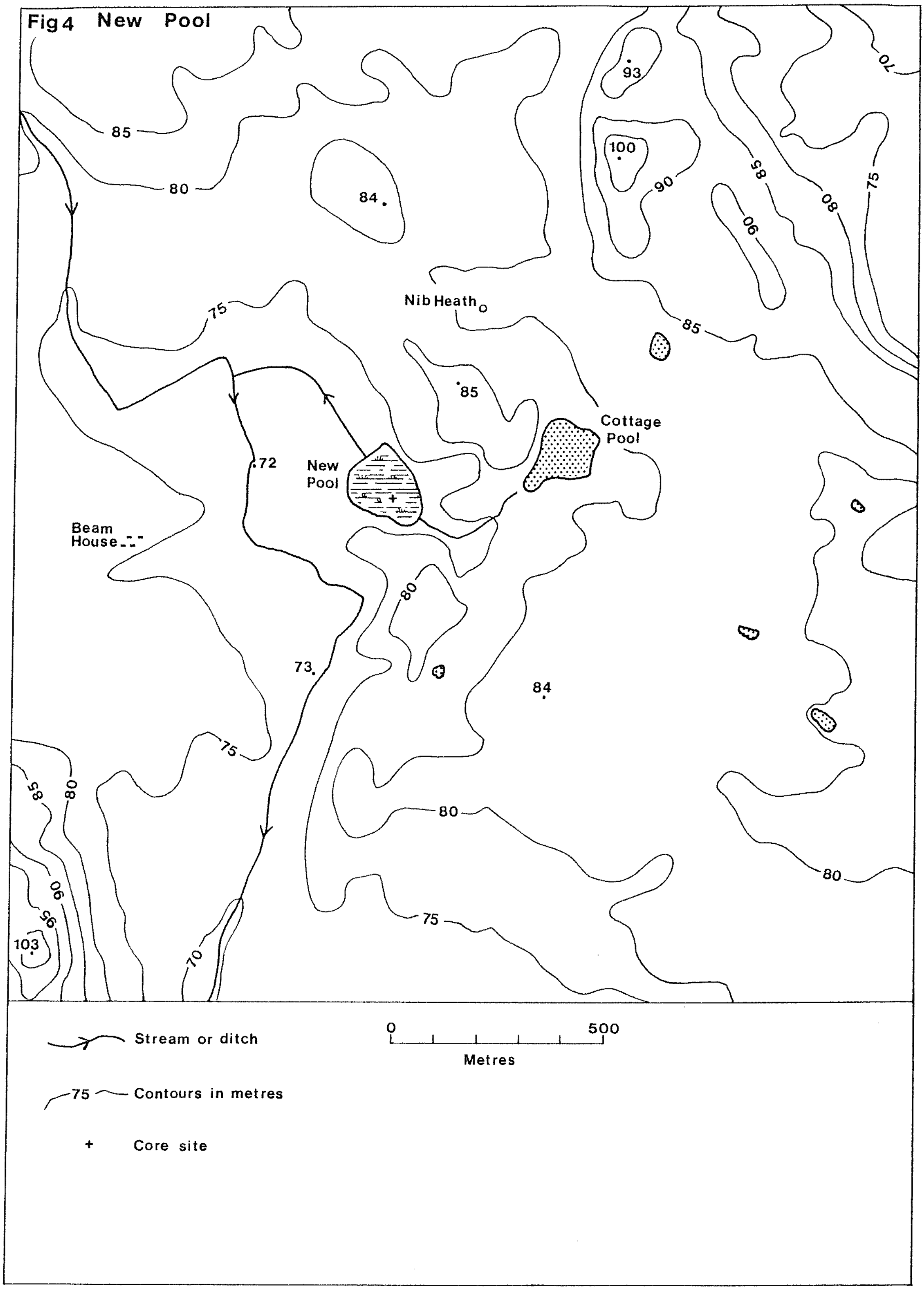


Fig 4 New Pool
85
80
84
93
100
90
85
80
75
70
Nib Heath
75
85
Cottage Pool
New Pool
72
Beam House
80
73
84
75
80
80
75
85
80
90
95
103
70
Stream or ditch
75 Contours in metres
+ Core site
0
500
Metres

Plate 1. The Baschurch Pools, vertical air photograph

Plate 2. Berth Pool, Birchgrove Pool and Boreatton Moss, vertical air photograph

Plate 3.   New Pool, vertical air photograph

Plate 4.   New Pool, Core site

Plate 5. Birchgrove Pool

Plate 6. Berth Pool with the Berth Hillfort in the background

Plate 7. Fenemere

Plate 8. Marton Pool

Plate 9.   Boreatton Moss, central core site

Plate 10.   Boreatton Moss, marginal core site

detail (1.3.1). Davis et al (1971) examined pollen frequencies across the surface sediments of seven lakes in southern Michigan; intra-site variability in tree pollen percentages was found to be relatively slight but considerable variations were observed in respect of certain herb taxa. Forty surface mud samples from lakes in central Sweden were examined by Prentice (1983a) and substantial variations observed in terms of forest composition and the effects of man on the vegetation. The pollen spectra from a lake and bog in southern Finland were examined by Donner et al (1978). Pollen concentrations fluctuated to a greater extent within the peat column and locally derived pollen had a stronger influence in the peat samples. The peat bog examined by Donner et al was 500m x 800m in extent but supported pine trees, a factor which could act to reduce its effective pollen source area (cf Jacobson and Bradshaw 1981). Two of the sites in this study, Boreatton Moss and Marton Pool, are similar in size but regional pollen appears to be more influential in the lake (Chapter 5).

In northern Britain Turner and Hodgson (1979) examined pollen data from the Boreal period at fifty-two peat mosses. Variations in forest composition were inferred at scales of a few hundred metres although site size variations were not discussed in detail.

Previously published research is discussed further in section 1.3. At this point it is sufficient to note that whilst a variety of multi-site studies have been designed to examine modern pollen frequency variations there is a clear need for more multi-site studies to be produced which concentrate on palaeoecological data (Edwards 1983). Variations between pollen profiles have been shown to occur at scales of a few km (Turner and Hodgson 1981, Bennett 1986) and a few tens of metres (Price and Moore 1984). Thus study has therefore been designed to complement modern pollen studies which have involved suites of sites by comparing and contrasting palaeoecological data. The site selection has been made specifically for this purpose and exploits a group of sites in a given area which vary in terms of size, morphology and depositional type.

1.2.2 Division of the Pollen spectra

The use of objectively defined pollen assemblage zones has been advocated by Cushing (1967) and Birks (1986a). Other workers have preferred to identify 'episodes' within the pollen spectra (eg, Oldfield 1963), 'zonules' (eg, Edwards 1979), 'sections' (eg, Turner 1964a) or 'phases' (eg, Hirons and Edwards 1986). In these cases, the criterion for division of the pollen spectra is more subjective and is based on the inferred impact of man on the pollen spectra. Intra-regional correlations of phases of palynological change can be made with reference to chronological and/or biostratigraphic correlation between spectra (Beales 1980, Waton 1982, Beales and Birks 1973).

In this study, phases of vegetational change have been defined in relation to the inferred impact of man on the pollen spectra. The raw pollen data have, however, been subjected to numerical zonation procedures (1.2.4), the objective of which was to examine the extent to which phase boundaries, which were in the first instance subjectively defined are idenitifed as significant boundaries by numerical zonation procedures. The one exception in this procedure involves the division between the upper two phases at Berth Pool, B13 and B14. In this case the division between the two phases was made with direct reference to zonation splits. Complete zonation diagrams (Birks and Gordon 1986) are not shown, since numerical zonation does not form the basis of phase designation. The order in which the zone splits were made is shown on the pollen diagrams, where they can be compared to the positions of the subjective phase boundaries.

Fourteen phases of vegetational change have been identified. The prefix B indicates that they relate primarily to the Baschurch area. Figure 16 shows the chronology of the phases; this chronology is based primarily on radiocarbon dates from Boreatton Moss, New Pool and Fenemere (Appendix 1). The spectra from the sites where no radiocarbon dates are available, Berth Pool, Birchgrove Pool and Marton Pool, have been correlated biostratigraphically to the spectra at the dated sites. Where the precise division between phases cannot be satisfactorily fixed at a particular site, the span of the combined phases is indicated. In most cases, biostratigraphic correlation is used to mark the phase boundaries. At the Baschurch Pools correlation has been assisted by reference to correlated age/depth profiles at Berth Pool, Marton Pool and Birchgrove Pool. Correlation of the upper and lower radiocarbon dated horizons at Fenemere to the three other pools proved to be straightforward, except in the case of the upper radiocarbon date from Fenemere and the pollen spectra from Berth Pool. A significant arboreal pollen decline dated by extrapolation at Fenemere to 800 bc (Chapter 5) could be identified at all four pools. At Berth Pool this date for the arboreal decline together with a correlated date of 1240 bc for the second Tilia decline was used to construct an age/depth profile and to show which horizons at Berth correlated chronologically to those radiocarbon dated to 1890bp/60ad (SRR 2920) at Fenemere.

The correlated age/depth profiles for the Baschurch Pools show that sediment accumulation rates were more rapid in the prehistoric period at Marton and Fenemere. Accumulation rates at each individual site are not thought to have varied markedly over the time period of primary interest in this project, spanning phases B2 to B11. The four meres today are fed and drained by ditches and field drains which have been cut in the historic period; their terrestrial catchments are shown in Figure 2. Flat peat deposits surround each site; the variations in relief across the catchments are limited (Figure 2). In the absence of inflow streams and with the low lying areas of marsh and fen which would have existed around the meres acting as a buffer between cleared and farmed land and the meres themselves, prehistoric clearance activity in the area would not necessarily lead to significant increases in sedimentation in the meres. For the above reasons, the use of linear age/depth profiles is thought to be realistic, at least for the meres in the prehistoric period; there is evidence for enhanced sedimentation in the meres in the historic period (2.2.1). Correlated age/depth profiles at the pools are used to support the inference of biostratigraphic correlation between levels which have no actual radiocarbon dates, for example, phase B9 at the Baschurch Pools (Chapter 5).

The following accumulation rates have been calculated for the Baschurch Pools:

Fenemere and Marton Pool	8.9 C14 yrs/cm
Birchgrove Pool	17.3 C14 yrs/cm
Berth Pool (Core II)	22.0 C14 yrs/cm

These rates refer to the sediment horizons from which the pollen diagrams have been derived and do not take into account changes in accumulation rate which might have occurred in the early Holocene or in the later historic period. Stratigraphic details of the sites are given in section 2.2. Fenemere and Marton are not thought to have had inflow streams in the prehistoric period and nor are their terrestrial catchments thought to have been extensive at that time (cf Figure 2). The comparatively high accumulation rates at these two sites, in comparision to Berth and Birchgrove and to Crose Mere (Beales 1980), are thought to be indicative of high autochthonous primary productivity (cf Reynolds 1979).

The division of the pollen spectra into phases has been done primarily to facilitate inter-site comparisions for relatively short time periods. The presence of a phase boundary is not intended, in the first instance, to imply any break in the continuity of human culture or economy in the Baschurch area.

1.2.3 Field and Laboratory methods

1.2.3.1 Field sampling and sample storage

Peat and sediment cores for pollen analysis were collected using a modified 50cm x 5cm Russian corer (Barber 1976). For the upper horizons of lake sediments, a 1.2m Mackereth corer (Mackereth 1969) was used to core the mud-water interface. Only the Mackereth core from Berth Pool (Berth M1) was used for pollen analysis. Samples for radiocarbon dating were collected using a large 30cm x 10cm diameter Russian corer (Barber 1984). C14 cores were correlated to the main cores by pollen analysis. Details of the radiocarbon dates and of the C14 to main core correlations are given in Appendix 1. Lakes were cored from a platform consisting of two inflatable dinghies tied alongside one another and securely anchored to the lake floor. This arrangement is, however, only advisable when weather conditions are calm and wind speeds negligible. Peat and sediment cores were transferred in the field into sections of plastic drain pipe of semi-circular cross section, wrapped in aluminium foil and sealed in polythene bags, samples were then kept refrigerated. Mackereth cores were extruded vertically in the laboratory and cut into 2cm slices and transferred to taped petri-dishes for refrigeration. A number of core sections, including a trial core from Berth Pool, Berth I, taken at the start of the project,were frozen for storage purposes. When these cores, including peat and sediment core sections were thawed some water loss was evident in the peat but excessive water loss occurred from the lake sediment and some disruption of the sediment was observed. The peat cores were transferred to a refrigerator but the lake sediment sections were discarded. The freezing of fresh lake sediment samples appears to be inadvisable, unless they are to be sub-sampled whilst frozen, or following freeze drying. All the lake sediment samples used to construct the diagrams in this project were refrigerated, not frozen. Two trial borings of the consolidated peat deposits in between Marton and Fenemere (2.2.3) were made using a soil auger.

1.2.3.2 Laboratory methods

Stratigraphic description

The stratigraphy of each core is described following the system of sediment description of Troels-Smith (1955). Stratigraphic columns have been included on the pollen diagrams. The symbols are those given by Aaby (1979). The use of the Troels-Smith system is discussed by Birks and Birks (1980) and Oldfield (1981). The presence of clay is denoted on the stratigraphic columns using only the symbol for Argilla granosa (cf Beales 1980). The stratigraphy is described on the basis of field observation, observation of the residues during pollen preparation and the selective microscopic examination of samples representative of individual stratigraphic units. Full stratigraphic descriptions are given in 2.2. Only the section of stratigraphy used in pollen diagram construction is shown on the pollen diagrams themselves.

pH measurements

pH measurements were made to complement the general descriptions of the study sites (section 2.2). The changing water conditions at the sites are not of primary interest in this particular study. However the present alkaline algal-rich status of the majority of the Shropshire-Cheshire meres is thought to reflect a long history of anthropogenic impact on the sites (Reynolds 1979).

Boreatton Moss

pH measurements were made using a hand-held pH meter at several locations across the surface of Boreatton Moss, including the moss proper, open water at the northern end of the moss and in the 'channel' surrounding the moss. Measurements are shown in 2.2.2.

New Pool

The peat surface at this site is almost certainly a truncated deposit. A sample of peat from the top of the main pollen core was mixed with distilled water and a pH measurement made in the laboratory.

The Baschurch Pools

pH measurements at the Baschurch Pools were, for the purpose of standardisation, carried out on the same day, 23rd September, 1986. Weather conditions were warm and dry and had been so for the preceding week, the water in the pools was cloudy and green-tinged, indicating high algal productivity (Sinker 1962, Reynolds 1979). Measurements are given in 2.2.

Pollen analysis

Sampling strategy

In order to facilitate inter- and intra-site comparisons which were reasonably detailed, the sampling interval used varied from a maximum of 8cm to a minimum of 1cm. The choice of sampling interval was determined by the depth of deposit spanned by the time period of primary interest and by the time available for data collection. Samples were taken by using a scalpel or small spatula to extract c. 0.5cm^3 of peat or sediment from 2 - 3mm either side of the exact depth to be sampled, thus, where a 1cm sampling interval is used, each sample is separated from those above and below it by a narrow band of unsampled deposit. Sediment surfaces were carefully cleaned in the laboratory prior to sampling, care was taken to remove fresh plant remains from the surface of the peat cores, in particular from the lower end of the core sections where modern material dragged down by the corer can be incorporated in the sample when the core chamber is rotated. Lake sediment from the upper and lower ends of core sections was not sampled. To avoid the possibility of sampling sediment contaminated by mud or water seepage at the top and bottom of the fin, sediment was sampled 2cm above or below the ends of core sections, to preserve a minimum 4cm interval. Peat at the ends of core sections was, however, sampled since fresh plant material could be seen and removed in the field and in the laboratory. An 8cm sampling interval was only used in the upper horizons at Berth Pool, where inter-site comparisions with other cores were not made. Where temporal overlaps between cores occur at the Baschurch Pools, a 4cm sampling interval is used; a 1cm to 2cm sampling interval was used at Boreatton Moss and New Pool.

Pollen preparation and counting

Samples for pollen analysis were prepared following Barber (1976), mounted in silicone oil and counted at x 400 magnification on a Nikon Optiphot Microscope; x 1000 magnification, with oil immersion, and phase contrast were also used to aid identification of certain pollen types. Pollen identification was made with reference to the keys in Faegri and Iversen (1975) and Moore and Webb (1978) and with reference to type slides. Experimental studies of pollen frequency variations in respect of total pollen counts (Crabtree 1975, cf Brooke and Thomas 1968) together with practical experience (Barber 1976, 60) has shown that pollen frequencies do not vary significantly once a sum of 200 to 250 grains has been reached, although some workers advocate the use of larger pollen sums, of up to 1000 grains (Berglund 1968, Vuorela 1977). For this project, the decision was made to count a minimum of 250 land pollen grains per sample, excluding Coryloid and Cyperaceae at all sites, and Ericaceae at the two mosses. This minimum of 250 constituted the main pollen sum, on which the relative frequencies of types within that sum were based.

Indeterminable and unidentified pollen is shown as a percentage of total pollen, including Indet./Unident. Indeterminable pollen consists of palynomorphs which were determined to be pollen grains but which could not be confidently assigned to any taxon since they had undergone too great a degree of corrosion and degradation of the grain wall. Occasionally, grains were encountered which were relatively well preserved but despite reference to keys and type slides could not be confidently identified, such grains were rarely encountered, and never exceeded 0.9% of total pollen. The exclusion of certain pollen types is a departure from the recommendations of Wright and Patten (1963). The intention in this project was to make inter-site comparisions in respect of the pollen frequencies of the main terrestrial tree, shrub and herb taxa. Cyperaceae pollen could be derived from taxa at the water's edge at the pools, and on the moss surfaces, and Ericaceae pollen from the moss surfaces; these two types were therefore eliminated from the main pollen sum. Coryloid pollen was not included in the main sum since it was thought that it could be derived in part from bog myrtle, *Myrica gale* (*cf* Edwards 1981). *Myrica gale* was formerly widespread in north west Shropshire (Sinker et al 1985) and favoured lowland peat bogs and wet heath on moist to damp peat. It is also a characteristic species of the transition zone between acid raised bog crowns and surrounding more base-rich fen. It was thought possible that areas around, or on Boreatton Moss and New Pool could have supported *Myrica*, although none was observed when the sites were visited. The peats around the Baschurch Pools could have supported the taxon. Coryloid pollen proved to be abundant. Inclusion of this type in a land pollen sum, particularly when differentiation is, potentially, uncertain at least for a proportion of the grains (Edwards 1981), could have led to the more irregular recording of certain relatively rare herb tree or shrub pollen types, when time constraints demanded the adoption of a relatively low pollen sum.

Relative percentage pollen frequencies have been calculated throughout. A satisfactory study of pollen influx variations would have demanded the analysis of a larger number of cores and the provision of a large number of radiocarbon dates, which could in any case be unreliable during clearance phases (Pennington et al 1976, Beales 1980). The focus of sedimentation in a lake basin (Lehman 1975) can change location over time (Dearing 1983), this could seriously undermine reconstructions of vegetation change based on pollen influx data (Edwards 1983, 601). Where pollen concentrations are high, influx data and percentage pollen data often show similar patterns (Huntley and Birks 1983, Beales 1980).

Relative pollen frequences from a single core are generally representative of the basin as a whole (Webb et al 1978) but the total pollen influx can vary throughout the lake basin (Davis et al 1973, Davis et al 1984).

Pollen diagram organisation

Trees

Arboreal pollen types are shown as percentages of total determinable land pollen, excluding Coryloid and Cyperaceae at the pools, and also excluding Ericaceae at the mosses.

Shrubs

Corylus/Myrica is shown as a percentage of total determinable land pollen, other shrub types are shown as percentages of total determinable land pollen, excluding Coryloid and Cyperaceae at the pools, and also Ericaceae at the mosses.

Heaths

At the Baschurch Pools, total Ericaceae pollen is shown as a percentage of the main sum, total determinable land pollen excluding Coryloid and Cyperaceae.

At Boreatton Moss and New Pool, total Ericaceae pollen is shown as a percentage of total determinable land pollen.

Gramineae and cultivars

Pollen types which could represent cultivated taxa are grouped with total Gramineae pollen (cf. Waton 1982), types are shown as percentages of the main sum: total determinable land pollen excluding Coryloid and Cyperaceae at the pools, and also excluding Ericaceae at the mosses.

Open habitat indicators

Amongst the herb pollen types a separate category is reserved for pollen types most commonly referred to as open habitat or anthropogenic indicators (Turner 1964a, Behre 1981, Vuorela 1977). Types are shown as percentages of the main pollen sum. Rumex acetosa/acetosella are not differentiated, nor are Plantago media/major.

Other herbs

The remaining herb pollen types are included after the open habitat indicator group; taxa from a variety of habitats contribute to this group. Cyperaceae is shown as a percentage of total determinable land pollen, other herb types are shown as percentages of the main sum.

Aquatics

Pollen from aquatic and emergent taxa is shown after the herb pollen groups, types are shown as percentages of total determinable pollen.

Pteridophytes

Pteridophyte spores are shown as percentages of total determinable land pollen plus total pteridophyta, and constitute the last main group on the pollen diagrams.

Sphagnum

Sphagnum spores are shown as a percentage of total determinable pollen and spores and Indeterminable/Unidentified as a percentage of total pollen. Summary curves are shown for total tree, shrub and herb and heath pollen, calculated as percentages of total determinable land pollen. The positions of numerical zone splits, (1.2.4) together with the order in which they occurred, are shown where they can be compared with the positions of the subjectively defined phase boundaries. The percentage variation in the data set accounted for by each zone split (cf Birks and Gordon 1985) is also shown on the pollen diagrams.

Sediment loss on ignition

Wet sediment samples of c. 10-15g were taken from selected levels in the cores from Berth Pool and Fenemere. The stratigraphic positions of the L.O.I. samples were selected with reference to the positions of the samples taken for magnetic measurements. L.O.I. samples for Berth Pool were taken from the main core, Berth II (2.2.2). Samples from Fenemere were taken from the C14 core and their equivalent position on the main core was determined with reference to the skeleton pollen diagram constructed for the C14 core. The C14 core was used at Fenemere for L.O.I. measurements since it enabled measurements to be made on sediment known to be adjacent to the actual material submitted for radiocarbon dating. The intention was to show if any substantial reduction in organic content was directly associated with any of the radiocarbon samples.

Sample size for L.O.I measurement was determined with reference to Clark (in prep.): c. 10-15g samples of wet sediment were oven dried for 12 hours at 95°C, the dried samples were then disaggregated using a pestle and mortar and then oven dried for a further 12 hours at 95°C. Samples were then weighed and transferred into pre-weighed platinum crucibles and placed in a muffle furnace for 4 hours at 550 $\pm$ 50°C. Percentage weight loss on ignition was then calculated as a measure of organic content (Allen 1974).

Magnetic measurements

Sediment samples for magnetic measurements were selected from the cores from Berth Pool (II) and Fenemere since these sites contrast in size and in terms of their pollen spectra (2.2.1 and following). Magnetics samples were selected after the pollen diagrams had been constructed and were taken from levels in the stratigraphy of the sites where the pollen evidence pointed to progressively increasing degrees of human impact and where chronological correlations between the sites were thought to occur. 10ccs of wet sediment from each of the selected sampling levels was sent for preparation and measurement at the Dept. of Geography, University of Liverpool. Samples were analysed and the raw data returned (G. Yates, Pers. Comm.).

Sediment samples were dried for 4 days at $\leq$40°C in a drying cabinet then wrapped in cling film without sample disaggregation and secured in 10cc pots. The principles of mineral magnetic analysis and details of measurements and equipment are described in Molyneux (1971), Oldfield et al (1978), Thompson et al (1975), Oldfield et al (1985a) and Thompson and Oldfield (1986). Magnetic measurements of sediment samples allow linkages to be proposed between sediment and source (Oldfield et al 1985a, Bradshaw and Thompson 1985, Hirons and Thompson 1986, Björck et al 1982, Thompson and Morton 1979, Oldfield et al 1979). Magnetic measurements can be carried out rapidly, enabling many cores from a lake basin to be correlated to one another, allowing rates of sedimentation to be estimated (Foster et al 1986, Coard et al 1983) and allowing variations in lake sedimentation to be linked to catchment erosional processes (Dearing et al 1982, Dearing and Flower 1982, Dearing et al 1981). Rapid and accurate core to core correlation can show how the pattern of sediment accumulation within a lake basin can vary over time (Dearing 1983). Sediment-source linkages have been proposed for lakes on the Shropshire-Cheshire Plain by Smith (1985) and, on the basis of data presented in Smith (1985), by Oldfield et al (1985a).

Full details of the magnetic measurements used in this project are given in the above references, particularly Oldfield et al (1985a) and Thompson and Oldfield (1986). At this point however a brief summary can be given.

Magnetic susceptibility; χ

Essentially a measure of the response of a sample to the presence of a magnetic field. Susceptibility can usually be seen as a guide to the concentration of ferrimagnetic minerals, eg, magnetite, in a sample although there are exceptions (Oldfield et al 1985a, 33). If χ is measured at both low and high frequencies the frequency dependent susceptibility, χfd, can be calculated and can be used to indicate the presence of viscous magnetic grains which typically occur in topsoils (Oldfield et al 1983)

Saturation Isothermal Remanent Magnetisation: S.I.R.M.

A magnetic field, for example at a field strength of 850mT can be induced into a sample in the laboratory. Initially, the magnetisation of the sample will increase but eventually further magnetisation will not occur. When the sample is magnetically saturated it is removed from the magnetic field; the magnetisation of the sample declines on removal from the magnetic field from M_S (saturation) to M_{RS} or SIRM (the magnetic remanence). SIRM can be affected by changes in magnetic mineral concentrations and magnetic grain sizes. The ratio of SIRM/χ is independent of concentration and can be used to determine the mineralogy of a sample. For example, haematite tends to have a high ratio of SIRM/χ and a magnetite a lower ratio (Oldfield et al 1985a). Downcore changes in the ratio SIRM/χ can indicate changes in the magnetic mineral assemblage or in magnetic grain sizes.

Reverse field ratios

Once a sample has been magnetically saturated, or at least been subjected to an applied magnetic field, it can be subjected to a series of weaker fields running in the opposite direction. At each successive reverse field strength the new remanent magnetisation (IRM) can be measured as a proportion of the original SIRM:

$$\frac{IRM - 20mT}{SIRM} \qquad \frac{IRM - 40\ mT}{SIRM} \qquad \frac{IRM - 100mT}{SIRM}$$

etc. The minus signs denote the reverse field. In this way, the demagnetisation of the sample can be observed and a coercivity curve can be calculated. The coercivity of SIRM, Bo(CR) represents the reverse field needed to reduce SIRM to zero. In this way the strength or hardness of the magnetic minerals in a sample can be assessed. Magnetite can be described as a 'soft' mineral with a lower Bo(CR) than the 'harder' haematite. Mineral hardness or softness is typically measured using the 'S' ratio (cf. Oldfield et al 1979), this is the ratio of IRM - 100mT (the reverse field at 100mT) to SIRM (in the applied forward field). For soft minerals, eg, magnetite 'S' will tend to approach -1.0 since most of the initial forward field will have been lost at a reverse field of -100mT. For hard minerals such as haematite 'S' could reach up to +1.0. Downcore changes in 'S' can thus point to changes in iron mineralogy; sediment source identification can also be made possible (Oldfield et al 1979).

Anhysteritic Remanent Magnetisation: ARM

In the laboratory ARM is imparted into a sample using a strong alternating forward field in the presence of a small steady field. In a soil profile (Thompson and Oldfield 1986, 78) ARM was found to decline down the profile as the relative importance of magnetite, in this case the fine form of magnetite typical in topsoils, decreased. Changes in the ratio of SIRM/ARM can indicate changes in magnetic grain size (cf Thompson and Oldfield 1986).

χ versus SIRM and SIRM/χ versus 'S'

Samples can be plotted on x and y axes dependent upon their values for the above parameters (cf Hirons and Thompson 1986). The samples will group on the scatter diagrams in accordance with their mineralogy; discrete groups of samples could characterise different levels in a given sediment core and could relate to down core changes in iron mineralogy.

A complex series of variables can affect the above parameters (cf Oldfield et al 1985a, Thompson and Oldfield 1986). In association however they can provide a guide to the iron mineralogy of a given sediment core and in combination with studies of catchment mineralogy (cf Smith 1985, Oldfield et al 1985a) can allow sediment - source linkages to be suggested and provide detailed information relating to environmental change within a lake catchment (cf Oldfield et al 1983b).

1.2.4 Numerical Methods

The pollen spectra in this study have been divided into phases on subjective, rather than objective criteria (1.2.2). Numerical methods have, however, been used to divide the pollen spectra objectively, and also used in an attempt to compare profiles. The spectra were zoned numerically in order to assess the extent to which subjectively defined boundaries would be marked by ZONATION boundaries and also to examine the extent to which the pattern of ZONATION boundaries varied from site to site; if the pollen spectra from two adjacent sites were identical, then the pattern of zones splits at one site, in terms of order and position, should be repeated at the other site, if important site to site contrasts occur, the pattern of zone splits would be expected to vary.

1.2.4.1 Zonation of the pollen spectra

Pollen data from each profile were encoded for computation in the

format given by Birks (1986a). The computer programs ZONATION and SLOTSEQ were then used to analyse the data files; details of the numerical procedures are given by Gordon and Birks (1972, 1974) Birks and Gordon (1985) and Birks (1986a). The FORTRAN program ZONATION (Birks and Gordon 1985, adapted for the Southampton computing system by I.C. Prentice) contains three separate numerical procedures, each designed to objectively divide the pollen spectra into a series of internally homogenous zones. The results of two of these procedures, SPLITINF and SPLITLSQ, are shown on the pollen diagrams.[1] The program permits the number of zone splits to be selected in advance. A maximum of 20 zones splits can be placed. The smaller number of 12 was however chosen as a standard for all 8 pollen diagrams to facilitate clearer site to site comparisons in respect of the positions of the main zone splits. A third numerical procedure, CONSLINK, is not considered here; problems can arise in the interpretation of CONSLINK where more than 50 counted levels are analysed (Birks and Gordon 1985). The spectra from Boreatton Moss (centre), Berth Pool (core II) Fenemere and Marton Pool all contain more than 50 counted levels. To provide a standard comparison for all 8 diagrams only SPLITINF and SPLITLSQ are illustrated on the pollen diagrams. The results of ZONATION are intended to represent a measure of the importance, in purely numerical terms, of particular horizons in the pollen spectra where changes in pollen content occur. A standard group of pollen taxa was chosen for numerical zonation procedures. The most consistently abundant tree and herb types were selected, although Cyperaceae and Ericaceae were not included since it was thought they could be locally over-represented at the two moss sites. Fluctuations in these types could represent highly localised variations in species abundance on the mosses themselves. The objective was to compare the sites in terms of temporal variations in the frequencies of the main terrestrial pollen types. Corylus/Myrica was included in the standard set since there was an observed tendency for this type to fluctuate in frequency in a way which suggested that Corylus avellana was predominant. The Coryloid curve tends to decline at all sites where major reductions in arboreal pollen totals occur. The taxa used in ZONATION are as follows :-
Betula, Pinus, Ulmus, Tilia, Quercus, Alnus, Fraxinus, Coryloid, Gramineae, Liguliflorae, Plantago lanceolata, Rumex acet and Pteridium.

1

Samples at 140cm and 144cm at Boreatton Moss Margin were not included in ZONATION analysis. These were only included on the pollen diagram after statistical analysis had been carried out.

1.2.4.2 Comparison of the pollen spectra

Several combinations of site files were paired and analysed using the FORTRAN program SLOTSEQ (Birks and Gordon 1985, modified for the Southampton computing system by I.C. Prentice). SLOTSEQ is designed to discover the optimal slotting fit between pollen spectra; if a series of sites are subjected to numerical zonation and comparision, standardised regional pollen assemblage zones can be established (Birks and Berglund 1979, Birks 1986a). One important problem with the procedure incorporated in SLOTSEQ is the tendency for 'blocking' to occur (Birks and Gordon 1985, Birks 1986a). Blocking occurs if two sequences incorporate a series of levels with little within - sequence variability. There is a tendency for a whole series of levels from one sequence to be grouped together without any levels from the other sequence being slotted in, even if genuine site to site correlations occur in these levels. In this study, blocking did occur when several paired profiles, particularly those from Marton and Fenemere, were compared. Furthermore, Prentice (unpublished information sheet, Geography Department, Southampton University) states that when two sequences are compared using SLOTSEQ, slotting should be carried out 'both ways round' that is first using profile A as sequence 1 and B as 2 and then profile B as sequence 1 and A as 2. If the slotting fit produced is clearly different when profile orders are reserved the fit produced by SLOTSEQ should not necessarily be trusted. Several combinations of profiles were compared following the above procedure and the slotting fit varied when the profile order was reversed. The results of SLOTSEQ have thus not been used in this study as they are thought to be potentially unreliable. Conceivably, beneficial modifications could be made to the numerical procedures incorporated in SLOTSEQ (I.C. Prentice, pers. comm.). Selected inter- and intra-site pollen frequency comparisions are made with reference to the mean frequencies across a series of levels; the standard deviations of the means are shown.

1.3 Literature Review

1.3.1 Pollen production

The nature of the relationship between pollen frequencies and vegetation communities is a subject of great importance, and some controversy (Faegri 1966). The amount of pollen produced by a given species is rarely proportional to the abundance of that species in the vegetation community. Davis (1963) discussed the concept of the R value, the ratio of the percentage of a pollen taxon to its percentage cover in the vegetation; this general approach is still considered productive (Bradshaw and Webb 1985). Empirical work has shown that, in order to make more accurate deductions about vegetation composition pollen frequencies should be corrected (cf Andersen 1973). There are problems with the use of the R value approach (Faegri 1966), some species are insect pollinated, and so their pollen frequencies should not be viewed in exactly the same light as wind pollinated species. Also, some pollen types are far more susceptible to decay than others, which can alter their representation in the fossil pollen record (Hall 1981, Havinga 1967, 1984). Components of the pollen input at a site can be derived from much older deposits (West 1973) and, at worst, this derived input could make diagram zonation and vegetational inference meaningless. Faegri (1966) cites the case of *Larix* pollen, which can be extremely difficult to recognise and count. *Taxus* and possibly *Juniperus* could be included in this category. Andersen (1970, 1973), however, studied the relative pollen productivity of forest trees in detail, and the following 'corrected factors' were proposed:

Quercus, *Betula*, *Alnus*, *Pinus*, *Corylus*, *Taxus*	1 ÷ 4
Carpinus	1 ÷ 3
Ulmus, *Picea*	1 ÷ 2
Fagus, *Abies*, *Populus*	1 x 1
Tilia, *Fraxinus*, *Acer*	1 x 2

This study was carried out in a closed forest, Draved, in Denmark. The efficacy of R values, or correction factors produced at a specific location at one point in time, must be questioned. The problem of the transference of R values from one location to another has been raised by Faegri (1966) Oldfield (1970), and Faegri and Iversen

(1975). An individual pollen frequency for a single species can be derived from a complex variety of sources, in terms of source strength and distance from the collection point (Oldfield 1970). Applying R values to pollen curves where the pollen has been derived from a variety of sources is therefore clearly problematic. As an extension of the R value model, and in order to eliminate the problems inherent in the interdependance of pollen frequencies in percentage calculations (Faegri and Iversen 1975) the use of pollen influx values was developed (Davis and Deevy 1964). It was believed that pollen influx values could be directly related, via the R value model, to actual composition change in vegetation communities. However, studies on intra-site variability in sediment accumulation rates (Lehman 1975; Bonny 1976, 1978; Dearing 1983; Davis et al 1984) have cast doubt on the representativity of pollen influx values, since the zone of sediment focussing can change over time.

The pollen concentration in a sediment layer can be uniform, but intra-site variability in sediment accumulation rates will lead to intra-site differences in annual rates of pollen deposition (Bonny 1978), which are a function of sedimentation processes and not vegetational change. Under these circumstances, attempting to convert from absolute pollen influx rates, to vegetational composition, is fraught with difficulty (Pennington 1973, Edwards 1983). Despite problems of interpretation, particularly when pollen production variability is complicated by variable despersal efficiency (1.3.3), work on the calibration of pollen frequencies in relation to vegetation composition has continued (Webb 1974, Webb et al 1978, Bradshaw 1981a, 1981b; Delcourt et al 1983, Parsons et al 1984). If the influence of trunk-space pollen transfer is held to be minimal (Faegri and Iversen 1975) as the results of Andersen (1970, 1974a, 1974b) suggest, then a certain level of accuracy in the calibration of pollen spectra to tree cover, in a closed forest, is probably attainable. It must be assumed that the locally produced pollen is not unduly affected by a substantial component derived from elsewhere. However, once a bog or lake margin is encountered, and it is in these localities that the best palaeoenvironmental record is preserved, highly localised sub-canopy pollen representation is then subjected to more complex processes of mixing and addition in the air, and processes of transfer and integration in the peat or water and sediment column. In very general terms, where trees dominate the vegetation around a relatively small site (Jacobson and Bradshaw 1981) it could be expected that Andersen's correction values will be a useful guide to the over- or under-representation of arboreal taxa. Surface sample studies within closed forests may well contine to bear out the observations of Andersen, although Bradshaw and Webb (1985) and Prentice (1985) draw attention to the variability in R values consequent upon changing basin size. Once deposited, the variable resistance to decay, amongst pollen types (Cushing 1967) could lead to further problems of representativity not directly related to pollen productivity, it is therefore always advisable to record the proportion of deteriorated and indeterminable pollen grains as an indication of the general degree of pollen destruction in a deposit.

It should also be remembered that, at the margin of a lake or bog there is an obvious break in the vegetation, which, if trees or shrubs in particular are well represented, can lead to more vigorous flowering and pollen production with greater insolation to lower levels in the vegetation.

In conclusion, the location of a species in the vegetation community, its pollen production per anther, its season of flowering and the dispersal efficiency of its pollen combine, particularly in an open vegetation community, to make the precise interpretation of fossil pollen frequencies very difficult, and it is necessary for all possible variables to be constantly borne in mind. The vegetation pattern around a given site can be reconstructed in general terms, allowing for the over- or under-representation of particular pollen types in the pollen record. For an accurate reconstruction of local spatial variations in species abundance, however, a multi-site study is necessary (Jacobson and Bradshaw 1981, 83). A further advantage of this type of multi-site approach is that inter-site contrasts can give an indication of the likely extent of the dominant pollen source area at a given site (cf Bennett 1986).

1.3.2 Pollen dispersal

Theoretical and empirical work on the processes of pollen transfer by Tauber (1965, 1967a, 1967b, 1977) showed that the true 'pollen rain', that which was removed vertically from the atmosphere by rainfall, could amount to only 10 - 20% of the pollen arriving at a basin.

Assuming exclusive aerial transport of pollen to a site, Tauber (1977) suggested that at a basin site of several hundred metres diameter, up to 80% of the pollen was transported via the trunk-space of a forest. Faegri and Iversen (1975) do not hold with this proposed importance of the trunk-space. The fact that work by Andersen showed a very close correlation between canopy composition and forest floor pollen deposition is cited by Faegri and Iversen (1975, 55) as evidence that trunk-space transfer is minimal, since it had not excessively perturbed local pollen deposition. Perhaps of more interpretative value was Tauber's assertion that in a small basin, the above canopy pollen component could overshoot, and thus the smaller the basin, then the more under-represented would be long-distance pollen transport (Tauber 1965). Tauber (1977) proposed models which held the pollen composition of each component in his pollen transfer scheme to be variable from component to component; site factors could alter the relative representation of these components; this mechanism could influence the relative pollen proportions deposited at a series of sites in the same vicinity.

Andersen (1974a, 1974b) has further studied seasonal and annual pollen deposition related to wind conditions in a mixed deciduous forest. Andersen considers that a major part of tree pollen drops to the ground in rain drops or large aggregates. Krzywinski (1977) drew attention to pollen deposition due to litter-fall after the season of flowering. In part, these studies agree with Tauber's emphasis on pollen filtering, although at present the true nature of trunk-space transport and filtering is still open to further research. Much of this work has been carried out within forests, in a non-forested upland Price and Moore (1984) have suggested that air-streams moving up valleys either side of an interfluve can have different pollen loads, and that a transect across the summit will reflect the changing predominance of these separate pollen bearing air-streams. It appears clear that the 'pollen rain' cannot be seen as a single homogenous source of pollen (Tauber 1965), but rather as a complex and variable source, subjected to a range of external influences. The pollen input to a site will, at least in part, be a function of these factors, which adds a further complication when attempting to associate pollen frequency changes with vegetational changes. Faegri and Iversen (1975) consider that the rate of fall of pollen grains in still air is not a significant factor in dispersal, since average windspeeds in turbulent air are more than an order of magnitude greater than pollen settling velocities. Prentice (1985) however, considers that the differential rates of deposition from the atmosphere, amongst pollen types, are significant. Prentice (1985) presents simulated pollen source areas for taxa with different settling velocities, with the more buoyant taxa originating over a much larger area. This 'dispersal bias' (Prentice 1985) can have an important influence on pollen representation, particularly when the pollen of a given species is both poorly produced and poorly dispersed; alternatively, a high pollen producer can enjoy excellent dispersal as well. Pollen representation is therefore a result of the combination of production variables and dispersal variables. The work by Andersen (1970, 1973) has made an important contribution to the subject to pollen production. Since much of Andersen's work was carried out in a closed forest, it is necessary to consider the variations in pollen dispersal and site size, which, together with pollen production, add up to produce pollen representation (Prentice 1985). Tauber (1977) showed how pollen could be dispersed within a number of different dispersal modes: Canopy transfer, trunk-space transfer, waterborne transfer, and rainout. Site diameter was considered to be important not only in its effects upon the proportions of these components contributing to the total pollen input but, as a direct consequence of its effect upon these proportions, also in its effects upon the pollen source area. Potentially, the variability in site size which occurs between the six sites under examination in this study could affect the deposition of pollen at the individual sites; the relative importance of pollen dispersed below, within or above the canopy could vary according to the size of the site (cf Tauber 1977).

1.3.3 Pollen source areas

Janssen (1966) carried out a detailed study of pollen source areas based on transects across forest formations in Minnesota. Surface samples were taken from bogs in an area with a mosaic of vegetation types in an attempt to identify the regional component in the pollen rain. This component was taken to be derived from upland areas beyond the immediate slopes of the basins in the transect. A characteristic of the regional pollen rain is a high degree of mixing of its pollen content, resultant from the distance it has travelled and therefore the time it has remained airborne. The results

(Janssen 1966) allowed the identification of a regional pollen rain, a local component, dominated by plants growing on or at basin sites, and an extralocal component derived from vegetation in areas adjacent to basin margins. Janssen (1966) considers the extralocal component to derive from trunk-space transfer (Tauber 1965). In later work Janssen (1973) proposed that an extralocal pollen trajectory would only be important over a few hundred metres from a pollen source. The idealised relationship between pollen rain and distance from the source, given by Janssen (1966) showed a rapid fall-off in the amount of local pollen present as distance from this local source increased. Oldfield (1970) noted that pollen source strength could be variable, based in part on the number of individuals contributing to the pollen rain, and their distance from the collecting point. In this way, an identical pollen percentage at a site could be derived from a combination of different pollen source strengths and source distances. This will complicate any inferences about pollen percentage decay from a point source, since in practice the exact nature of that source cannot be identified from fossil pollen spectra. A synthesis of theoretical and empirical work on pollen source areas was presented by Jacobson and Bradshaw (1981). This synthesis combined Janssen's idealised relationship between the pollen proportions at a site and the areas of origin of that pollen, with Tauber's model describing the effect of site diameter upon the representation of the components of the pollen rain. It might appear to be a statement of the obvious that some pollen arrives at a site from a short distance, some from a middle distance and some from long distance. However, once it is established that not only does each of these distance components have its own characteristics, but that their proportions can vary according to the size of the site, then the identification of regional extralocal and local sources becomes of great interpretative value. Within each distance component (Janssen 1966), Tauber (1965, 1977) identified different modes of dispersal; a canopy component (C_c), a trunk-space component (C_t), a rainout component (C_r) and a waterborne component (C_w). To allow for Janssen's source with its maximum local effect, Jacobson and Bradshaw (1981) defined a gravity component (C_g) which represents vertical dry deposition of pollen by anthers overhanging a sampling site. Basin size, incorporating Tauber's ideas, is then related to the source areas as defined by Janssen (1966). The effect of this combination is to propose a relationship between site - size, with no inflowing streams, and the relative proportions of pollen originating from the different areas around the site. Hence, with a small site diameter, local pollen producers are well represented; with increasing site diameter, the extra local and regional sources have an increasing effect. An important assertion made in this model (Jacobson and Bradshaw 1981) is that the extralocal pollen could constitute 50-70% of the pollen falling on a basin of 1-200m diameter. The concept embodied by Tauber's (1977) ideas concerning the overshoot of regional pollen in small basins is accommodated by Jacobson and Bradshaw (1981) who show that the regional or far-travelled component of the pollen input at a site will not begin to predominate in the pollen spectra until site size exceeds c. 5ha; local pollen is defined as that originating within 20m of the basin margin at a closed basin, extralocal pollen originates in the vegetation between 20m and several hundred km of the basin edge and regional pollen is derived from greater distances. The cutting of inflow streams into a formerly closed lake basin could effectively increase the pollen source area of that basin (Pennington 1979), also pollen source area can increase when woodland is cleared from around a site (Tauber 1965, 1967b). The Baschurch meres almost certainly did not have inflowing streams during the prehistoric period, the ditches linking the meres today having been cut in historic times. This synthesis of source areas and basin sizes is a useful guide to interpreting fossil pollen spectra since it allows the close attention which is paid to the immediate surrounds of a site to be justified by reference to carefully controlled experimental work. Prentice (1985) has also sought to draw together theoretical and empirical work on pollen representativity, source area and basin size. Prentice (1985) defines pollen representation as a combination of production bias, the result of differential pollen production by trees, and dispersal bias, due to differential pollen dispersion amongst taxa. Dispersal bias is the variable affected in part by basin size. Prentice (1985) bases a theoretical model of pollen dispersal in part on the use of equations developed by Sutton (1947, 1953) to describe the mass behaviour of particles released at or above ground. The zero-height form of Sutton's equations is held to be the best for this theoretical approach (Prentice 1985). Faegri and Iversen (1975) also consider pollen generated at the canopy to be effectively at zero altitude, since it is immediately susceptible to filtering by the vegetation. Prentice emphasises the effect of individual deposition velocities amongst pollen taxa. Lighter pollen grains are shown to originate within a greater average distance of the basin than heavier pollen taxa. The theoretical formulations of Prentice (1985) agree with empirical evidence. Local pollen deposition is predominant at within-forest sites (Bradshaw 1981a). Extralocal and regional pollen predominates in moderately sized basins (Webb 1974). If anything, Jacobson and Bradshaw (1981) allow extralocal pollen a greater predominance, particularly in the range of basin sizes considered in Shropshire in this study. Jacobson and Bradshaw (1981) allow the trunk-space component to contribute to this extralocal effect. If trunk-space transfer is considered with the scepticism advanced by Faegri and Iversen (1975) it could be that there is an important pollen input at basin margins from the immediate down-draughting of pollen as above-canopy air is dragged down by slacker circulations above the sheltered basin surface (Bonny and Allen 1984, Caborn 1957). Naturally this is less likely to occur where a site margin is completely open, but at many lowland lake margins a fringing Alnus and Salix belt often persists which may perpetuate down-draughting at the lake-shore; the fringing tree belt thus acts as a partially penetrable shelterbelt (Caborn 1957). The basin diameters of the sites in this study range from ca.100m for Birchgrove Pool and New Pool, to ca.300m for Fenemere, it is possible that the dominant pollen source area with a closed forest will be 'extralocal' at New Pool, Berth Pool and Birchgrove Pool but a wider 'regional' pollen source area would be expected to affect to pollen input at Fenemere, and theoretically, at Marton Pool (cf. Jacobson and Bradshaw 1981). Once woodland clearance begins however, and the woodland opens up, the pollen source area of a site can effectively increase (Tauber 1965, 33; 1967b, 139). In this study, the pollen spectra examined span clearance phases in the vegetation and the dominant pollen source areas for each individual site could vary in extent over time, although in the first instance Berth Pool, Birchgrove Pool and New Pool would be expected to have more restricted pollen source areas than Marton Pool, Boreatton Moss and Fenemere (cf. Tauber 1977, Berglund 1973, Jacobson and Bradshaw 1981, Bradshaw and Webb 1985, Prentice 1985).

1.3.4 Intra-site variability

Research into the variability of pollen frequencies at the same site has been carried out over a long period, and over a wide variety of basin types and geographical areas. At first sight, the areal nature of pollen output and transfer does not appear to lend itself to elucidation by relatively random point-based sampling. Davis (1968) working on Frains Lake, Michigan, observed a smoothing of pollen frequencies within the lake which was due to the resuspension and redeposition of pollen grains. She found that up to 80% of pollen grains deposited in water column traps were resuspended, and only 20% new input. Davis (1968, 798) notes the 'uniformity and consistency' of pollen content caused by redeposition. In this way, pollen frequencies preserved in the sediment are 'mean frequencies', representative of the total pollen deposited in the lake, and not of localised input variations at the time of primary deposition. In later work, Davis (1973a) stressed the importance of the absence of thermal stratification as a pre-requisite for extensive sediment mixing and redeposition. Davis and Brubaker (1973) sounded a note of caution in respect of the differential settling velocities of pollen grains, particularly if horizontal currents transport lighter pollen grains which do not penetrate the thermocline in a stratified lake. Davis et al (1971) showed that inter-site variability in deepwater Ragweed: Oak pollen ratios could occur when no shallow water variation existed from time to time. R.B. Davis et al (1969) indicated that variation in pollen spectra could occur within lakes. Seven lakes were examined, six in north-east Wisconsin, in all cases, variation was found between deep and shallow water spectra, although deep water core groups were more homogenous between themselves. No pattern was apparent for individual taxa (cf Davis et al 1971), R.B. Davis et al (1969) concluded that, if possible, more than one core should be taken from a lake to assess the possible effect of intra-site heterogeneity, and that cores should be concentrated in the deepest portions of basins. The results of R.B. Davis et al (1969) were based on surface samples. Davis et al (1984) examined cores from Mirror Lake, New Hampshire. These cores obviously included fossil spectra and the pollen percentage diagrams derived from them were almost identical despite their varying positions within the lake basin.

Edwards and Thompson (1984) and Hirons and Edwards (1986), showed in a study from Lough Catharine, Ulster, that palynological patterns were reproducible between marginal and central cores. This general similarity held for the types and percentage representation of pollen and spore taxa. Tolonen (1984) compared 4 cores from within a

Finnish kettle-hole lake. Slightly higher herb pollen frequencies were found in the middle of the lake, although Tolonen concluded that there were no major differences in pollen percentage assemblages in different profiles. Interestingly, Tolonen (1984) found slightly higher Secale frequencies in deep water; Edwards and Thompson (1984) located cereal pollen earlier in their central Lough Catharine core, compared to the lake marginal core. Clearly, if Secale, Rye pollen were used as an indicator of cereal cultivation, then a central core would set this cultivation earlier than the marginal core.

Berglund (1973) working with pollen traps in a Swedish lake found that redeposition of pollen grains was responsible for 'astonishingly similar percentage values' in sediment traps, and confirmed the conclusion of Davis (1968) that redeposition of pollen grains within lakes created a uniformity and consistency in pollen content. Bonny & Allen (1984), in a study based on Crose Mere, a small lake in Shropshire very close to the Baschurch meres, found evidence for a uniform input of pollen from non-local tree taxa. Crose Mere is ca 15ha in area, moving into the size range where a regional pollen input becomes discernible (Beales 1980). In line with the findings of Davis (1968), Berglund (1973) and Tauber (1977, 53), Bonny and Allen (1984) observed considerable circulation and resuspension of pollen in the water column. Bonny & Allen suggest that in lakes with high primary productivity, pollen may form aggregates with other mineral, algal, fungal and insect fragments and in this way enhance pollen sedimentation, since these floccules will be sedimented more rapidly than individual pollen grains. Bonny & Allen (1984) do find some variations in surface pollen frequencies; the exposure of older sediment by littoral erosion is mentioned as a possible cause. Water level lowering by artificial drainage could be responsible, exposing littoral sediments which were deposited at a time of greater water depth with less potential for wind stress in these shallower zones.

Also, Bonny & Allen detect a tendency for pollen from local plants at the lake shore to be deposited within 30m of the shore. Once deposited, however, they will be subject to resuspension and redeposition. Bonny & Allen conclude that air-currents flowing over rather than through a canopy are more important than initial theories suggested (Tauber 1965, 1977). In the light of the findings of Caseldine (1981) that N.A.P. was very rapidly filtered out on entering a forest, and that a high proportion of N.A.P. was transported over the canopy, it appears that the 'trunk-space' transport component should be more critically examined. As far as the moderately-sized lakes considered in this study are concerned, therefore, a pattern has emerged over a wide geographical area of a repeated tendency for pollen stratigraphies to be preserved which are satisfactorily reproducible within the lake. Pollen frequencies in lake sediments, therefore, represent averaged values, averaged both over the area of the lake and over several years as grains are subjected to repeated resuspension and redeposition. Separate cores obtained in this study from Berth Pool show pollen frequency changes which are closely similar in magnitude and form at a time of substantial vegetation alteration. Despite the cautions advanced by Davis and Brubaker (1973) in respect of variability in the frequencies of certain buoyant pollen taxa such as ragweed or pine, and the observations by R.B. Davis et al (1969), the consensus in the literature is that limnic sediment preserves a pollen record which is representative of the pollen input to the whole site. A slight and apparently random tendency for individual taxa to over- or under-represent in certain places for a variety of reasons is shown; this has not, however, undermined confidence in the intra-site representativity of pollen curves.

Bonny (1976, 1978) examined the processes by which pollen was recruited to the sediments of several Lake District Lakes. Local pollen deposition from the lakeshore vegetation was found to decrease with distance away from the source. In the littoral region of Blelham Tarn, processes of resuspension and redistribution of sediment were not apparently sufficient to smooth variations in pollen percentages caused by strong localised pollen emitters. However, the pollen percentage composition and pollen concentration were found to be uniform within the 8m depth contour. This recalls the conclusions of R.B. Davis et al (1969). Bonny (1976) suggested that account should be taken of the proportions of shallow water littoral sediment present in a lake basin, since these areas are a strong source of pollen derived from resuspension. Within the Baschurch group of meres, Marton Pool and Fenemere are, today, shallower and less steeply shelving at their margins, in comparison to Berth Pool and Birchgrove Pool.

The intra-site variation in pollen frequencies at peat bogs was examined by Turner (1964b, 1970, 1975). This work is also considered in section 1.3.6. The pollen spectra from multiple profiles from a large raised bog were examined by Barber (1981) and a high degree of correspondence was observed between the profiles. There is, however, an apparent need for the degree of pollen frequency variation across peat surfaces to be examined in more detail, particularly with reference to cores taken in very close proximity to the edges of peat mosses (cf. Edwards 1982, 1983). In this study, two cores have been taken for analysis from the deep-water zone of Berth Pool (2.2.1) and two cores taken from Boreatton Moss, one at the centre of the moss and one 22m from the edge.

1.3.5 Inter-site variability

Whilst some work on inter-site variability has revolved around parallel studies of intra-site variability (R.B. Davis et al 1969), other researchers have tended to accept single core representativity and use it as the basis for comparative inter-site studies. Pennington (1973) considered absolute and relative pollen frequencies from lakes of different morphometry. Pollen deposition rate since the Elm-decline, 5000 B.P, was found to decrease with increasing size of lake (Pennington 1973). Variation in pollen trapping efficiency between lakes was suggested (Pennington 1973).

Pennington (1970) compared a pollen diagram from Burnmoor Tarn in the S.W. Fells of the Cumbrian Lake District with pollen diagrams from two other lakes in the same area, Devoke Water and Seathwaite Tarn. Interestingly, for this study, a very similar horizon is correlated from site to site at which Oak declines and herbs and grasses expand. This is dated to 1080 ± 40 b.c. at Seathwaite Tarn. This date identifies the episode as a Bronze-Age vegetation clearance. The correlation of diagrams also enables Pennington (1970) to show that the Betula revertence, an expansion of Birch pollen, was non-synchronous and therefore not a stratigraphic marker for the onset of the sub-atlantic period. A more detailed inter-site pollen diagram comparison by Pennington (1979) considered the effect of the presence or absence of an inflowing stream on the pollen spectra of a lake. Peck (1973) had observed high pollen proportions of certain taxa, eg, Ericaceae, in inflowing streams. Tauber (1977) had suggested that in an open lake basin with inflows, up to 50% of the pollen reaching the sediment could have been waterborne. The study by Pennington (1979) therefore compared two lakes, one with an inflow, Blelham Tarn, and one without, Whinfell Tarn. Prior to substantial vegetation clearance, the open lake, Blelham Tarn received 50% of its pollen input from pollen rain transported from the catchment. After clearance this amount rose to 83%. The high proportion of catchment - derived pollen would therefore extend the regional pollen representation in comparison to a closed lake of the same size. The erosion of catchment soils would supply older pollen to a stream-load with contemporary pollen (West 1973). Tauber (1977) found that streamborne pollen at a closely monitored lake greatly distorted the relationship between pollen reaching the sediment and the vegetation in the immediate vicinity of the site. The implication of these comparative studies is that to avoid unwanted complication in respect of the likely regional pollen source area at a site, closed basins are preferable for study. This is particularly true if an attempt is made to examine the effects of site diameter and spatial heterogeneity in vegetation clearance at sites in close proximity. Sims (1973) produced pollen diagrams for two meres 10km apart in East Anglia, Hockham Mere and Seamere. Sims concentrated his interpretation on Hockham Mere, without attempting comprehensive inter-site comparisons. An interesting feature of the analysis by Sims (1973) was an attempt to suggest the population levels needed to cause the observed tree pollen reductions at a time of vegetation clearance. This was complicated by the fact that the location of the inferred clearance could not be precisely fixed. When it is not known where the clearance has occurred, it cannot be known whether it was a localised clearance by a few settlers, or a more distant and more extensive clearance by a larger group. Clearly the location of The Berth Hillfort at Berth Pool, and its established occupation during the Iron Age could be useful in making more precise assessments of human impact on the Baschurch area. The caution of Turner (1964a) should be recalled, however; it was suggested that a single coherent clearance interval at Whixall Moss could reflect, in fact, a composite of several separate clearances not recorded as such in the pollen profile. Vuorela (1977) examined pollen profiles contained in contrasting deposits in very close proximity. A Sphagnum bog and mineral soil profile were examined on an island in a large lake, and a lake sediment profile was also taken. The sites were 0.5 to 1km apart, equidistant from the location of cultivation on the island. At a time of increasing agricultural indicators in the pollen counts, the peat and soil profiles showed a decline in deciduous tree species, but the lake sediment diagram did not show this. However, the total present of agricultural indicators was practically the same in the lake and peat profiles. Vuorela (1977) recommends that non-arboreal pollen groups should be considered as percentages of the total non-arboreal types at sites of contrasting sediment matrix.

On a wider scale, Turner and Hodgson (1979) considered the variation in pre-elm decline woodland composition in the Pennines. In this study, the potential influence of site size on pollen representation was held constant; variation in Flandrian forest composition was explained by reference to, in part, edaphic and altitudinal factors. Prentice (1978, 1983a) used surface mud samples from 40 moderately sized lakes in south and central Sweden to map variations in forest composition. The modern pollen spectra are used to sense gradients and patterns of regional vegetation (Prentice 1983a), in this way synoptic pollen maps are developed. Prentice (1983b) reports on the potential for the synoptic pollen mapping of simultaneous species migration and retreat, but at time intervals of 500-1000 years. At this level of temporal resolution, at a continental and sub-continental scale, there is a great potential for synoptic pollen mapping. Over a shorter time scale, and a smaller area, however, complex factors of basin size, localised pollen dispersal and representation, vegetation community pattern, edaphic contrasts and areal and locational changes in clearance activity must be considered.

Bradshaw and Webb (1985) compared pollen frequencies with tree inventory data using regression equations. A variety of basins were studied in Wisconsin and Michigan and a relationship was found between basin size and the pollen-tree relationship. Bradshaw and Webb stress the need to derive correction factors from basins where conditions match those at a site where fossil spectra are examined, reiterating the point that a concern for basin size is necessary when using regression parameters as correlation coefficients for fossil data. Bradshaw and Webb (1985) repeat the recommendations of Jacobson and Bradshaw (1981). Research on modern pollen dispersal, transfer and deposition has shown that sites vary in their ability to 'sense' vegetational patterns through their pollen spectra (Webb et al 1978).

Site selection should be matched carefully with the analyst's requirement for spatial precision (Bradshaw and Webb 1985)

Limnic sediment has therefore been shown, at a wide variety of spatial scales and geographical locations, to preserve a palynological record which is representative of the total pollen input to the site and which is amenable to inter-site correlation and comparison in a way which allows both site factors (Pennington 1973, 1979; Bradshaw and Webb 1985) and vegetational contrasts (Prentice 1978, 1983a) to be identified. A study with similarities to that carried out by Vuorela (1977) was presented by Donner et al (1978). A raised bog profile from Varrasuo, Finland, has been compared with a profile from the adjacent Lake Työtjärvi. The profiles were both radiocarbon dated. Greater arboreal pollen fluctuations were observed in the peat profile, possibly due to the effects of trees growing on the bog surface.

Fluctuations in the growth rates of peat will cause significant changes in pollen concentration which are not a result of vegetation change (Rowell and Turner 1985). Edwards (1983) used pollen 'difference diagrams' to compare variations in pollen frequency between contemporaneous levels in a lake sediment core from Loch Davan, Aberdeenshire, and a peat moss 250m from the loch. Pinus and Quercus frequencies were comparatively higher at the moss. This was taken to indicate the local dominance of pine and oak at the southern end of the loch. Clearly, examination of just one site would not have permitted detailed inferences about the spatial heterogeneity of the vegetation pattern to be made. Turner and Hodgson (1981) observed significant variations in the pollen spectra from sites a few km apart in the northern Pennines.

Multiple site studies also enabled Turner and Hodgson (1979, 1983) to examine spatial variations in the composition of Flandrian woodlands. Bennett (1986) examined the pollen spectra from two sites c. 3km apart in East Anglia and concluded, on the basis of several observed contrasts between the pollen spectra, that the pollen source areas of sites could be more restricted than theoretical models would suggest. The Baschurch Pools vary in size and are in closer proximity to one another than the sites examined by Turner and Hodgson (1981) and Bennett (1986) and potentially, pollen frequency contrasts between the sites could allow the theoretical models of pollen source area versus basin size, produced by Jacobson and Bradshaw (1981) and Prentice (1985), to be critically examined. A degree of inter-site variation in the timing of interference and regeneration phases in the vegetation was observed by Edwards (1979, 260) at two Scottish Lochs, c. 3km apart. This finding, in association with those of Turner and Hodgson (1981) and Bennett (1986) shows the clear potential for relatively localised variations in vegetation pattern, and calls into question the extent to which any one site is adequately representative of the vegetation of even a relatively small area. A series of pollen sites on the Isle of Mull, Scotland have been examined by Walker and Lowe (1985) and Lowe and Walker (1986). Variations in the pollen frequencies of three relatively small sites, c. 1.25ha or less in extent, suggested that local pollen inputs were important at the smaller two sites (Lowe and Walker 1986, 431). Pollen frequency contrasts between six sites on Mull showed that species abundance amongst woodland taxa varied across the island during the Flandrian period. For example, juniper could be shown to have avoided the more exposed localities (Lowe and Walker 1986). Multiple-profile studies permit detailed inferences to be made in respect of vegetation patterns. There is a perceived need for more multiple-profile studies to be carried out for the specified purpose of examining pollen profile replicability (Edwards 1983), although, to date, several studies which were not initially designed to look specifically at the question of profile replicability have shown that, in general, similarities can be expected (Edwards 1983, 592). This study was intended, at the outset, to provide palaeoecological data which would allow inter-site variability and profile replicability to be critically examined.

1.3.6 Sampling transects

Turner (1964b, 1965, 1970, 1975) made a pioneering attempt to exploit intra-site pollen frequency variation at a peat moss. In a study from Bloak Moss, Ayrshire, Turner attempted to identify the location of vegetation clearance at the site margin by the use of '3- dimensional pollen diagrams' (Turner 1970, 1975). To the aspects of age and pollen frequency a third was added; area. A transect was taken across the moss, peat corings were made at intervals on this transect, and the pollen frequencies at matched depths from each core were compared to observe any changes in pollen frequency which could be due to a distance-decay effect away from the bog margin. Turner hypothesised that if a discrete clearance occurred in the vegetation at one side of the moss, the characteristic pollen assemblage from this clearance would decline in its representation away from the source, the static moss surface having preserved this pattern in a way one would not expect at a lake-site (Davis 1968). Variations in pollen frequency were encountered across Bloak Moss (Turner 1970, 1975), however, Edwards (1983) suggests that Turner's nearest samples to the margin, were, at 100m from the woodland edge, too distant to record highly localised influences in the 20-50m range (cf Andersen 1973, 1974a, Jacobson & Bradshaw 1981, Prentice 1985). Edwards (1983) believes that Turner (1975) picked up a strong regional pollen input at the centre of Bloak Moss, following a basin size bias as defined by Jacobson & Bradshaw (1981) and Prentice (1985).

Tinsley and Smith (1974) carried out surface pollen counts across a woodland-heath transition. They found that Quercus pollen, as a % of total pollen, declined from over 40% at an oak woodland edge to ca 15% at 100m. Edwards (1982) suggests that, realistically, the Quercus representation levelled off to its lowest level within 30m of the woodland edge. The likelihood of this sort of variability being preserved depends largely on whether a lake or bog constitutes the receiving surface. Edwards (1982) notes that a woodland-girded bog margin could substantially filter pollen from relatively local clearances, for this reason, not only woodland edge recession should be considered when defining pollen inputs, but also the likelihood of a dense thicket of carr woodland remaining at a site margin. Further to this point, Caseldine (1981) in a study of a transect across Bankhead Moss, Fife, found that woodlands were very efficient barriers to non-arboreal pollen and drew attention to the possibility that early clearances left low-lying damp woodland around lakes or bogs untouched. This could tend to mar the registration of interference activity in quite close proximity to a site. Caseldine (1981) observed that the pollen of Plantago species and Rumex species was very easily dispersed. These plants, Plantains, Docks and Sorrel, are often used as indicators of clearance activity (Behre 1981, Maguire 1983). Edwards (1979) noted that Plantago should not be used in an unqualified way to infer pastoralism, since it is a heavy pollen producer with good dispersion. The findings of Caseldine

(1981) appear to support this caution. Caseldine also observed in the same study that up to 55% of Gramineae pollen could be transported above the woodland canopy.

Caseldine (1981) is not in complete agreement with Tinsley & Smith (1974) on the value of Plantago peaks in the inference of interference activity and is more cautious about the value of Plantago, believing that more pollen could be transported above the canopy than Tauber (1965) predicted. If anything, this suspicion regarding trunk-space transport (cf. Faegri & Iversen 1975) should lead to a wider potential pollen source area being considered, particularly if a strong extra-local pollen component is postulated at a site, with the trunk-space afforded high representation (Janssen 1966, 1973, Jacobsen & Bradshaw 1981, Prentice 1985). In the context of pollen diagram variability in the Baschurch meres, surface pollen studies have helped to elucidate processes of pollen dispersal, and to test the hypotheses of Tauber (1965), in this way these studies will be an invaluable aid in the interpretation of the data from the Baschurch area.

A certain level of spatial variability in pollen frequencies over peat surfaces has been shown (Turner 1975), although a high degree of agreement was observed between pollen diagrams from several locations across Bolton Fell Moss, Cumbria (Barber 1981). Price and Moore (1984) however observed dissimilarities between pollen diagrams from sites only a few tens of metres apart at a plateau site in South Wales and thus the possibility that sites in very close proximity to each other could have different pollen source areas is one that must always be considered.

1.3.7 Summary

Oldfield (1970) makes the point that however refined modern pollen rain studies become, they only serve a real purpose when they assist in the accurate interpretation of fossil spectra.

The influence of basin size upon pollen source area is relatively well understood (Tauber 1965, 1977; Berglund 1973; Jacobsen and Bradshaw 1981; Prentice 1985; Bradshaw and Webb 1985), there is still, however, an apparent uncertainty surrounding the extent of an extralocal pollen source area at a given site (Prentice 1985 cf.

Jacobsen and Bradshaw 1981). This uncertainty is important where relatively small sites are concerned, particularly if it is of interest to know if a given archaeological site does or does not lie within the dominant pollen source area of a site. A pollen analyst can refer to the findings of modern pollen rain studies when interpreting fossil spectra; there is, however, an apparent need for the collection of more fossil spectra where the specific, stated purpose is to contrast these spectra as part of an assessment of pollen profile replicability, representativity and pollen source area (Edwards 1983). Prentice (1985) refers to extralocal pollen as being derived from the vegetation up to 2km away from the margin of a site, whereas Jacobsen and Bradshaw (1981) define extralocal pollen as that derived from up to several hundred metres from the edge of a basin. There is reasonable agreement about the extent of the local pollen source area at a small site. At a few, to ca.20m in diameter, local pollen will be derived from ca.20m to 30m from the basin edge (Jacobson and Bradshaw 1981, 82; Prentice 1985, 81). Once a basin exceeds 20-30m in diameter, however, pollen source areas beyond this local range will become important, the question is: for sites in the size range where more than local but less than regional pollen source areas are dominant, what is the precise extent of these areas for basins which vary in size between c. 30m and c. 300m in diameter? This is an important question for the environmental archaeologist, particularly where pollen spectra are to be related to human activity. For example, Birchgrove Pool (Plate 2) should, theoretically, have a pollen source area which is more than local. However, is it realistic to think of The Berth, a small Iron Age hillfort 500m away from Birchgrove Pool (Plate 2, Figure 3) as being within or outside the dominant pollen source area of Birchgrove Pool? The results of many studies of the contemporary pollen spectra at a variety of sites (Tauber 1977, Berglund 1973, Andersen 1973, Bonny and Allen 1984, Bradshaw and Webb 1985, Caseldine 1981, Cundill 1986, Randall et al 1986) suggest that at least to a certain extent more local and more distant pollen sources can be identified, although this is not always the case (cf. Oldfield 1970, Bennett 1984). For these studies to be of value in the interpretation of fossil spectra, it must be possible to show, by the detailed inter-site comparisons of fossil spectra, that the representation of pollen types taken to have a more local origin should be consistently better at small sites and pollen taken to be more distant in origin should consistently occur at higher frequencies at larger sites.

CHAPTER TWO

THE STUDY AREA

2.1 General background

2.1.1 Geographical background

Shropshire, at 1346 square miles is the largest land-locked County in Great Britain. It is bordered by the English Counties of Cheshire, Staffordshire, West Midlands and Herefordshire, and by the Welsh Counties of Clwyd and Powys. The County includes several natural regions: The North-West Uplands, The Northern Plain, The Coalfield, the Eastern Sandstone Plain, Southern Hills and Clun Forest (Rowley 1972). The County also includes extensive tracts of the Welsh Marches, the natural border area between the English Midlands and the flanks of the Welsh Hills. The presence of the 8th Century Offa's Dyke running parallel to the Shropshire border in the West attests to the importance of the County's geographical position in an area of long-standing political and cultural interaction and stress between England and Wales (Rowley 1972). The region of the County of interest in this study is the Northern Plain, lying between the River Severn and the border with Cheshire (Figure 1). This Plain is, in reality, the southern extension of the much larger Shropshire-Cheshire lowland Plain. This Plain, lying predominantly below 100m O.D. extends from the River Severn in the Shrewsbury area, north to the natural border at the Mersey Basin in the Manchester area. The Plain is enclosed to the east by the Pennines and to the west by the Welsh Marches and the flanks of the Welsh Hills. The Plain therefore forms a very well defined lowland land unit some 1300 square miles in extent. It has a relatively uniform solid geology with a diverse Pleistocene drift mantle. The locality under examination here lies in the southern part of the Plain in the vicinity of Baschurch, 10km north west of Shrewsbury (Figure 1). Six basins in the glacial drift deposits of the area have been selected for the recovery of peat and sediment cores for the purpose of making inter- and intra-site correlations and comparisons of the palaeoenvironmental record preserved in their accumulated deposits, details of these sites are given in 2.2.

2.1.2 Solid geology

The Shropshire-Cheshire lowland consists of a well defined depression of carboniferous rocks which enclose a broad basin of younger Triassic rocks. The carboniferous strata outcrop all round the periphery of the Lowland basin (Reynolds 1979). Toghill and Chell (1984) and Cannell and Harries (1981) discuss the most recent classification of the Trias:

New terminology		Former terminology:
Bridgnorth Sandstone	Oldest	Lower Mottled Sandstone
Kidderminster conglomerate	Sherwood Sandstone Group	Bunter Pebble Beds
Wildmoor Sandstone		Upper Mottled Sandstone
Bromsgrove Sandstone		Ruyton and Grinshill Sandstones
Mercia Mudstone Group	Youngest	Keuper Marl and Keuper Waterstone

Sandstones of the Sherwood Group were deposited by river systems emerging from local upland. The rocks of the Mercia Mudstone Group are the result of a Marine transgression. During the Trias the depth of rock accumulated in the area varied from 600 to 2000 metres (Toghill and Chell 1984). Post-Triassic and post-Jurassic faulting occurred; the Wem fault is post-Jurassic and crosses the basin from south-west to north-east (Toghill and Chell 1984). These Triassic strata today underlie the mantle of Pleistocene drift with its till deposits and fluvioglacial sand and gravel ridges (1.2.2). The underlying strata in the study area are shown in figure 7. The geological formations have a direct bearing upon many of the soil series of the area (Crompton and Osmond 1954). Triassic material is also well represented in many of the glacial deposits of the area. The Baschurch series brown earths, which can have a righ proportion of Triassic sandstone in their parent material, constitute some of the best arable soils in Shropshire (2.1.5). They are well drained and easily cultivated and with their light texture would have been favoured by prehistoric farmers (Limbrey 1987).

2.1.3 Drift. (Figure 6)

The solid geology of the area is overlain by a mantle of Pleistocene glacial drift, up to 100m thick in places (Johnson 1971). Extensive tracts of sand and gravel deposits are also present, having been deposited by fluvioglacial processes (Shaw 1972). The source areas for this drift were the north west and the Welsh Mountains. The north-west ice brought granites, flints and marine shells from Scotland, the Lake District and the Irish Sea Basin (Shaw 1972). Triassic material from the Shropshire-Cheshire basin is incorporated into this drift (Shaw 1972). The other source area, the Welsh mountains, brought both erratics and a matrix derived from Palaeozoic formations, although in some cases Triassic detritus dominates the Welsh ice matrix (Shaw 1972). The maximum extent of the main Irish Sea glaciation was marked by an ice-limit through Church Stretton and Wolverhampton (Shaw 1972). West of Shrewsbury, Welsh ice deposits overlie the deposits of the main Irish Sea glaciation; this is the result of an event termed the 'Little Welsh Advance' (Wills 1950).

Reynolds (1979) and Worsley (1970), show the postulated limits of the most important advances in the area. The area of confluence and osscilation of the two ice masses (Crompton and Osmond 1954) was a zone stretching south-east from Ellesmere via Cockshutt to Shrewsbury (Reynolds 1979, Shaw 1972, Worsley 1979): A complex glacial disintegration topography has been developed in this area of ice-mass confluence. The area is now characterised by a belt of distinctly hummocky country with meres and peat mosses in glacial kettle holes.

The drift is generally divisible into heavier clay-rich till with coarser stonier belts of fluvioglacial sand and gravel often forming distinct ridges in the topography. This characteristic topography of the Shropshire-Cheshire Plain has had important effects upon, for example, soil development and past and present land use. The brown earth and brown sand soils, including those which have developed on fluvioglacial sand and gravel ridges, were the most favoured sites for early settlement and agriculture in Shropshire (Rowley 1972, Sinker et al 1985). Reynolds (1979) considers several theories regarding the origins of the meres and mosses of the Shropshire-Cheshire Plain. Hollows in the drift surface of the Shropshire-Cheshire Plain contain more than 60 open water meres and more than 200 peat filled mosses (Reynolds 1979). These basins are grouped, rather than randomly distributed. Although c.70% of the Plain is covered with till, 66.4% of the north Cheshire basins occur within glacial sand and gravel belts (Tallis 1973). A similar percentage of 48 sites examined by Reynolds (1979) occur next to sand and gravel deposits. Most of the mere and moss basins are thought to be either kettle-holes or moraine dammed hollows. Reynolds (1979) notes that almost all the mere and moss basins lie within the limits of the most recent ice-fronts (cf Worsley 1970). The Crose Mere complex of sites, including Crose Mere itself, Whattal Moss and Sweat Mere, south-east of Ellesmere, and also the Baschurch group of pools all lie, approximately, at the maximum extent of the Little Welsh Advance (Shaw 1972); the sand and gravel deposits left behind by the melting ice masses in the country around Baschurch and Wem have been examined in detail by Cannell and Harries (1981). In some localities, the melting of the ice led to the inundation of intermediate hollows by meltwater streams, as these hollows are backfilled with outwash sands and gravels they became 'isolated as shallow basins, perhaps including kettle holes' (Reynolds 1979, 107); glacial sand and gravel ridges occur in close proximity to the Baschurch Pools and to Boreatton Moss and New Pool (Figure 6). Cannell and Harries (1981,6) note that peat flats occur at former lateglacial lake sites and regard the Baschurch Pools as remnants of a larger lake.

2.1.4 Climate

The Plain of north Shropshire is one of the drier areas of the British Isles (Reynolds 1979, Crompton and Osmond 1954). The reason for this is its position in the rain shadow of the Welsh Mountains. Reynolds (1979) compares climatic data from Ringway, near Manchester, to Shawbury near Shrewsbury.

	Ringway (Manchester)	Shawbury (Shrewsbury)
Mean annual precipitation	802.0mm (31.6 ins)	672.9mm (26.5 ins)
Average annual wet days	193	177
Average annual days with ground frost	88	110
Average annual sunshire hours	1201.5	1378.4

Source: Reynolds (1979, 104)

The figures indicate a weaker oceanic influence, moving south to Shawbury and into the rain shadow. The Soil Survey Memoir for the Wem District of Shropshire, north of Shrewsbury (Crompton and Osmond, 1954) compared rainfall changes north and west of Shrewsbury.

	Altitude	Av. annual ppt
Whitchurch (North)	82.6m	687.8mm
Oswestry (West)	212.7m	857.6mm
cf Shrewsbury	58.2m	566.6mm

The rainfall figure for Shrewsbury is notably lower in Crompton and Osmond's (1954) data. This could reflect the fact that their figures were based on means covering a run of drier years in the earlier part of the century. Their figures indicate, respectively, the increases in the effects of departure from the rainshadow, and increasing altitude. Given its north-westerly position, Shrewsbury, and its immediate environs, experiences a drier and more variable climate than would be expected if oceanic influences were completely reponsible.

2.1.5 Soils. (Figure 5)

The region of the Shropshire-Cheshire Plain under study, its southernmost extent in the Shrewsbury area, supports a variety of soil series. The major soil groups are examined by Burnham and Mackney (1964), Crompton and Osmond (1954), and, for the Midlands as a whole, Mackney and Burnham (1964). The demarcation of soil types in this area is very closely related to the boundaries of the various glacial drift types (2.1.3). Relevant details of the soil types in the study area will now be examined.

Gley soils

The presence of a water table dominates these soils, impeded drainage leading to strong gleying conditions. Till with a heavy texture has given rise to an extensive area of heavy gley soils, the Crewe series, to the north west of Shrewsbury (Crompton and Osmond 1954). These are closely allied to, and associated with, gley soils of the Cegin and Salop series, typified by their poor natural drainage. These three gley soil types are of immediate interest to this study since they occupy extensive tracts in the Baschurch-Myddle area where the study sites are located. The peat-filled basin in which the four Baschurch Pools are located is bordered on the west by gley soils. Their poor drainage is exemplified by the Crewe series which is characterised by the tendancy for water to lie on the surface following heavy rains (Crompton and Osmond 1954). There is a certain amount of variation in the structure of these soils, but they are mostly clay loams and tend to favour grassland, although with artificial drainage in favoured localities, arable farming can be carried out (Crompton and Osmond 1954).

Organic soils

The Baschurch meres themselves are located within a basin in glacial sands and gravels. This basin now contains a highly organic soil. Crompton and Osmond (1954) consider that these organic soils originated on sites occupied by rivers or swamps subject to regular flooding. A distinction should preferably be drawn between organic soils formed in flat areas of river valleys, and those formed under fen or carr in enclosed basins, as at the Berth (SJ 430 235) (Burnham and Mackney 1964). In profile, organic soils are fairly uniform, usually with a pH of less than 6.0. A sample of organic soil at the margin of Marton Pool (SJ 449 234) had a pH of 5.9. A peaty loam at Ellerdine had a surface pH of 5.8 and was underlain by a deposit of white sand. A yellow sand deposit was found 40cm deep under the organic soil in between Marton Pool and Fenemere (SJ 445 229). At the base of these organic soils, or peats, lake-bottom deposits are found (Crompton and Osmond 1954). Tracts of shallow water remaining in the Shropshire-Cheshire basin immediately after the ice melted at the end of the Devensian would be extremely favourable sites for colonisation by fen and swampy carr. Extensive drainage of these soils has continued for centuries (Hey 1974) but today they are still only used for pasture and not arable farming.

Brown earths

In contrast to the first two soil types considered, the soils of this type have very free natural drainage down to at least 60cm (Crompton and Osmond 1954). Generally there is very little translocation of silica or sesquioxides in the profile. In the Baschurch-Myddle area, two types of brown earth are found, the Newport and Baschurch series. The parent material of these soils is glacial sand and gravel as opposed to till. They consist of loamy sands, with varying proportions, and are typically stony. Today, Baschurch series loamy sands form some of the best arable soils in the area. The light texture

Fig 5 Soils

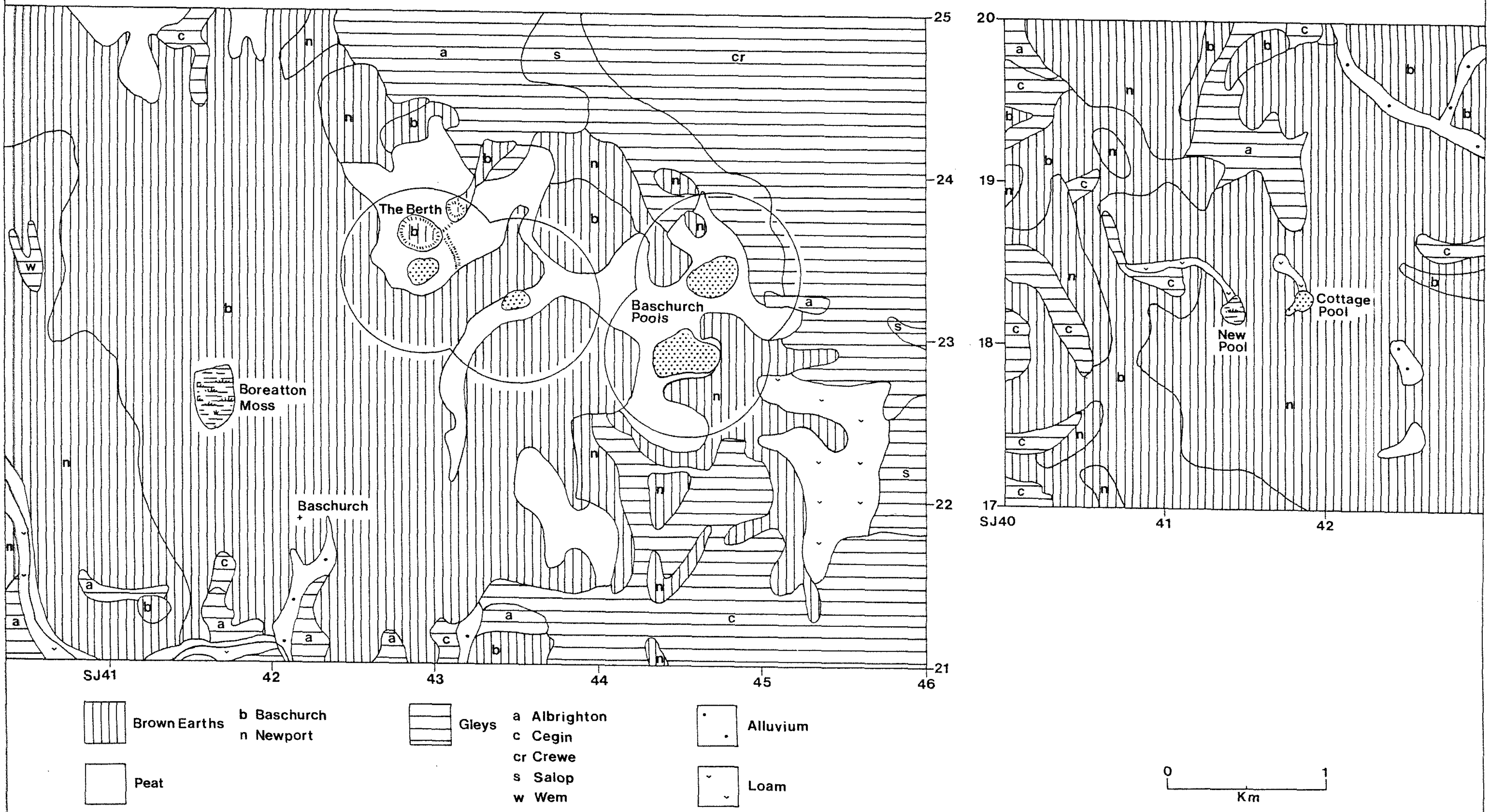

The Berth
Baschurch Pools
Boreatton Moss
Baschurch
New Pool
Cottage Pool
SJ41
42
43
44
45
46
25
24
23
22
21
SJ40
41
42
20
19
18
17
Brown Earths
b Baschurch
n Newport
Gleys
a Albrighton
c Cegin
cr Crewe
s Salop
w Wem
Alluvium
Peat
Loam
0
1
Km

Fig 6 Glacial Drift

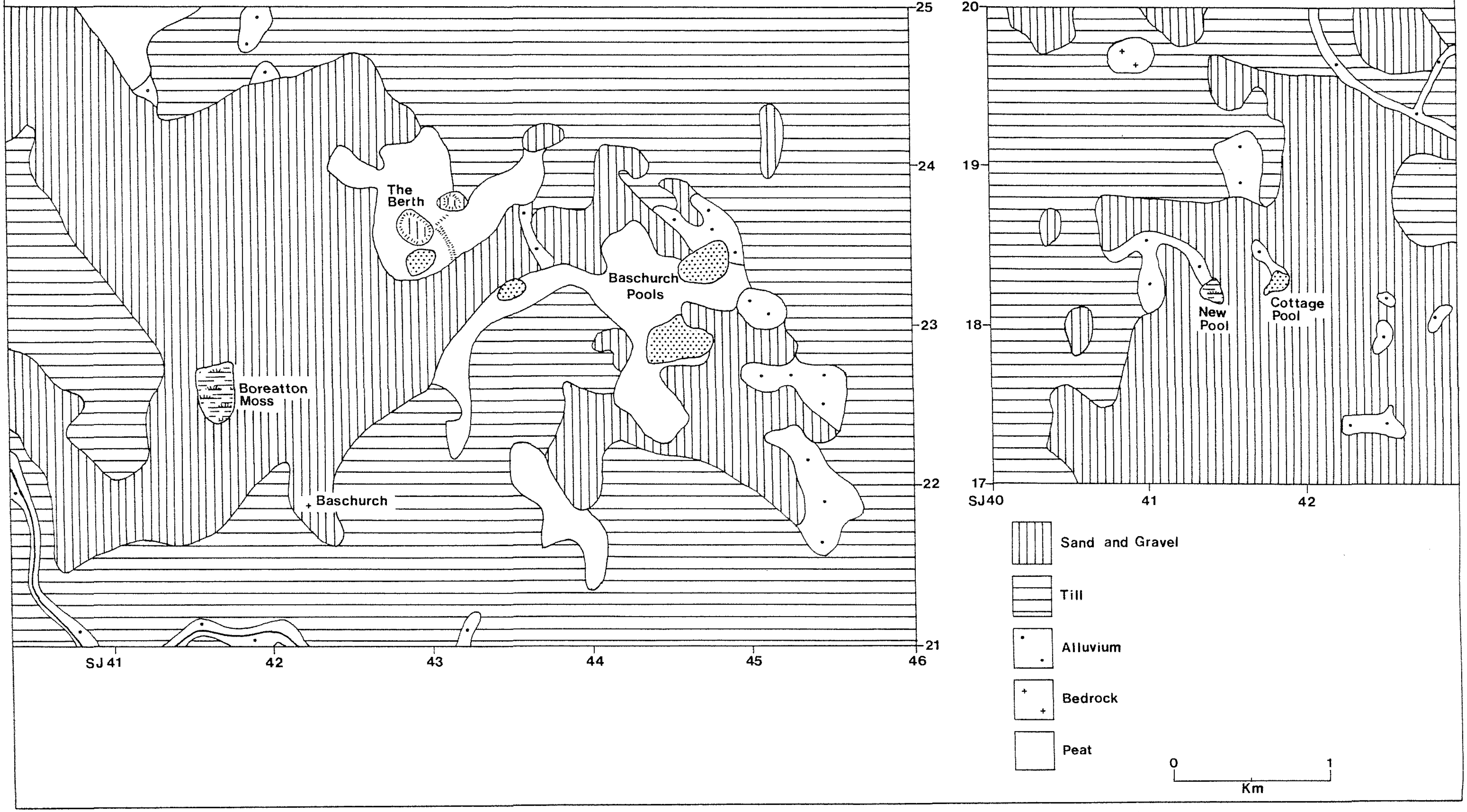
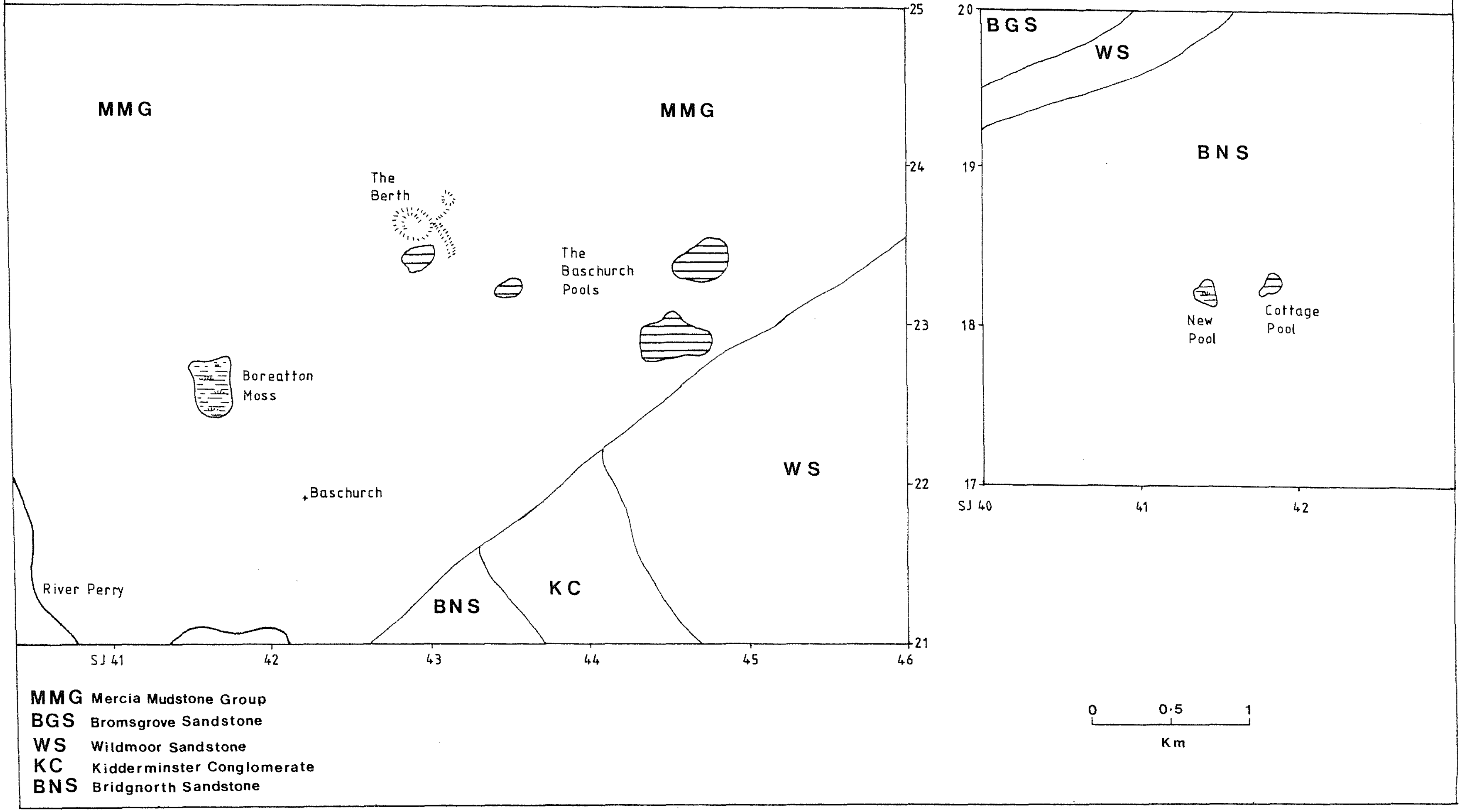


Fig7 Solid Geology



and free drainage provide for easy cultivation at all seasons, and tends to produce early growth (Crompton and Osmond 1954). Compared to the heavy ill-drained gley soils and the marshy low-lying mosslands, the brown earths represent the most readily exploitable soils of the area. They need minimal preparation by drainage and as such would have been eminently attractive particularly to prehistoric farmers. Baschurch series brown earths exist in very close proximity to the Baschurch meres, they constitute the dominant soil type immediately to the south-west of the meres, existing on distinct ridges enclosing the low-lying organic soils. It is highly likely that, if prehistoric clearance and farming occured in the Baschurch area, these brown earths would be preferred, for their favourable characteristics, and their very close promimity to the study sites is therefore important.

2.1.6 Archaeological background

Early evidence of man's presence in the study area comes from the crest of the Long Mynd in south-central Shropshire (Figure 1). There is evidence that an ancient track, the Portway, was used from the Neolithic period onward, still recognised as a King's highway in the Middle-Ages (Rowley 1972). Hill-crest or interfluve tracks were thought to be important in the Bronze-Age (Chitty 1963, Rowley 1972).

The hillforts of the later Bronze Age and Iron Age provide the most dramatic traces of prehistoric settlement in Shropshire. Stanford (1972a) mapped the location of 54 Iron Age hillforts in the central Welsh Marches and attempted to show how each fort could be allocated a territory which was in porportion to the size of the enclosed area at each site. Stanford (1972a) also attempted to estimate the population of the area on the basis of the number of dwellings likely to be located within each fortified enclosure. This approach has been strongly criticised. Fowler (1983) believes that the assumption that the entire population lived only in the hillforts is unacceptable. Taylor (1984) sees hillforts as a very variable settlement type, not lending themselves to simplistic hypotheses of distribution patterns. If the population of the central Marches was at least as high, if not higher during the iron age, as Stanford suggests, then the area supported a similar population density in the 5th century b.c. as it did at the time of the Domesday returns. Fowler (1983) is still prepared to accept that Stanford's estimates could be of the right order of magnitude, and proceeds to question the assumption that the later prehistoric population of the country was necessarily less than the 11th century ad Domesday estimate of ca. 1.5 million inhabitants.

Evidence from the Welsh Marches has helped to establish the case for a later Bronze Age origin for the hillfort building tradition (Megaw and Simpson 1979). A number of Bronze Age dates for artefacts and construction features have been obtained at the Breiddin hillfort (Musson 1976) which is within 25km of the Baschurch area. A late Bronze Age socketed axe was excavated with part of a willow shaft still in place. This wood yielded a date of 754±50 bc. An occupation soil associated with pottery sherds gave a date of 868±64 bc. Charcoal samples from the base of post-holes in the earliest ramparts gave two dates: 828±64 bc and 800±41 bc. Musson (1976) suggests that the whole of the 30 hectare hilltop at the Breiddin could have been enclosed at this early stage. Rectangular 'floor areas' at the Breiddin have been dated to 1550±100 bc. This date could represent evidence for early Bronze Age occupation in the Shropshire and Welsh Marches area in the second quarter of the second Millennium bc. A very similar date has been obtained by Stanford (1982) from a prehistoric cemetery at Bromfield, near Ludlow in southern Shropshire (Figure 1). Charcoal associated with early pottery in a grave pit was dated to 1556±178 bc. Additional dates on charcoal from the Bromfield cemetery are 850±71 bc and 762±75 bc. Stanford (1982) asserts that the central Marches were not a cultural backwater. Stanford stresses the stability and continuity of the society associated with the Bromfield cemetery, a society which remained stable for over a millennium. The early Bronze Age dates at the Breiddin and Bromfield show that, potentially, interference in the vegetation associated with human occupation could be expected in the area during the first half of the second millennium bc. Palstaves (Bronze Age axes) were found at Whixall Moss and Wolverley, near Wem (Chitty 1933, 1968). The Whixall Moss palstave was dated, on typological grounds to the middle Bronze Age (Hardy 1939). The palstave was lying on the roots of a pine stump in the pine stump layer at Whixall; the date of the palstave, on archaeological grounds, is ca. 1000 bc. On this basis, Hardy (1939) suggested that the pine stump layer should be dated to ca. 1000 bc. At Whittall Moss, c. 7km south of Whixall, a dugout canoe was found in the peat. Hardy believed the canoe was of more recent age than the palstave from Whixall, although it could still have a late Bronze Age date since Hardy felt its stratigraphical position was possibly below a recurrence surface corresponding to RY III.

The profusion of Iron Age hillforts in the central Marches has already been noted. Iron Age occupation levels were excavated at the Breiddin (Musson 1976), radiocarbon dates were obtained for a burned roundhouse: 479±55 bc, and also from a four-posted building in the hillfort interior which was dated to 238±70 bc. This dating sequence went against the initial chronological interpretation of the excavators. Additional dates were obtained for the roundhouse site: 460±100 bc, 375±63 bc and 320±80 bc. Additional dates from the four-posted buildings confirmed the original chronology suggested by the first radiocarbon dates: 294±40 bc, 240±80 bc and 238±70 bc. Many hillforts belonging to the Welch Marches hillfort culture have been excavated (Stanford 1972a, 1972b).

Classification of the material remains (Peacock 1968) has shown that the stone tempering in much of the pottery from the hillforts originated in the Malvern Hills. Malvernian pottery fabric group A, probably distributed from ca 170 bc onwards (Stanford 1972b), makes up 44.6% by weight of the total Iron Age pottery recovered from the Berth (Morris 1980). Also recovered at the Berth was a ceramic type designated Group D (Morris 1980). This type had a mudstone fabric, probably with a Worcestershire source and also belongs to the Malvernian tradition. Another distinctive pottery type recovered at the Berth was the Very Coarse Pottery or V.C.P. which Gelling and Stanford (1965) considered to represent fragments of Iron Age ovens. Morris (1980) prefers to explain the Cheshire Stony-tempered V.C.P. found at the Berth as being fragments of salt drying containers although Gelling and Stanford (1965) firmly rules out this explanation on the grounds that the internal surface of the material was too rough and would therefore have led to excessive waste if used as a salt container.

The Berth clearly represents the best surviving evidence for Iron Age occupation in the vicinity of the Baschurch Pools (Plate 6). Two possible Iron Age or Romano-British enclosures have been identified on the drier brown earths ca. 500 metres south of Birchgrove Pool and Fenemere (Sites and Monuments Records, C.R.O., Shrewsbury).

Since the precise antiquity of these enclosures is unknown, they cannot of course be directly related to any phase in the pollen spectra from the Baschurch Pools. Further, specific references to archaeological evidence are made as the phases of vegetational change are discussed (Chapters 3 to 6).

2.1.7 Regional palaeoenvironmental context

Questions about pollen profile representativity apply to any site, at any time (Faegri 1966). In this study, the decision was made to examine pollen profile representativity during a period of cultural and economic change, when an increasing level of anthropogenic activity affected the vegetation. Data from closely spaced sites, obtained from such a period would have relevance not only to basic questions of profile representativity and replicability, but also to the true representativity of pollen profiles in the inference of anthropogenic effects.

Previously published palaeoenvironmental evidence from the region of the Shropshire-Cheshire Plain has shown that significant vegetational changes occurred during the Bronze Age/Iron Age transition (cf Harding 1976, Megaw & Simpson 1979). The vegetation changes are characterised in the most general terms by significant reductions in woodland cover, an expansion and diversification of open habitat communities, and finally a degree of woodland regeneration.

Hardy (1939) presented pollen diagrams from Whattal Moss (SJ 433 310), Whixall Moss (SJ 4936) and Bettisfield (SJ 475 335). Whattal Moss lies 7km north of Baschurch and is part of the Crose Mere complex of sites which also includes Sweat Mere (Sinker 1962).

Phases of vegetational change inferred from the diagrams by Hardy were ascribed to the zonation scheme developed by Godwin (1940). Hardy, however, drew attention to the difficulty in matching clear recurrence surfaces in the peat at these sites to the classic sub-boreal - sub-atlantic recurrence surface RY III (Granlund 1932), also known as the Grenzhorizont (Weber 1900). Hardy (1939) suggests that climatically induced vegetation change can be seen in a tendency toward 'revertence'. This refers to a decline in Tilia frequencies, and in increase in Betula pollen frequencies. At the nearby Wem Moss (Slater 1972) the pollen spectra have many parallels to those produced by Hardy. At Wem Moss, a level at 190cm is marked by the end of a continuous Tilia pollen curve, increasing discontinuity in Ulmus representation and a decline in Quercus pollen frequencies. The clear implication in Hardy's use of the word revertence is that a climatic deterioration had occurred with cooler, wetter conditions favouring Birch rather than the thermophilous Lime. Turner (1962) pointed to an anthropogenic cause for the Tilia decline observed at many British sites, Turner (1964a) re-examined in greater detail pollen frequency changes at Whixall Moss at the Tilia decline horizon. Phases of vegetational change at Whixall were identified as indicating several different activities as human populations:-

i) Utilising forest products

ii) Controlling natural vegetation

iii) Destroying existing vegetation (Turner 1964a, 89).

The Tilia decline was dated to 3238±115 b.p. Following the Tilia decline, the pollen frequencies of Gramineae, Plantago and spore frequencies of Pteridium all increase whilst Betula and Fraxinus pollen frequencies decrease. There are vegetational similarities between these changes at Whixall and those above 190cm at Wem Moss (Slater 1972). A Tilia decline, and subsequent non-arboreal pollen increases, is identified at Crose Mere by Beales (1980). Crose Mere is only 7km from Baschurch. A date of 3714±129 b.p. was obtained by Beales from levels in between a decline in Tilia pollen to <1%, and a subsequent decrease in Quercus pollen. Beales believes that the date of 3714±129 b.p. is possibly too old, given that the vegetational changes at these levels are very similar to the Whixall levels which were dated to 3238±115 b.p. Old carbon inwashing into the mere, as a direct result of forest clearance and soil disturbance, is suggested as a possible cause of reversal of the C14 date.

Vegetation clearances with parallels to those seen at Crose Mere and Whixall Moss are identified by Birks (1965a, 1965b) at Chat Moss, Holcroft Moss and Lindow Moss. The three latter sites are within 25km of each other at the northern-most extent of the Shropshire-Cheshire lowland (Figure 1). The arboreal pollen decreases, and non-arboreal increases observed at these three sites by Birks represent the first substantial interference in the post-Ulmus decline woodland; this is also the case with the two clearance levels reported above from Crose Mere and Whixall Moss. The clearances are believed to date from the Bronze Age (Birks 1963-4,1965).

An Iron Age forest regeneration phase is postulated by Birks, this phase has vegetational similarities with a regeneration phase inferred at Crose Mere and dated to 2310±85 bp (Beales 1980). Turner(1964a) also detects a forest regeneration at Whixall Moss which develops after the main phase of post-Tilia decline disturbances. Above the regeneration at Crose Mere, further clearance activity is indicated. Beales (1980) acknowledges the fact that the evidence for a woodland regeneration contrasts with evidence for a country-wide expansion of clearances in the Iron Age (Turner 1981). The Welsh Marches have a high concentration of fortified Iron Age sites (Stanford 1972a, 1972b). Beales suggests that the hillforts, many of which are on higher sandy ridges, only had a localised influence in the Shropshire lowlands. Beales asserts that the more towards a cooler, wetter climate after 2800 bp rendered soils in the vicinity of the meres progessively more difficult to cultivate; the regeneration phase at Crose Mere certainly suggests that cultivation receded back from the land around the mere.

A peat infill from the old river bed at Shrewsbury was examined by Pannett and Morey (1976) but unfortunately the pollen content was found to be depleted in horizons where woodland reductions were indicated (C. Morey,pers. comm.) and precise correlations with the diagrams of Beales (1980) and Turner (1964a) cannot be clearly discerned.

The evidence considered above suggests that substantial vegetational change, similar in character from a variety of sites, occurred at approximately the same time over the whole region although biostratigraphic correlation is not, by itself, evidence for synchroneity. Bronze Age clearance activity, earlier or later, was certainly the cause of the clearance activity so far considered. Bronze Age clearances have been identified at Upland sites in Wales, the Pennines and Cumbria, the highland areas which, to a certain extent enclose the Shropshire-Cheshire basin. Bronze Age vegetation changes at Cefn Gwernffrwd, an upland basin peat in Mid-Wales, have certain similarities with changes in the lowland. Cefn Gwernffrwd (Chambers 1982) exhibits a phase of Bronze Age clearance commencing at 3335±80 bp.

At this level, Gramineae, Plantago and Pteridium frequencies increase in the pollen spectra. This change could reflect the establishment of pastoralism and indeed a nearby prehistoric complex could have its origins in the Bronze Age (Chambers 1982). Cefn Gwernffrwd is only 15km south of Tregaron bog where Turner (1964a) recorded a small, temporary clearance dating to the later Bronze Age. This clearance had vegetational similarities with the post-Tilia decline clearance phase at Whixall Moss (Turner 1964a) although it occurred over a much shorter period whereas Turner believes that the Whixall phase represented a complex series of successive clearances occurring over a much longer period (Turner 1965). To the north of the study area, in the south-west Cumbrian Lake District, Pennington (1970) has identified a phase of Bronze Age land use beginning at 1090 bc (3040±140 bp, NPL - 124) at Seathwaite Tarn. This phase has vegetational similarities with the clearances reported from Tregaron bog by Turner (1964a) and is characterised in particular by decreasing Quercus pollen frequencies in parallel with increasing grass and herb pollen frequencies. East of the study area, in the central Pennines (Figure 1), Tinsley (1976) has identified Bronze Age interference phases in the vegetation, in which increasing weed pollen frequencies are associated with increases in Ericaceae (heather) pollen. A link between Bronze Age deforestation and blanket peat inception is suggested by Tinsley. Sustained increases in grass, plantain and other weeds are seen in the Iron Age in the central Pennines (Tinsley 1976). In the Rhinog Mountains, directly to the west of the study area (Figure 1) , in north Wales, vegetation clearances are again sustained from the Bronze Age into the Iron Age (Walker and Taylor 1976). The vegetation clearances dated to the Bronze Age in the Pennines and the Welsh Mountains, the upland areas which ultimately border the Shropshire-Cheshire Plain to the east and west respectively are similar in character, the evidence points to the maintenance and intensification of clearances throughout the Bronze Age and continuing into the Iron Age. There is no simple dividing line between the Bronze Age and the Iron Age in Britain (Cunliffe 1978). A pattern of continental contacts, leading eventually to a full Iron Age, is suggested for the early and mid first millennium bc by Megaw and Simpson (1979). The continuity of many clearances could reflect the gradual, phased establishment of the Iron Age economy in Britain; a clear change-over from Bronze Age to Iron Age is not seen, a fact exemplified by the proven establishment of the Iron Age tradition of hillfort building in the later Bronze Age (Megaw and Simpson 1979). An alternative view of clearance longevity is provided by Buckland and Edwards (1984); post occupation grazing by herbivores is suggested as a possible cause in the maintenance of open land, with such grazing continuing after the areas has been abandoned by human occupants. Historical and present day evidence is used to make the case. As far as the Shropshire-Cheshire plain is concerned, clearance eposides have been shown to last several centuries in the earlier and later Bronze Age and in the Iron Age and to be succeeded by a woodland regeneration phase which is indicative of land abandonment by man (Beales 1980).

There are indications of later Roman clearances in Shropshire (Beales 1980) although land use intensity appears to have been reduced in Anglo-Saxon times. In the later historic period Shropshire took on a mainly pastoral character (Rowley 1972) but today the brown earth soil belts in particular constitute fine arable land (Crompton and Osmond 1954).

The results presented in this study are correlated and compared to the results of previous palaeoenvironmental investigations in the region. In some cases it is suggested that the chronology of environmental change given by Beales (1980) should be revised.

2.2 The Study Sites: Description and Stratigraphy

In this section, the contemporary appearance and the stratigraphies of the study sites are discussed. The full stratigraphy has been examined at the two peat mosses but not at the four meres. At the start of the project, a 6.5m core was taken from Berth Pool (Berth I) a skeleton pollen diagram was constructed using this core and this showed that the series of pollen frequency changes sought at the start of the study (2.1.7) occurred in the upper 3m of the stratigraphy. It was therefore not deemed necessary to recover the full stratigraphy at the pools, although the upper 4.5m to 5.0m were recovered. Data from Berth I are not considered here.

2.2.1 The Baschurch Pools (Plates 1,2,5-8 and 11-13)

Field walking of the land surround these Pools (Figure 3, Plate 1) has established the existence of two breaks in slope at the boundary between the sand and gravel ridges and the peatlands around the pools themselves. Both slope breaks are particularly evident in the fields near Eyton Farm, SJ 442 228 (Plate 11). Elsewhere, only one break can be clearly seen, particularly where the sand and gravel ridges are relatively close to the pool margins, as at Berth Pool and Birchgrove Pool. These slope breaks could indicate former, higher lake levels. Pollen analysis of peat deposits in between Marton Pool and Fenemere (Figure 15) suggests that this peat began to accumulate from the early Boreal period (cf Godwin 1975), c.7000 bc. Below the peat in between Marton and Fenemere a light yellowish-brown calcareous mud occurs, overlying yellow sand. It is almost certain that during the late Devensian and early Holocene periods, a single sheet of water existed in the basin now occupied by Marton Pool, Fenemere and Birchgrove Pool (cf Cannell and Harries 1981, 6). A large area of open water can be similarly postulated in the peat basin which now surrounds Berth Pool (Figure 5). The upper peat filled basin, including Berth Pool, is now drained into the basin containing the three other pools, via a ditch cut through a dip in the sand and gravel ridge at SJ 437 235, near Martontan House. Mapping of the drift geology of the area (Figure 6) shows that this dip is filled with alluvial deposits (Figure 6). The ditch cut through this dip is only a narrow field drain fed by Berth Pool and the flat peat lands which surround it (Figure 5). It is unlikely

Plate 11. Slope Breaks near Eyton Farm

Plate 12. Marton Pool showing flooding of the pool margin

Plate 13.   The Berth Hillfort and Berth Pool, Oblique air photograph

Plate 14.   The Berth Hillfort showing the causeway to drier ground

that this ditch is responsible for depositing all the alluvium in this dip and it is possible that the dip represents the site of a former, if small, overflow channel which drained water into the lower basin, when lake levels were higher. During the time period of principal interest in this study, c.2000 bc to c.200 ad, it is thought, mainly on the basis of the apparent longevity of the peat deposits in the basins, that the four pools existed as separate entities. The three pools in the lower basin could have experienced some limited water surface coalescence, Fenemere and Marton in particular, but it is thought that local reports of severe flooding around Marton Pool and Fenemere probably reflect the influence of the many field drains which now rapidly conduct runoff into the pools. Berth Pool and its environs drain, via cut ditches, into the lower basin which is itself only drained through a narrow entrenched ditch cut through a low sand and gravel ridge at Mereside, SJ 447 223, the War Brook. After heavy rain the narrow War Brook is probably of insufficient capacity to drain away runoff rapidly enough to prevent some flooding of the peat basin. Local reports suggest that, after particularly heavy rain, when water levels in the pools are already high, the ditch draining Birchgrove Pool and, indirectly, Berth Pool can come to a standstill, or even flow back towards Birchgrove, pointing to the inefficiency of the War Brook in the drainage of the lower peat basin. Before ditches were cut to drain many of the meres and mosses (cf Rowley 1972, Hey 1974) the basins were fed and drained, at least in part, by water percolation through the surrounding drift deposits (Sinker 1962, Reynolds 1979), the catchment areas of the sites are thus difficult to define precisely.

Surface catchment areas have been estimated for the Baschurch Pools on the basis of the relief around the sites although Birchgrove, Marton and Fenemere could have some catchment areas in common. Also, it is not known to what extent the peat basin around Berth Pool drained into the lower basin in the absence of a cut ditch at SJ 437 235, the estimated catchment areas are shown in Figure 2. Realistic subdivision of the catchment for the lower basin is problematic, since part of the catchment includes level peat deposits. On the basis of Figure 2 the following ratios of catchment area (including lake area) to lake area can be calculated:

Berth Pool	151.7	:	Lake 2.9 ha,	Catchment 440 ha
Birchgrove Pool	47.0	:	Lake 1.7 ha,	Catchment 80 ha
Marton Pool	32.2	:	Lake 6.8 ha,	Catchment 220 ha
Fenemere	12.7	:	Lake 9.4 ha,	Catchment 120 ha

The above calculations assume that, under natural conditions, surface runoff from the Berth catchment collected in the peat lands around the pool itself, and obviously in the pool, although percolation into the Birchgrove/Fenemere/Marton basin is a possibility. Given the estimated extent of the Berth catchment, however, the indications are that ditch cutting could potentially double the surface catchment of the lower peat basin. Runoff times to the pools would be reduced and coalescence between Marton and Fenemere would tend to occur, particularly if the War Brook was not properly maintained.

Today, the brown earth soils on the sand and gravel ridges around the pools are used for arable farming, the peats have been drained sufficiently to permit the establishment of grazing land. The contemporary vegetation around the pools has been examined by the Nature Conservancy Council (N.C.C., Attingham Park, pers. comm.): All four sites are surrounded by at least a partial woodland fringe (Plate 1) consisting of Alnus glutionsa, Salix fragilis and Salix cinerea (S. cinerea not noted at Berth Pool), Fraxinus excelsior occurs occasionally around Birchgrove Pool. Emergent and fen vegetation is poorly developed at Berth Pool, where the site margins are disturbed by cattle trampling, limited, and discontinuous stands Phragmites australis and Typha angustifolia occur and P. australis occurs in the field layer of the fringing woodland. Birchgrove Pool is a relatively poor site in botanical terms, fen and emergent vegetation is limited although Cladium mariscus, the great fen sedge, occurs at Birchgrove but is generally rare in Shropshire (Sinker et al 1985). Marton Pool is mostly surrounded by a woodland fringe, with relatively extensive stands of emergent vegetation, particularly the common reed, Phragmites australis. Fenemere is also mainly surrounded by Alnus/Salix woodland/carr, extensive water-lily beds occur, with Nuphar lutea and Nymphaea alba, the mere is almost completely encircled by a belt of Phragmites australis, up to 20m wide, with Typha angustifolia also frequent. Fenemere is regarded as botanically important, particularly given the presence of species rich fen pasture. The distribution of plant macrofossils in relation to parent plants around Fenemere was examined by GreatRex (1983), detailed ecological information relating to wetland sites in Shropshire is given by Sinker (1962) and Sinker et al (1985). Other work on the meres and mires of the area is discussed in Oswald and Herbert (1965). Details of the individual pools, and the stratigraphy of the pollen cores are given in the next section.

Site size, morphology and stratigraphy

Berth Pool (Plates 1, 2, 6 and 13)

Grid ref:	SJ 430 234	
Area (ha):	2.9	
pH:	8.4	
Water depth at core sites:	Berth II	3.2m
	Berth III	3.2m
Max. depth recorded (Reynolds 1979)		3.8m

Berth Pool lies at a slightly higher elevation than the other pools. The difference in elevation however appears to be marginal (Figure3) Drainage ditches have been cut both into and out of Berth Pool. The date of the earliest ditch construction is not known although both inflows and outflows are shown linking all four Baschurch Pools on a 1794 Parish Map (Shropshire County Records Office, Hunt Collection, H/900, 17270). Additional ditches were cut around Berth Pool when the land was enclosed in 1821. Three deep water sediment cores were taken for analysis from Berth Pool, the first core was discarded after disturbance during storage was suspected (1.2.3.1), a second core was taken in the same locality as the first and subsequently a third taken to facilitate intra-site comparisons. Below 50cm, sediments were recovered using a Russian-type peat and sediment sampler (1.2.3.1), a mini-Mackereth corer (Mackereth 1969) was used to recover a short core spanning the mud-water interface in the coring locality of Berth I and Berth II (Figure 3). Seven pollen samples were counted from this short core and are incorporated in the main pollen diagram for Berth Pool, a depth overlap occured between the lowermost sediment of the Russian core, pollen frequency differences between 46-48cm (short core) and 56cm (Russian core) are very slight but a consideration of the most recent pollen frequency changes is not of central importance to this study (Chapter 7). Pollen from Berth III was counted after counting for Berth II had been completed and served to show that a crucial section of the sediment (140cm to 170cm in Berth II; 160cm to 190cm in Berth III) had been correctly sampled. Marked pollen frequency contrasts occur between Berth Pool and Birchgrove Pool in phase B11 (Chapter 6) and it was thought initially that this could have been due to sampling error when Berth II was taken. This is not now thought to be the case. No marked breaks in stratigraphy were noted in core section 150-200m in Berth III and the B11 inter-site contrast between Berth and the other sites is not therefore attributed to a hiatus in the sedimentary record. Berth Pool is, today, the second smallest and second deepest of the Baschurch Pools, the deepest water occurs towards the north east shores of the pool, although this was avoided when coring in case any sediment slumping had been associated with steep underwater sediment slopes.

Stratigraphy

Berth II — Coring position fixed by compass bearings to the shore (Figure 3).

Mackereth core (Berth M1), 0 - 56cm

0 - 8cm	Mid grey-brown fine detritus mud. Nig 2, Strf 2, Sicc 1, Elas 0 - 1, Humo 3. $Ld^3 3$, As 1, Ag^+, Dg^+. Lower boundary gradual.
8 - 46cm	Grey-brown fine detritus mud, more cohesive. Nig 2, Strf 2, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, As 1, Ag^+, Dg^+. Lower boundary gradual.
46 - 56cm	Light grey-brown, increasingly clay - Rich fine detritus mud. Nig 2, Strf 2, Sicc 2, Elas 1, Humo 3. $Ld^3 2$, As2, Ag^+, Dg^+.

Russian core (Berth II)

50 - 100cm	Light grey-brown, clay rich fine detritus mud. Nig 2, Strf 2, Sicc 2, Elas 1, Humo 3. $Ld^3 2$, As2, Ag^+, Dg^+.

	Gradual change, reduced clay content towards 100cm
100 - 119cm	Darker, Grey-brown fine detritus mud, some darker bands interspersed. Nig 2 - 3, Strf 2, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Ag 1, As^+, Dg^+, Dh^+, Ga^+. Lower boundary relatively well defined across 1 - 2cm.
119 - 165cm	Darker brown, more homogenous, more organic detritus mud with occasional shells. Nig 3, Strf o, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, Ga^+, (test (moll)$^+$). Lower boundary very gradual.
165 - 195cm	Stratigraphy as 119 - 165cm, but with more abundant shells, sediment becoming darker in colour below 180cm. Nig 3, Strf o, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, Ga^+, (test (moll)1). Lower boundary relatively well defined.
195 - 200cm	Dark brown to black detritus mud with frequent shells. Nig 3 - 4, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, Ga^+, (test (moll)1). Lower boundary well defined.
200 - 215cm	Dark brown detritus mud with occasional lighter bands. Nig 3 - 4, Strf 1, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dg^+, Ag^+, Ga^+, (test (moll)$^+$). Lower boundary well defined.
215 - 450cm	Homogenous dark detritus mud with occasional shells (narrow shell rich band at 219cm). Nig 4, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 4$, Dg^+, Dh^+, Ag^+, Ga^+, (test (moll)$^+$).

The stratigraphy changes at 200cm occurred at the junction of two 50cm core sections; in the field, a separate section, 175 - 225cm was taken to check the stratigraphy changes and the same changes were observed, a period of enhanced sediment inwashing could be in evidence at 200 - 215cm.

<u>Berth III</u> The coring position was determined, with reference to points on the shore, to be centre-lake, c.50m from the site of Berth II (Figure 3).

50 - 90cm	Light grey-brown fine clay - rich detritus mud,

	interspersed with darker bands.
	Nig 2, Strf 2, Sicc 2, Elas 1, Humo 3.
	$Ld^3$2, As 2, Ag^+, Dg^+.
	Lower boundary gradual
90 - 134cm	Darker grey-brown fine detritus mud, some banding present.
	Nig 2 - 3, Strf 2, Sicc 2, Elas 1, Humo 3.
	$Ld^3$3, As 1, Ag^+, Dg^+.
	Lower boundary well defined.
134 - 195cm	Homogenous brown detritus mud with occasional shells.
	Nig 3, Strf o, Sicc 2, Elas 1, Humo 3.
	$Ld^3$3, Dg 1, Dh^+, Ag^+, Ga^+, (test $(moll)^+$).
	Lower boundary gradual.
195 - 220cm	Darker brown detritus mud with more frequent shells.
	Nig 3 - 4, Strf o, Sicc 2, Elas 1, Humo 3.
	$Ld^3$3, Dg 1, Dh^+, Ag^+, Ga^+, (test (moll)1).
	Lower boundary gradual.
220 - 300cm	Dark brown to black detritus mud with occasional shells.
	Nig 3 - 4, Strf 0, Sicc 2, Elas 1, Humo 3.
	$Ld^3$4, Dg^+, Dh^+, Ag^+, Ga^+, (test $(moll)^+$).

In both cores, the degree of stratifaction of the uppermost sediment layers was assessed in the field. Russian and Mackereth cores are not however ideal for the identification of finely laminated sediments in both cases, the sediment surface can be slightly disturbed when cores are extracted from the core chambers or core tubes. The use of a freeze-corer at both Birchgrove Pool and Berth Pool has shown that fine laminations are indeed present in at least the upper layers of the sediment at these sites. The recent ecological history of the meres is not, however, of primary interest in this project. Pollen analysis has shown that the major stratigraphic change at 119cm in Berth II correlates to that at 134cm in Berth III. The feature appears to date to Anglo-Saxon times (Chapter 7).

Birchgrove Pool (Plates 1, 2 and 5)

Grid ref: SJ 436 232
Area (ha): 1.7
pH: 9.0
Water depth at core site: 4.2m
Max. depth recorded (Reynolds 1979): 4.8m

Birchgrove Pool is today the smallest and deepest of the Baschurch Pools. It is separated from Berth Pool by a low sand and gravel ridge. The northern shore of the pool borders the sand and gravel ridge and only a narrow belt of peat separates the pool from an area of till deposits to the south. A single core was taken from deep water in the centre of the lake.

<u>Core stratigraphy</u> (Russian core)

50 - 60cm	Light brown fine detritus mud. Nig 2, Strf 2, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, As^+, Ag^+, Dh^+. Lower boundary well defined.
60 - 118cm	Dark brown detritus mud. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, Ga^+. Lower boundary gradual.
180 - 230cm	Mid brown detritus mud. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dh 1, Dg^+, Ag^+, Ga^+. Lower boundary gradual.
230 - 260cm	Dark brown detritus mud, occasional shells. Nig 3 - 4, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, (test $(moll)^+$). Lower boundary gradual.
260 - 310cm	Dark brown detritus mud with frequent shells. Nig 3 - 4, Strf 0. Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, (test (moll)1). Lower boundary gradual.
310 - 370cm	Dark brown to black detritus mud with frequent shells. Nig 4, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, (test (moll)1). Dense cluster of shells at 349cm. Lower boundary gradual.
370 - 450cm	Grey-black detritus mud with occasional shells. Nig 3 - 4, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+.

The sediments of Berth and Birchgrove are similar in that cores from both sites contain abundant mollusc shells in certain sections.

Marton Pool (Plates 1, 8 and 12)

Grid ref: SJ 448 234

Area (ha): 6.8

pH: 8.8

Water depth at core site: 2.3m

Max. depth recorded (Reynolds 1979): 2.8m

Marton Pool is today the second largest of the Baschurch Pools and is surrounded, particularly around the south-western shores, by extensive peat deposits. It lies on the periphery of the sand and gravel ridge system of the Baschurch area and close to an extensive belt of gley soils developed on till (Figure 5). A single core was taken from the centre of the lake.

Core stratigraphy (Russian core)

The coring position was fixed by compass bearings to points on the shore.

40 - 120cm	Light grey-brown fine detritus mud interspersed with darker bands. Nig 2, Strf 2, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, As 1, Dg^+, Dh^+, Ag^+. Lower boundary very gradual.
120 - 172cm	Light brown fine detritus mud with darker bands, clay content tending to decline. Nig 2, Strf 2, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, As^+, Ag^+. Lower boundary well defined.
172 - 200cm	Mid brown detritus mud, homogenous, with no trace of interspersed black deposits. Nig 2 - 3, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ag^+, Ga^+. Lower boundary gradual.
200 - 490cm	Dark brown detritus mud. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3. $Ld^3 3$, Dg 1, Dh^+, Ga^+, Ag^+.

In contrast to Berth Pool and Birchgrove Pool, no mollusc shells were observed in the sediments of Marton Pool.

Fenemere (Plates 1 and 7)

Grid ref: SJ 446 229

Area (ha): 9.4

pH: 8.9

Water depth at core site 2.2m

Max. recorded depth (Reynolds 1979): 2.2m

A single centre-lake core was taken for pollen analysis, the coring position was fixed by compass bearings to points on the shore. Further samples were taken subsequently for radiocarbon dating, these samples were correlated to the main core by pollen analysis.

Core stratigraphy (Russian core)

50 - 130cm	Fine grey-brown detritus mud.
	Nig 2, Strf 2, Sicc 2, Elas 1, Humo 2.
	$Ld^{3}3$, Dg 1, Dh^{+}, Ag^{+}, Ga^{+}, As^{+}.
	Lower boundary well defined.
130 - 500cm	Relatively homogenous brown detritus mud.
	Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3.
	$Ld^{3}3$, Dh 1, Dg^{+}, Ag^{+}, Ga^{+}.

The homogenous brown detritus muds of the Fenemere core appear to be slightly coarser than those from Marton Pool; no Mollusc shells were noted in the Fenemere core. Several field drains flow into Marton Pool (Figure 3), but only the ditch linking Birchgrove, Marton and Fenemere flows into Fenemere; sediments of Roman age occur at 160cm at Fenemere and 210cm at Marton (Chapter 7), a more rapid post-Roman sediment accumulation rate is indicated at Marton, with the deposition of a clay rich detritus above 120cm. The existence of field drains around Marton could be contributing to the higher inorganic sedimentary input at that site, in comparison to Fenemere.

Summary

The Shropshire-Cheshire meres today are predominantly alkaline, with high biological productivity (Reynolds 1979). The process of advanced eutrophication is probably a consequence of recent human

Fig8 Berth Pool II: Age-Depth Profile (Correlated dates)

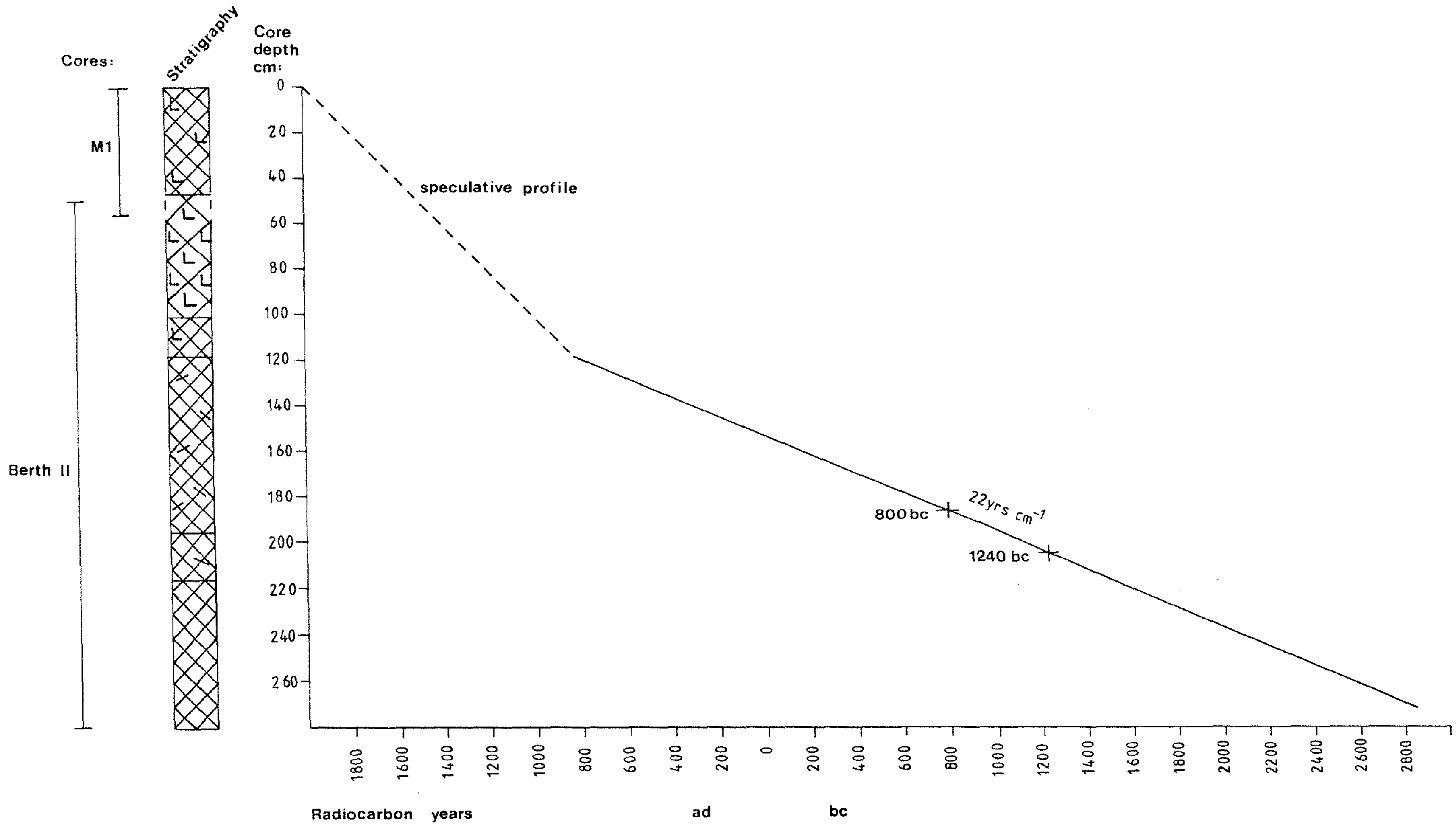


Fig 9 Fenemere: Age-Depth Profile

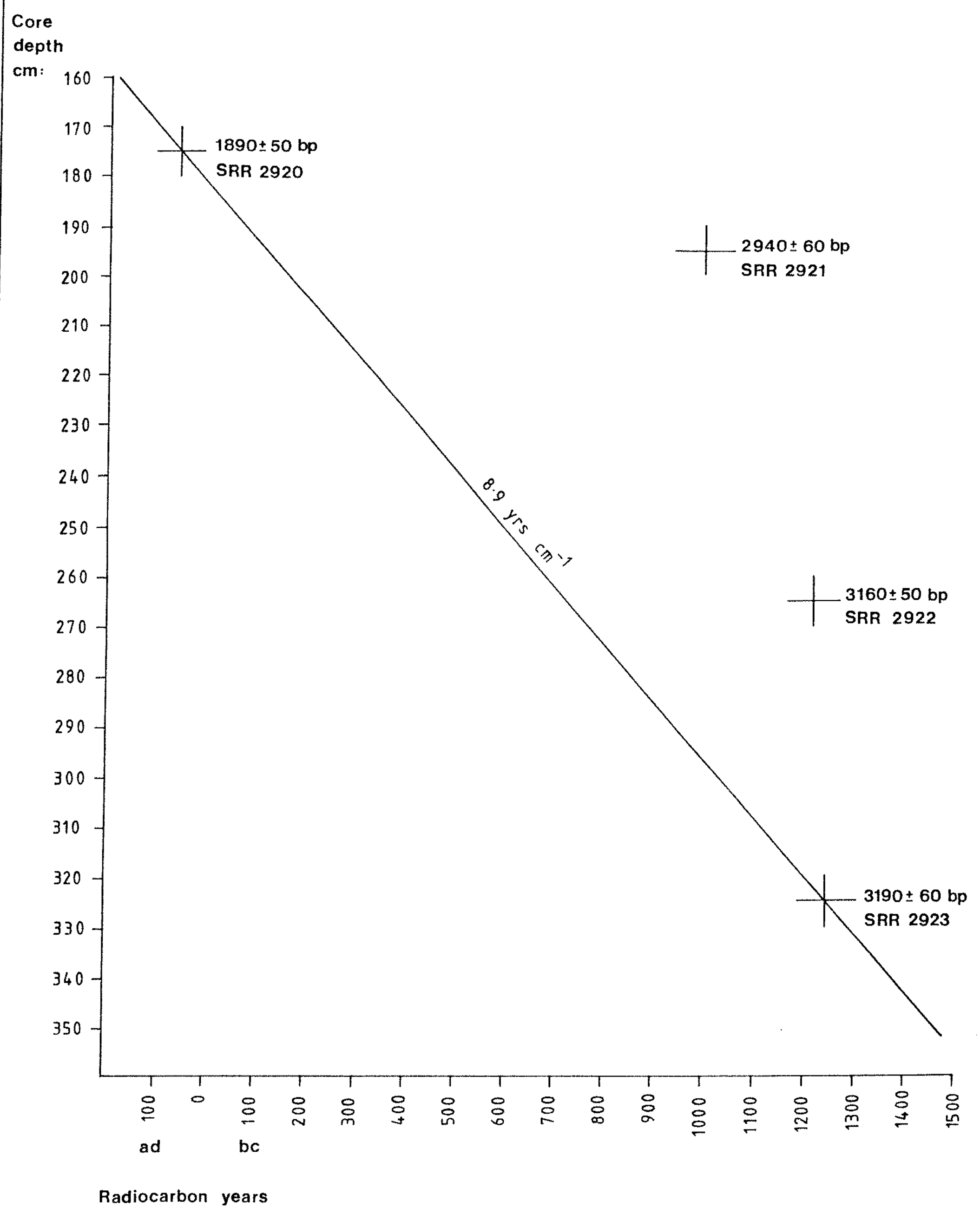
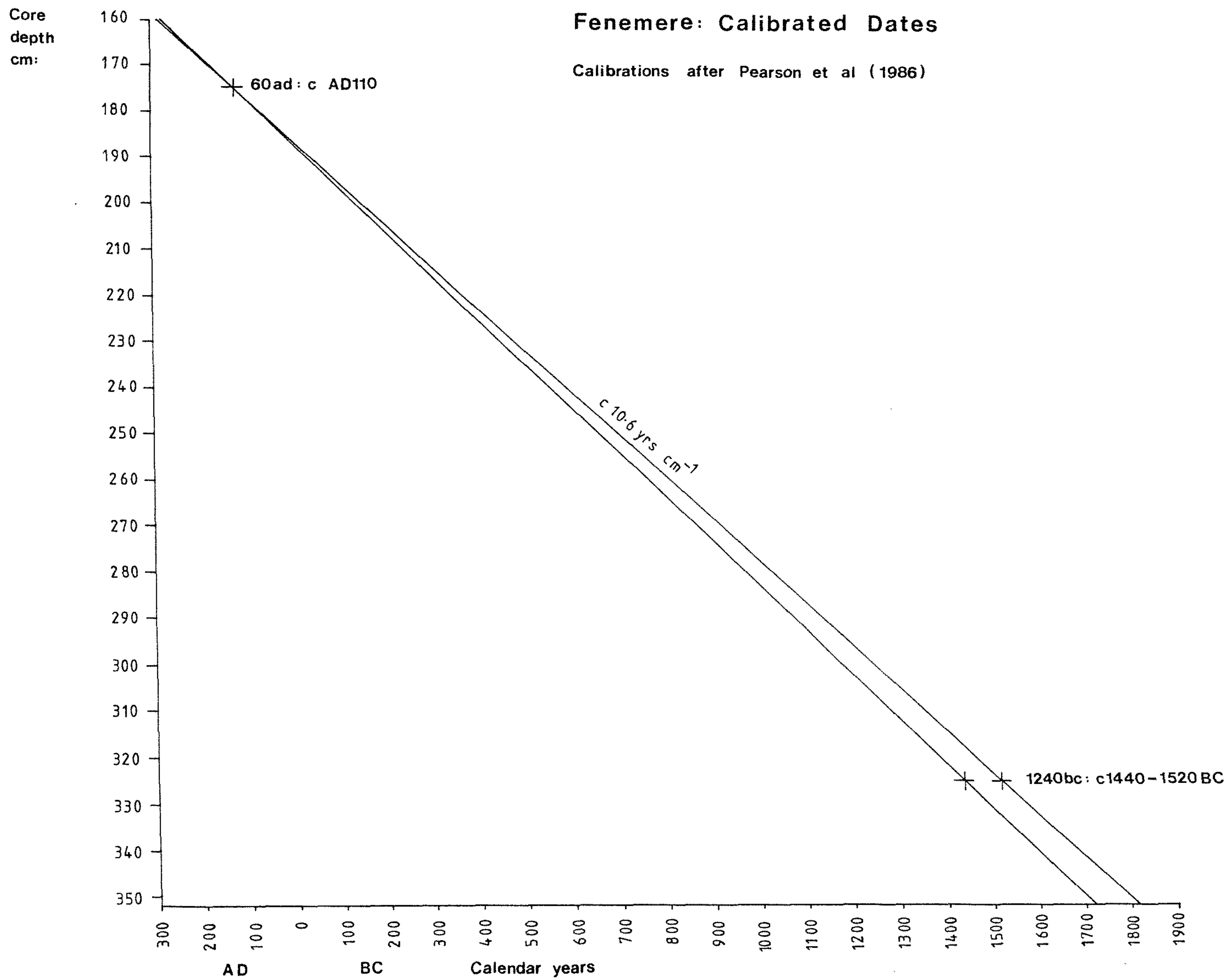


Fig 10



Fenemere: Calibrated Dates
Calibrations after Pearson et al (1986)
Core depth cm:
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
60ad : c AD110
c 10·6 yrs cm-1
1240bc : c1440–1520 BC
300
200
100
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
AD
BC
Calendar years

Fig11 Marton Pool: Age-Depth Profile (Correlated dates)

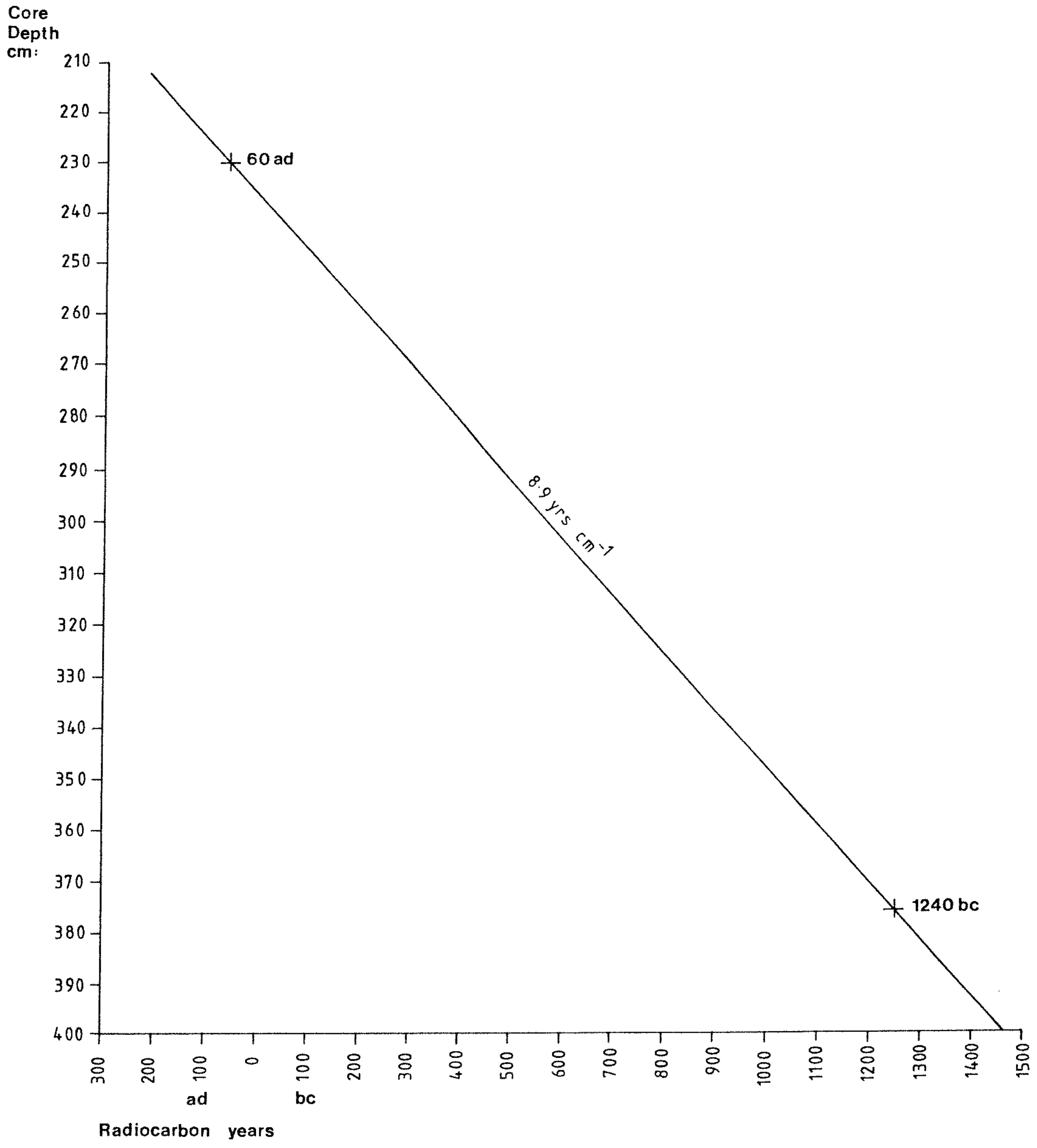
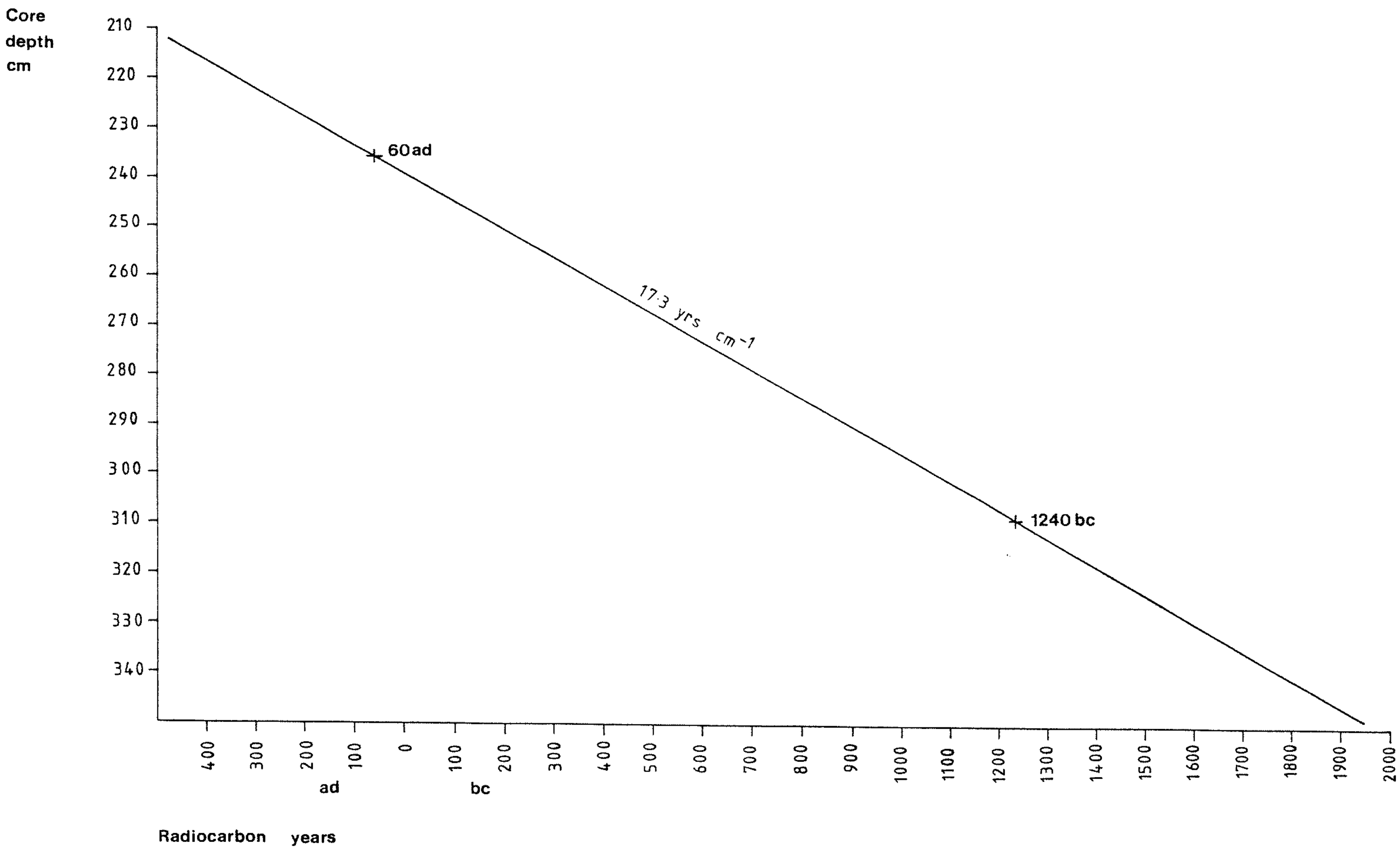


Fig 12 Birchgrove Pool: Age-Depth Profile (Correlated dates)



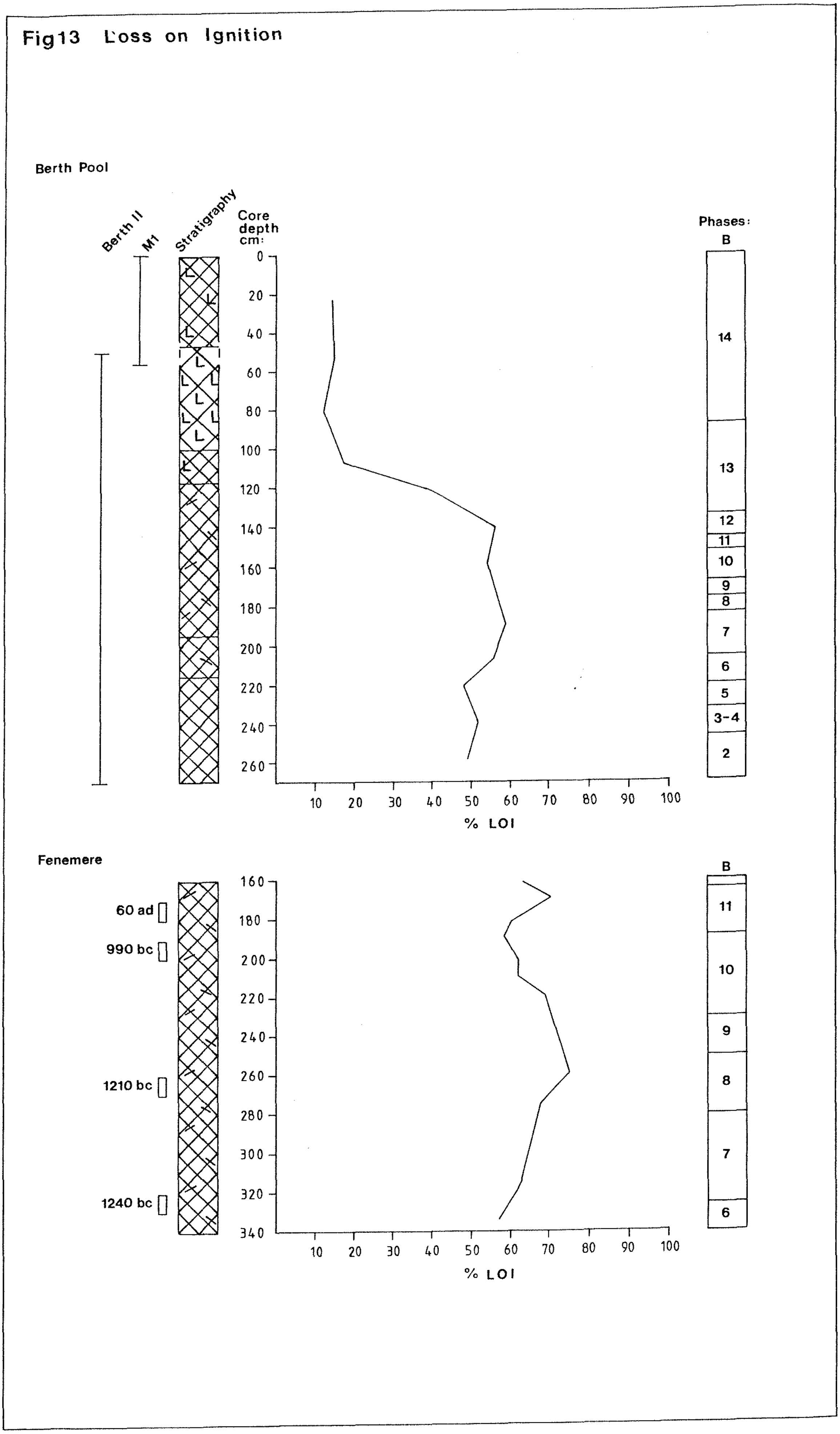


Fig13 Loss on Ignition
Berth Pool
Berth II
M1
Stratigraphy
Core depth cm:
0
20
40
60
80
100
120
140
160
180
200
220
240
260
10
20
30
40
50
60
70
80
90
100
% LOI
Phases:
B
14
13
12
11
10
9
8
7
6
5
3-4
2
Fenemere
60 ad
990 bc
1210 bc
1240 bc
160
180
200
220
240
260
280
300
320
340
10
20
30
40
50
60
70
80
90
100
% LOI
B
11
10
9
8
7
6

impact (Reynolds 1979). However the fact that under natural conditions most of the mere basins would have been closed, combined with the potential for nutrient imputs from groundwater percolation could mean that the meres had a natural tendency to be eutrophic (Reynolds and Sinker 1976). Drainage of the meres and mosses had proceeded throughout the historic period (Rowley 1972, Hey 1974). During most of the postglacial period, however, the meres, including the Baschurch Pools would have been closed and therefore would have derived their pollen content from aerial transport and surface washing (cf Bennett 1986). Of the four radiocarbon dates at Fenemere, only the upper and lower dates, 1890±50 bp (SRR - 2920) and 3190±60 bp (SRR - 2923) are used to calculate accumulation rates.

It is considered probable that the other two dates have been reversed, due to old carbon inwashing in clearance phases (Pennington et al 1976). Using the upper and lower dates an accumulation rate of 8.6 C14 yrs/cm can be calculated for the sediment at Fenemere, at least for the time period of interest; rates probably increase above the 130cm stratigraphy change, assuming a constant accumulation rate for the brown detritus mud a date of c.430 ad can be derived for 130cm. Correlation of the two dates used above at Fenemere, to Marton Pool gives an accumulation rate of 8.9 C14 yrs/cm for the sediment at that site. Using this rate a date of c.560 ad can be calculated for the 172cm stratigraphy change. Correlation of the Fenemere dates to Birchgrove Pool permits an accumulation rate of 17.3 C14 yrs/cm to be calculated for the sediments at that site, at least in the later prehistoric period. An obvious point of correlation between Berth Pool and the three other sites at c.1900 bp cannot be easily discerned (Chapter 6). However, correlation of the *Tilia* decline at 204cm in Berth II to that at c.325cm at Fenemere and correlation of the arboreal pollen decline at 184cm in Berth II to that at c.280cm at Fenemere (extrapolated date 2750 bp) allows a sediment accumulation rate of 22 C14 yrs/cm to be calculated for the main core at Berth Pool and allows a date of c.780 ad to be calculated for the major stratigraphy change at 119cm in Berth II.

2.2.2 Boreatton Moss and New Pool (Plates 2 - 4, 9 and 10)

Boreatton Moss was selected for analysis because of its proximity to the Baschurch Pools. New Pool, however, was selected partly because of its relative proximity to the Baschurch area; it lies only c.4km to the south of Boreatton, whereas Marton and Fenemere lie c.3km to the east of Boreatton, and partly because other sites in the vicinity of New Pool, initially selected for comparison to the Baschurch Pools, proved unsatisfactory. Isle Pool, located within a meander loop of the River Severn (SJ 461 170) appeared to have a disturbed sediment stratigraphy; coring proved difficult as the sediments appeared to be unusually compressed, compared to the other pools. Furthermore, a 19th century Ordnance Survey map housed in Shropshire County Records Office showed no open water on the site occupied by the pool today. Additional documents held in Shropshire C.R.O. suggest that the pool was drained during the 18th century. The lateglacial and early postglacial sediments at the site could be undisturbed, but the more recent sediments have almost certainly undergone some disturbance.

Similarly, Shrawardine Pool (SJ 398 160) contained Devensian lateglacial grey clays, but pollen samples from the shallow overlying organic deposits suggested that the stratigraphy was disturbed, possibly truncated. During the summer of 1984, Shrawardine Pool contained no water at all. At other times, c.30cm of water covered parts of the site.

A core was taken at Cottage Pool (SJ 418 183) close to New Pool. Only 1.7m of sediment could be recovered, using a Russian corer from a boat. A sharp stratigraphic boundary occurred at 66cm, where a fine limnic mud gave way to a much coarser, rootlet rich detrital deposit. Pollen samples suggested a Boreal age for this lower deposit. Furthermore, a local report suggested that some pools had been created in the area as fish ponds during the early historic period. It is possible that a marshy hollow, or small fen existed at the site of Cottage Pool, and this was excavated in historic times to create a pond.

After Isle Pool, Shrawardine Pool and Cottage Pool/Pond were deemed to have disturbed late Holocene stratigraphies, a core was taken from New Pool (SJ 415 182, 1:50000 1st Series).

Initially, this core was thought to be complete. However, subsequent sampling for radiocarbon dating samples suggested that the upper half metre of peat had been disturbed in places. Some peat could also have been removed (local report). The pollen diagram and radiocarbon dates obtained, however, are thought to be satisfactory, although the diagram itself was not counted above 50cm.

Boreatton Moss (Plates 2, 9 and 10)

Grid ref: SJ 417 226
Area (ha): 7.1
pH at core site: 4.5

A track, built on reclaimed ground, follows the north side of the moss. This separates a small area of low lying ground from the moss proper and the slopes leading down to the moss at the northern end. The area of the whole basin is therefore c. 8.1 ha, but today only 7.1 ha lie within the 'channel' surrounding the moss.

A number of pH measurements were taken, and indicated an acid environment:

Sphagnum lawn at moss centre: 5.5
Open water at north end: 5.6
Sphagnum lawn towards southern margin of the moss: 4.9

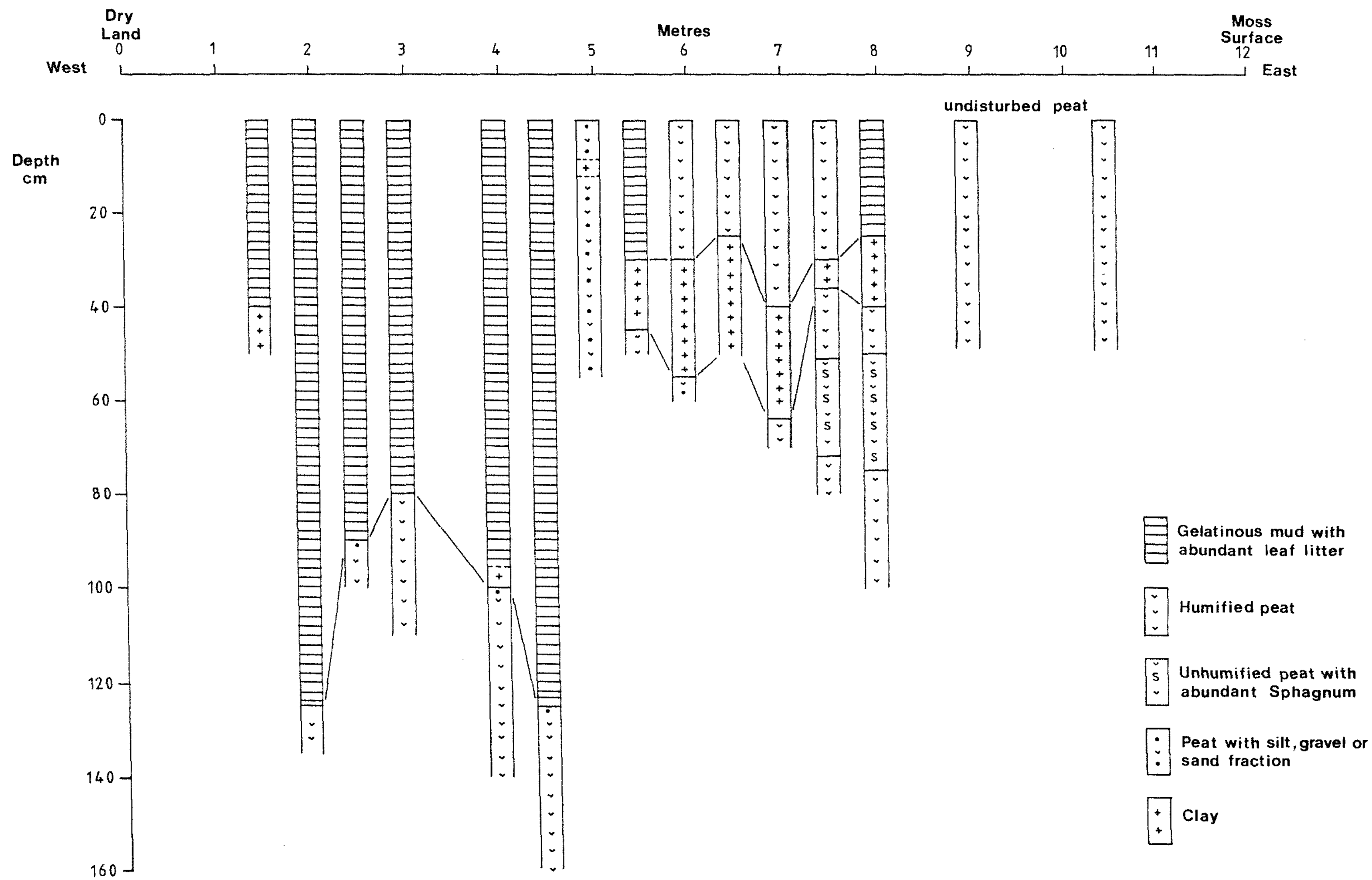
A pH of 7.0 was found in the 'channel' along the western side of the moss, and a pH of 6.2 was found between the central core site and the western moss margin, close to the site of the marginal core. Epilobium and Castanea seedlings were present at this locality and Quercus seedlings and a few small Quercus individuals c. 2m high occurred towards the northern end of the moss. The moss itself is completely colonised by Betula and Pinus, with some standing dead pines c. 20m high. Beneath the trees there are lawns with Sphagnum sect. Cuspidata; Calluna vulgaris, Juncus and Oxycoccus occur and, towards the southern end of the moss Pteridium occurs. The moss is surrounded by a 'channel' approximately 10m wide, several ditches are cut across the moss and the area of open water at the northern end is almost certainly a flooded cutting, with markedly straight sides (Plate 2). Corings were made across the peripheral 'channel' at the western edge of the moss, at a point where a plank bridge permits access to the site (Figure 3) The stratigraphic cross section is shown in Figure 14. Palynological and macrofossil evidence points to a mesotrophic character for the site (below, and Chapter 3). This 'channel' is not therefore interpreted as a 'lagg', and Boreatton Moss is not a raised moss (cf. Sinker 1962). Records formerly held by the Shrewsbury Local Studies Library, but now unfortunately missing from the archives, refer to contracts to drain the moss at the end of the 18th century. Any attempt to convert the site into grazing land, something which occurred at many wetland sites in the area (Rowley 1972, Hey 1974), evidently failed and ditches on the moss were allowed to infill. The stratigraphic section in Figure 14 shows a peaty gelatinous mud, with leaf remains, and in some places clay, overlying humified moss peat. The clay includes a coarser fraction, and sand and gravel occur at the contact between the humified peat and superficial peaty mud.

It is possible that ditches were cut across the centre of the moss and linked to a peripheral ditch, the 'cutting' at the northern end of the moss could have been constructed as part of an attempt to drain the site, but this is only speculation. Trial peat corings at the site showed a maximum of c. 6.5m of organic deposits overlying a grey clay. Two peat cores were analysed, a core from the centre of the moss and one 22m out from the western side of the moss (Figure 3). The objective in taking marginal and central cores was to examine the degree of intra-site variability in pollen spectra at Boreatton, the marginal core was thought to be sufficiently close to the edge of the moss to be influenced by local pollen (cf Edwards 1982). Evidence presented below points to the mesotrophic character of Boreatton and, if the moss was not raised during the time period under study, then to a certain extent pollen could have been washed across the moss surface and variations in pollen frequency between the marginal and central cores need not be due wholly to variations in aerial pollen deposition (cf Turner 1975). Contrasts do occur between the pollen spectra of the marginal and central cores, however, and there are indications that local taxa are influential at the marginal core (Chapters 3 to 6).

Boreatton Moss: Central core (Russian core)

The position of the central core was fixed by measurement, along compass bearings to the margins of the moss, the core was taken in a small area of *Sphagnum* lawn where tree roots could be avoided.

Fig 14 Deposits at the Margin of Boreatton Moss



Stratigraphy:-

0 - 10cm	Fresh Sphagnum peat. Nig 2, Strf 0, Sicc 1, Elas 3, Humo 0 - 1. Tb4, Th^+. Lower boundary gradual.
10 - 20cm	Light brown Sphagnum peat with herbaceous remains. Nig 2, Strf 0, Sicc 1, Elas 3, Humo 1. Tb3, Th1, Dh^+. Lower boundary gradual.
20 - 60cm	Mid brown Sphagnum and herbaceous peat; Scheuchzeria remains at 60cm. Nig 2, Strf 0, Sicc 2, Elas 2, Humo 2. Tb2, Th2, Dg^+, Dh^+.
(57 - 59cm)	No sample retained by borer. Lower boundary gradual.
60 - 174cm	Moderately humified Sphagnum and herbaceous peat, Scheuchzeria present at 90cm. Nig 2, Strf 1, Sicc 2, Elas 2, Humo 2. Th2, Tb 1, Dh1, Sh^+, Ga^+, Gs^+ Gg $(min)^+$. Lower boundary well defined.
174 - 240cm	Humified, dark brown herbaceous peat. Nig 3, Strf 0, Sicc 2, Elas 1 - 2, Humo 3. Th2, Dg 1, Dh 1, Tb^+, Ag^+, Ga^+. Lower boundary gradual.
240 - 250cm	Dark brown humified, predominantly herbaceous peat with Sphagnum becoming more abundant. Nig 3, Strf 0, Sicc 2, Elas 2, Humo 2 - 3. Th2, Dh 1, Tb 1, Dg^+, Sh^+, Ag^+, Ga^+. Lower boundary gradual.
250 - 260cm	Brown, humified Sphagnum and herbaceous peat. Nig 3, Strf 0, Sicc 2, Elas 2, Humo 2 - 3. Tb2, Th 1, Dh 1, Dg^+, Sh^+, Ag^+, Ga^+. Lower boundary relatively well defined.
260 - 300cm	Brown, humified herbaceous peat. Nig 3, Strf 0, Sicc 2, Elas 2, Humo 2 - 3. Th2, Dg 1, Dh 1, Tb^+, Sh^+, Ga^+. Lower boundary gradual.

300 - 530cm Darker brown, more humified predominantly herbaceous peat.
Nig 3, Strf 0, Sicc 2, Elas 2, Humo 3.
Th2, Dh 1, Dg 1, Tb$^+$, Sh$^+$.
Lower boundary gradual.

Obstructions encountered in the peat, c. 4 - 4.5m could be tree remains, possibly tree stumps.

530 - 580cm Dark brown, highly humified herbaceous peat.
Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3.
Th2, Dg2, Dh$^+$, Sh$^+$, Ga$^+$, Ag$^+$.
Gradual lower transition across c. 10cm.

580 - 610cm Peat matrix giving way to finer mud with increasing clay content.
Nig 2, Strf 1, Sicc 3, Elas 0, Humo 4.
As 2, Dgl, Dh$^+$, Th$^+$, Sh$^+$, Ga$^+$.
Lower boundary gradual.

610 - 635cm Grey clay with occasional organic remains.
Nig 1, Strf 0, Sicc 3, Elas 0, Humo 4.
As4, Dg$^+$, Sh$^+$, Ga$^+$.

Boreatton Moss appears to have developed first as a shallow lake and to have experienced a transitional stage where water levels were probably low, allowing the rapid invasion by herbaceous taxa. During microscopic examination of the deposits, pollen grains of Pinus, Quercus and Corylus/Myrica were encountered at 420cm. Peat accumulation at the site appears to date back to early Boreal times. Sphagnum leaves from the less humified peat above 174cm include leaves of Sphagnum section Subsecunda cf. subsecundum (abundant), also Sphagnum magellanicum and (probable) Sphagnum squarrosum, an assemblage which points to mesotrophic conditions at the moss centre (Smith 1980). It is believed on the basis of the available evidence that when drainage was attempted at Boreatton Moss in the late 18th and early 19th centuries the site was a mesotrophic mire (cf Daniels 1978, Moore 1984a). Ditch cutting across and around the moss led to reduced waterlogging at the centre, and allowed Pteridium colonisation, particularly towards the south of the moss. In recent years, however, water levels at the moss appear to have increased (Sinker 1962).

Boreatton Moss: Marginal core (Russian core)

Coring location fixed by measurement to the edge of the moss, a small Sphagnum lawn was selected, where tree roots could be avoided.

Stratigraphy :

0 - 27cm	Fresh, to slightly humified Sphagnum peat. Nig 2, Strf 0, Sicc 1, Elas 3, Humo 0 - 1. Tb3, Th 1, T^+. Lower boundary well defined.
27 - 65cm	Mid brown, more humified herbaceous peat with frequent Sphagnum leaves. Nig 2 - 3, Strf 0, Sicc 2, Elas 2, Humo 2. Th3, Tb 1, Dh^+, Dg^+, T^+, Ag^+. Lower boundary well defined.
65 - 79cm	Mid brown, moderately humified Sphagnum peat. Nig 2, Strf 0, Sicc 2, Elas 2 - 3, Humo 1. Tb3, Th 1, T^+, Dg^+. Lower boundary well defined.
79 - 90cm	Brown, humified herbaceous peat. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 2 - 3. Th2, Tb 1, Dh 1, Dg^+, Ag^+. Lower boundary well defined.
90 - 121cm	Mid brown, mildly humified Sphagnum peat. Nig 2, Strf 0, Sicc 2, Elas 2, Humo 2. Tb4, Th^+, Dh^+. Lower boundary well defined.
121 - 130cm	Mid brown, mildly humified, more herbaceous peat. Nig 2, Strf 0, Sicc 2, Elas 1, Humo 2. Tb2, Th2, Dh^+. Lower boundary sharp.
130 - 135cm	Brown, humified herbaceous peat. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 2 - 3. Th3, Tb 1, Dh^+, Dg^+. Lower boundary well defined.
135 - 139cm	Mid brown, moderately humified herbaceous peat. Nig 3, Strf 0, Sicc 2, Elas 2, Humo 2. Th2, Dh 1, Dg 1, Tb^+. Lower boundary well defined.
139 - 155cm	Brown, humified herbaceous and Sphagnum peat. Nig 3, Strf 0, Sicc 2, Elas 2, Humo 2 - 3. Th3, Tb 1, Dh^+, Dg^+, Ga^+.

Lower boundary gradual.

155 - 178cm Darker brown, more humified herbaceous and Sphagnum peat.
Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3.
Th3, Tb 1, Dh^+, Dg^+, Sh^+, Ga^+, Gs^+.
Lower boundary well defined.

178 - 180cm Brown, humified, but less compacted herbaceous and Sphagnum peat.
Nig 3, Strf 0, Sicc 2, Elas 1, Humo 2 - 3.
Th3, Tb 1, Dh^+, Dg^+, Sh^+.
Lower boundary sharp.

180 - 250cm Dark brown, humified herbaceous peat.
Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3.
Th3, Dg 1, Dh^+, Tb^+, Sh^+, Ga^+.

Peat was not sampled below 250cm.

Pollen analysis (Chapter 3) shows that the reduction in peat compaction at 178 - 180cm at the margin correlates to the reduction in humification and the increase in Sphagnum abundance at 174cm at the centre. In both cores,a coarse silt/sand fraction occurs in the peat, particularly where there is palynological evidence for clearance activity in the vegetation around the site.

New Pool (Plates 3 and 4) (Russian core)

Grid ref: SJ 415 182 (site not named on latest 1:50000 Maps)
Area (ha): c. 1.9 (Extent of site referred to as New Pool on Ordnance Survey Maps)
pH at core site: 5.4

New Pool today is completely wooded by alder, with a dense shrub and herbaceous understorey. Open water occasionally collects at the centre of the site, where some peat has been removed as part of drainage efforts. A small, deeper pool has been excavated at the western end of the site. This is possibly the reason why the name 'New Pool' has been attached to what is, in fact, a small peat-filled basin. New Pool is referred to as a 'mere fen' by Sinker, but appears to have held open water for only a brief period in the early Holocene. New Pool lies at the south eastern extremity of a narrow belt of peaty loam (Crompton and Osmond 1954), c.100m wide, which extends c.500m to the west of the site. Most of this peaty loam is now drained and farmed, with the exception of a small strip immediately adjacent to New Pool which is still wooded. It is clearly not correct to refer to the whole of this deposit as peaty loam; the deposits at New Pool are simple peat. The maximum width of this deposit, across the centre of New Pool itself is only c.150m. Any pollen preserved in the peat will be mainly local in character (cf Jacobson and Bradshaw 1981). A single core was taken from the central zone of the pet deposits referred to as New Pool.

Stratigraphy

0 - 122cm	Mid brown, moderately humified herbaceous, rootlet rich peat, with occasional Eriophorum vaginatum remains. Nig 2 - 3, Strf 0, Sicc 2, Elas 1, Humo 2. Th3, Dh 1, Tb^{+}, Dg^{+}, T^{+}, Ag^{+}, Ga^{+}. Lower boundary relatively well defined.
122 - 292cm	Light brown, mildly humified Sphagnum magellanicum/ Eriophorum peat with, frequent Scheuchzeria. Nig 2, Strf 0, Sicc 2, Elas 2, Humo 2. Tb3, Th 1, Dh^{+}, Dg^{+}, Sh^{+}. Lower boundary gradual.
292 - 300cm	Darker brown, increasingly humified herbaceous/bryophyte peat, becoming gelatinous in texture towards 300cm. Nit 3, Strf 0, Sicc 2, Elas 1, Humo 2. Th2, Dg 1, Sh 1, Tb^{+}. Lower boundary very gradual.
300 - 350cm	Dark brown, increasingly humified and gelatinous peaty mud, occasional leaf fragments, possibly Betula. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3. Dg2, Dh 1, Sh 1. Lower boundary gradual.
350 - 380cm	Dark brown gelatinous mud with visible plant remains. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 3. Sh2, Dg2, Dh^{+}. Lower boundary gradual.
380 - 430cm	Dark brown gelatinous mud, possibly deposited in water. Nig 3, Strf 0, Sicc 2, Elas 1, Humo 4. Sh3, Dg 1, Dh^{+}.
430 - 500cm	Grey clay. Nig 1, Strf 1, Sicc 3, Elas 0, Humo 4.

	$As4$, Ag^{+}, Ga^{+}.
	Lower boundary sharp.
523 - 524cm	Grey sand
	Nig 1, Strf 0, Sicc 3, Elas 0, Humo 4.
	Gs3, Ga 1, Ag^{+}.
	Lower boundary sharp.
524 - 560cm	Grey silty clay
	Nig 1, Strf 0, Sicc 3, Elas 0, Humo 4.
	As3, Ga 1, Ag^{+}, Gs^{+}.
	Lower boundary relatively well defined.
560 - 570cm	Grey-brown clay.
	Nig 2, Strf 0, Sicc 3, Elas 0, Humo 4.
	As4, Ag^{+}, Ga^{+}, Sh^{+}.

The stratigraphic evidence at New Pool suggests that the site held open water in the lateglacial and early Holocene period. A pollen sample from 280cm, where Sphagnum magellanicum is abundant, included to following arboreal types :-

Quercus	38.2%
Alnus	20.5%
Betula	15.0%
Tilia	8.4%
Ulmus	7.3%
Pinus	7.7%

(% Arboreal pollen)

The relatively high frequencies of Betula and Pinus could point to an early Atlantic age for this sample (cf Moore and Webb 1978, 4). Possibly, the gelatinous mud below 300cm dates to the Boreal period (cf. Godwin 1975) although this is a speculative estimate. An age/depth profile has not been constructed for New Pool; only two radiocarbon dates are available, but the fact that the peat at 66cm to 69cm dates back to 3550 ± 50 bp (SRR - 2833) or 1600 bc suggests that the deposits at the site are probably truncated. Local reports state that peat has been removed from the site in the course of drainage activity.

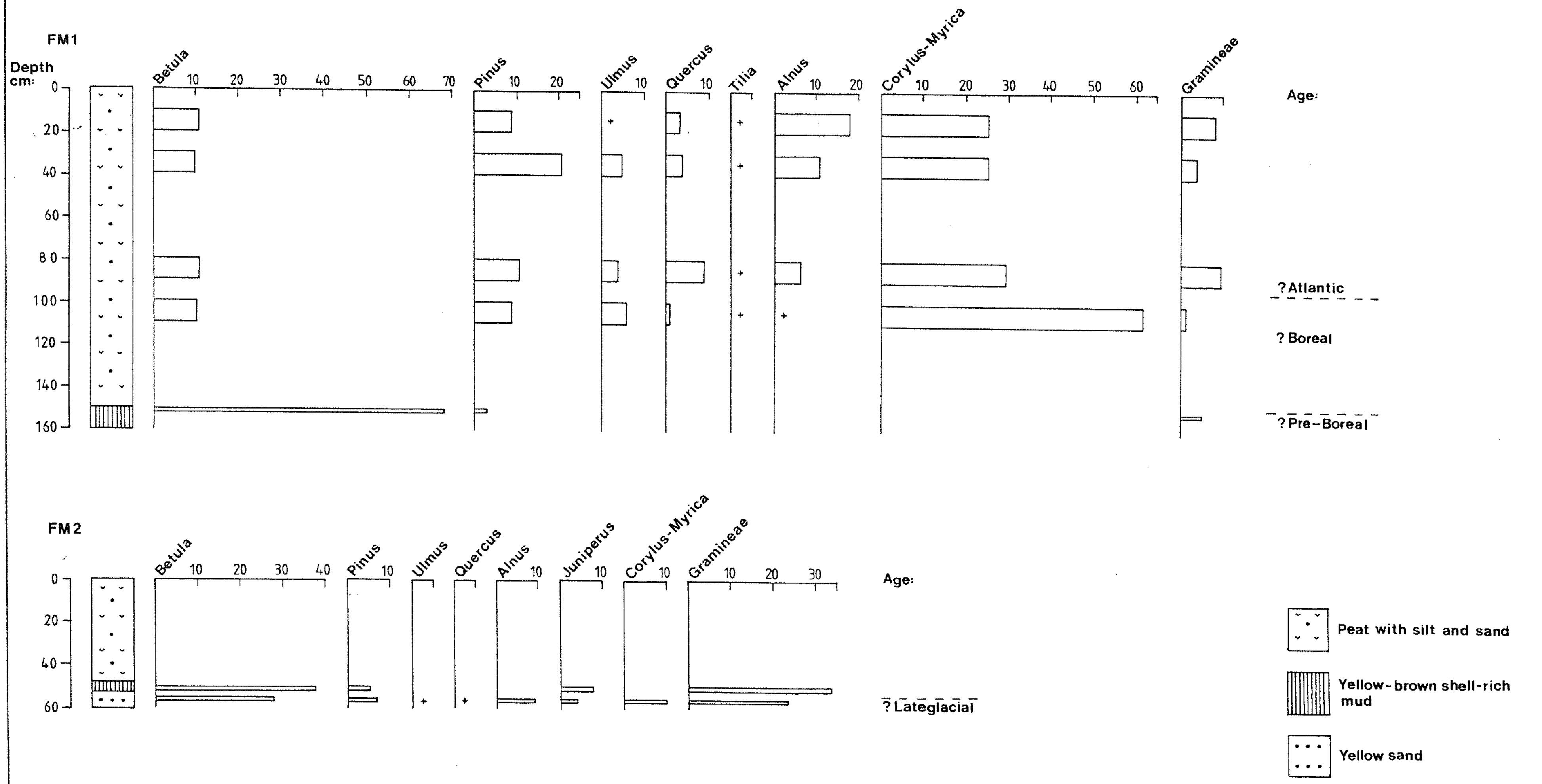
2.2.3 Peat deposits between Marton Pool and Fenemere (Plates 1, 11 and 12)

The peat deposits in between Marton and Fenemere were sampled at two locations, using a soil auger. Material from successive depths was sub-sampled for pollen analysis. The auger was withdrawn without counter-rotation and material carefully removed for analysis. This is not an optimum method, but served to illustrate the peat depth and underlying deposits and enabled an assessment of the chronology of peat accumulation to be made. The stratigraphy, and results of pollen analysis are shown in Figure 15, and the core site locations in Figure 3. At site F/M 1, directly between the two meres, 150cm of peat was present, overlying a light yellow-brown shell-rich mud. At 80 - 90cm and 100 - 110cm in F/M 1 the peat contained leaves of Sphagnum section Squarrosa cf squarrosum, Sphagnum section Subsecunda and Sphagnum section Sphagnum cf palustre. These taxa are typical of base-rich flushes, fens, swampy woodlands and mesotrophic marshes (Smith 1980). Pollen analysis (Figure 15) suggests that the peat c.90cm to 100cm dates to the onset of the Atlantic period, c.5500bc The pollen content of the light yellow-brown shelly mud (Figure 15) suggests an early pre-Boreal date, c.8000 bc, with Betula the dominant pollen type and Pinus and Gramineae occasional (cf Moore and Webb 1978, 4). Moderately high Pinus values persist after the Alnus rise in F/M 1, Conceivably, pine was present on the peat surface, Pinus pollen curves occur at Marton and Fenemere in phases B6 to B10 (Chapter 4 and Chapter 5) but frequencies are low and it is not clear if the curves represent weak, local sources of Pinus pollen (cf Oldfield 1970) or the long distance transport of Pinus from more distant sources (cf Bennett 1984).

At Site F/M 2 (Figure 15, c.50cm of silty peat was present, overlying a shell-rich mud and yellow sand. Pollen analysis of these lower deposits suggests a Zone II/Zone III date, c.8000 - 9000 bc, (cf Godwin 1975, Moore and Webb 1978, 4). More extensive pollen analyses, combined with radiocarbon dating would illustrate fully the chronology of deposition of these peats, for the purposes of this project, the following hypothesis can be suggested, mainly with reference to Cannell and Harries (1981, 6):-

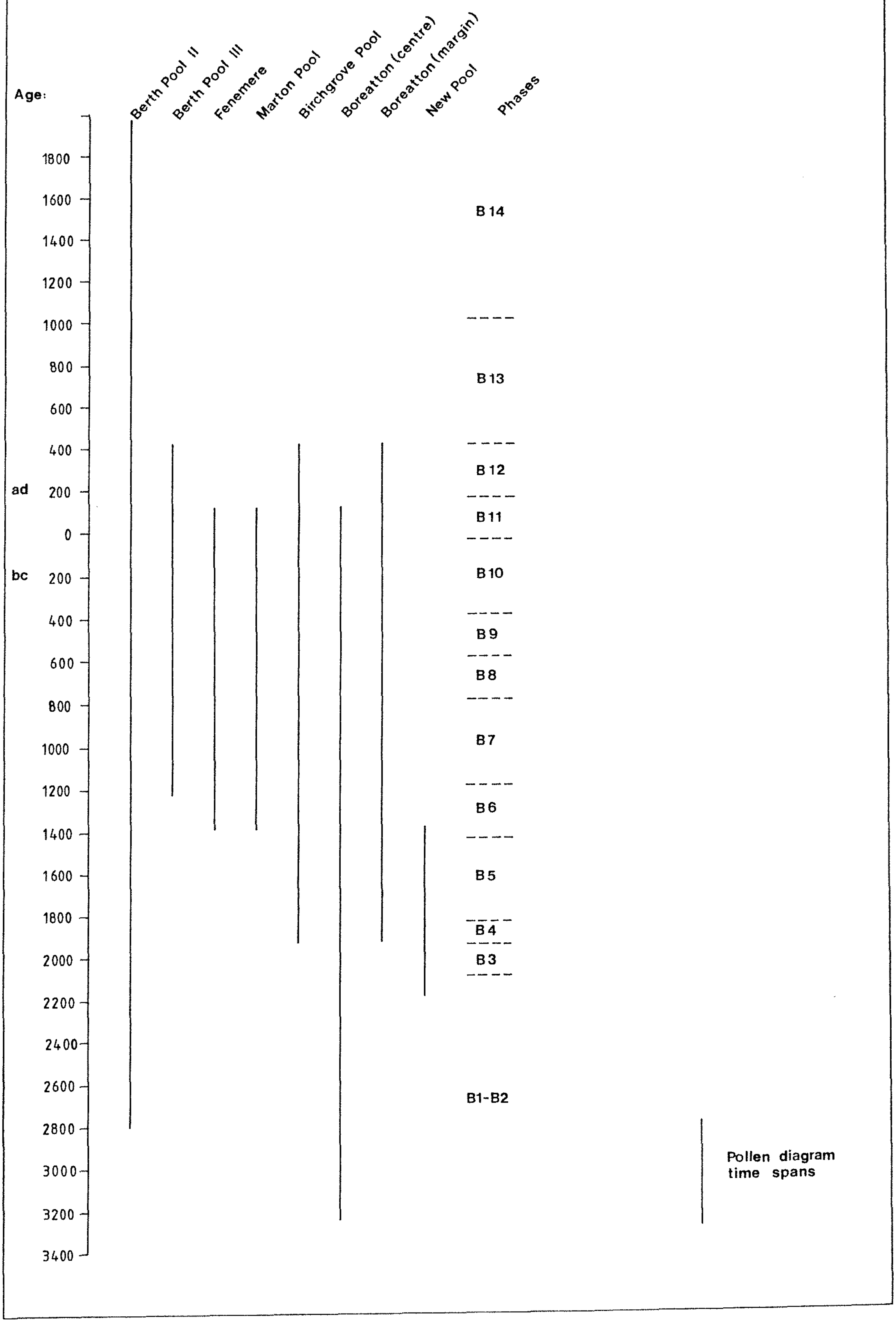
During the lateglacial and the earliest postglacial period, open water covered the whole basin now occupied by Birchgrove Pool, Marton Pool and Fenemere. From early postglacial times, water levels were reduced but three separate kettle holes within the basin continued to hold open water, Peat accumulation commenced in between

Fig15 Peat Deposits between Marton Pool and Fenemere: Pollen Analysis



% Total Pollen excl. aquatics. Selected types shown

Fig16 Pollen Spectra Correlation



the kettle holes. Slope breaks around the now peat-filled basin indicate former lake shore-lines, the upper slope break at Eyton Farm (Plate 11) could indicate a lateglacial shoreline, whilst the lower break could indicate a transitional lake level which existed prior to the isolation of the three intra-basin kettle holes.

Throughout most of the Holocene period, Birchgrove, Marton and Fenemere have existed as separate entities and accumulated independent sedimentary sequences. Inter-basin sediment movement between Marton and Fenemere is not thought to have occurred.

A similar hypothesis could be advanced for the wider basin surrounding Berth Pool; slope breaks are evident in the fields around that site, where the brown earth soils border the peat. These slope breaks can be discerned in the upper right hand corner of Plate 13.

CHAPTER 3

THE NEOLITHIC AND EARLIER BRONZE AGE PERIODS

3.1 Phases B1 and B2: The Neolithic period at Boreatton Moss, New Pool and Berth Pool

3.1.1 Phase B1: A Neolithic *Ulmus* decline at Boreatton Moss

Introduction

In order to construct an accurate age/depth profile for Boreatton Moss, a larger number of radiocarbon dates would be needed and extrapolation of the two dates available may not be representative of actual accumulation rates throughout the peat profile. It is possible to provide a guide to the likely age of the deposits at the base of the main pollen diagram from the centre of Boreatton Moss by assuming that the postulated woodland regeneration phase, B11, at c. 115cm is the same phase which has been radiocarbon dated to 1890± 50 bp (SRR - 2920) at Fenemere. If c. 115cm dates to c. 1900 bp and c. 180cm to 3790 bp (radiocarbon dated), then 65cm of peat has accumulated at a rate of c. 29 radiocarbon years per cm; alternatively, if 200 cm dates to c. 4000 bp (biostratigraphic correlation to a radiocarbon dated horizon at New Pool), then 85cm of peat has built up at c. 25 radiocarbon years per cm. These rates are suggested with the necessary proviso that linear age/depth profiles are not necessarily accurately representative of the age of the peat throughout a profile (Walker 1970). On the basis of these suggested rates, an age estimate of c. 5000 bp can be made for the peat at the base of the main pollen diagram at the centre of Boreatton Moss, where a decline in *Ulmus* pollen is associated with increases in *Fraxinus*, Gramineae and *Plantago lanceolata*.

Main characteristics

Boreatton Moss (centre) 230cm to 216cm

Initially, *Ulmus* declines, *Quercus* increases and *Tilia* increases slightly. *Fraxinus* increases and *Alnus* decreases in the latter part of the phase. Increases in Gramineae and *Plantago lanceolata* are associated with low Ulmus frequencies, Pteridium appears in consecutive samples above 226cm.

Vegetational changes in B1

Phase B1 is only identified at Boreatton Moss, an age/depth profile at Berth Pool suggests that the spectra commence after 3000 bc (Figure 8). There is some uncertainty about the chronology of B1 and B2. Inter-site comparisions are possible in B2 (3.1.2) but examination of these two phases is intended mainly to place subsequent, more significant vegetation changes in context. Although the B1 Ulmus decline itself cannot be seen in the context of the preceding woodland composition around Boreatton Moss, the estimated date for the decline and the other species changes associated with it lend support to the hypothesis that this is in fact the typical elm decline which is observed throughout the British Isles c. 3000 bc (Sims 1973). An Ulmus decline at Crose Mere, Shropshire (Beales 1980) has been radiocarbon dated to 5296±150 bp (Q - 1235), and the first well marked landnam phase at Hatchmere, Cheshire is dated to 5269±80 bp (Switsur and West 1975). A comprehensive examination of the evidence for a Neolithic Ulmus decline is not intended here and the phenomenon has recently been reviewed by Birks (1986b) and is well documented in Europe (Iversen 1949, Troels-Smith 1960, Ten Hove 1968). The question of the causal factors of the Ulmus decline is reviewed in the above references but the pollen-analytical evidence in Britain has tended to point to anthropogenic causes for the Ulmus decline, for example, Oldfield (1963), although the clearance of woodlands by man could mask the effects of climatic fluctuations on vegetation and soils. The discovery of wing cases of the elm disease-carrying beetle Scolytus scolytus in peat deposits below an Ulmus decline horizon at Hampstead Heath (Moore 1984b) has maintained interest in the disease hypothesis (Watts 1961). Recently, evidence that soil fertility loss resulting from mesolithic activity in the north Pennines contributed to the Ulmus fall has led to the view that the specific character of the Ulmus decline should be examined on a site to site basis (Sturludottir and Turner 1985). Close interval pollen sampling has shown that the Ulmus fall can occur over a very short period, for example: less than 2 years at Ellerside Moss, Cumbria (Garbett 1981), and 3.8 to 7 years at Rimsmoor, Dorset (Waton 1982). The sampling interval at Boreatton Moss at the Ulmus decline is probably too coarse to allow a very detailed consideration of the feature, but it appears to have occurred over c. 180 years. Ulmus itself declines from 11.2% at 230cm to 2.0% at 224cm where a reduction in Betula occurs. Quercus frequencies increase and Alnus frequencies decrease above 224cm. Fraxinus is absent at 230cm but increases to more than 1% at 226cm. Hedera occurs at more than 1% throughout the Ulmus decline, and this could indicate improving light conditions within the woodland. Gramineae does not increase to more than 1% until 226cm and Plantago lanceolata does not exceed 1% until the Ulmus minimum at 224cm. Chenopodiaceae occurs at 230cm and 224cm and Urtica at 226cm and 224cm. The presence of these herb taxa could be due to an opening of the high woodland canopy, as could the presence of Mercurialis at 224cm, a species typical of secondary woodland (Pennington 1969, Martin 1968, Wardle 1959, Peterken and Game 1981). Cereal pollen was identified at 222cm in association with the appearance of Tubuliflorae and a slight increase in Plantago lanceolata. The rises in Quercus at 222cm and Tilia at 226cm suggest that Ulmus was selectively removed, contributing to enhanced flowering of other deciduous taxa. The occurrence of Pteridium at 226cm and in subsequent levels could be in response to a slight thinning in the woodland, but the low frequency means that this interpretation is not certain. After the initial slight rise in Tilia, there is a slight reduction at 220cm in association with declining Alnus values, this could indicate some encroachment of clearance activity onto damper soils. Even with the estimated 60 year sampling interval, there are indications that the Ulmus decline consists of an initial reduction in elm, with no clear evidence for the establishment of pasture, followed by a phase in which birch and alder also decline, plantain becomes established in clearings, and small scale crop growing occurs. This separation of the primary elm decline from the actual landnam (cf Iversen 1941) phase was made by Oldfield (1963) in the south-east Lake District and more recently, if tentatively, by Waton (1982) at Rimsmoor, Dorset. The relatively wide sampling interval at Boreatton Moss does not lend itself to a very detailed examination of the events surrounding the Ulmus decline, but nevertheless anthropogenic activity is indicated by the expansion of Plantago lanceolata and especially the occurrence of cereal pollen.

In terms of the woodland composition itself, elm appears to have been much less abundant than lime at ca. 5000 b.p. Whereas Ulmus can be over-represented in pollen diagrams (Andersen 1973), Tilia is known to be under-represented (Andersen 1973). Greig (1982) corrected lime pollen frequencies from a variety of sites in the British Isles and Continental Europe, using the factor X8, suggested by Andersen (1970). By this method, lime was suggested to be a dominant forest tree in many North European localities in the Atlantic period. There are, however, problems with the approach adopted by Greig (1982), all 'uncorrected' Tilia frequencies from a wide variety of sites were multiplied by the same factor; this does not take into account the effect on pollen frequencies of intrinsic site factors (Jacobson and Bradshaw 1981, Prentice 1985, Bradshaw and Webb 1985). The pollen input to a lake is mixed before deposition to a much greater extent than at a peat surface (1.3.4). Furthermore, any site which is substantially more than c. 50m in diameter will have part of its surface out of range of local pollen deposition (Bonny 1980, Bonny and Allen 1984, Tinsley and Smith 1974, Tauber 1977). In one of the most comprehensive studies to date of contemporary pollen-vegetation relationships, Bradshaw and Webb (1985) have shown, in a North American context:

> "that the size of the basin influenced both the pollen representation of different taxa and the size of the area around the site from which each pollen type was recruited".

Greig (1982) uses a correction factor for Tilia of X8, whereas Simmons and Tooley (1981) quote a factor of X2 from Iversen (1947, in Andersen 1973). Oldfield (1970), Birks (1973) and Birks and Gordon (1985) all sound cautionary notes about the uncritical transfer, over time and depositional type, of correction factors or R-values.

As far as Tilia representation at Boreatton Moss is concerned, some increases in Tilia pollen are seen at and after the Ulmus decline, in common with any sites in the north of England (Pigott and Huntley 1980). Post Ulmus decline Tilia increases are attributed by Pigott and Huntley (1980) to increased flowering of Tilia in response to the removal of all or part of the elm cover from the woodland canopy. The central core at Boreatton Moss (Figure 3) was taken from beyond the 30-50m marginal zone which could be subjected to comparatively high inputs from locally produced pollen. Tilia frequencies between 230cm and 214cm mostly exceed 15% of the main pollen sum. Pigott and Huntley (1980) showed that, around an isolated tree of Tilia cordata, Tilia pollen declined from 9% arboreal pollen to less than 1% between 50m and 100m away from the tree. In general terms, therefore, the post Ulmus decline frequencies of Tilia recorded in the centre of Boreatton Moss suggest that lime was very abundant in the woodland around the Moss. For a poorly dispersed low pollen producer to consistently contribute 15% or more of a land pollen sum, albeit excluding Coryloid pollen, at the centre of a moss of a minimum diameter of 200m, at a time when other tree and shrub taxa are well represented, a high relative abundance of that taxon in the vegetation would be necessary. Another contributary factor to the relatively high representation of lime, compared to elm, could be the fact that the brown earth soils around the moss were probably very free-draining, right up to the margin of the peat itself (Figure 5) The Baschurch Series brown earths have a relatively low base status (Crompton and Osmond 1954), under these soil conditions, lime could be naturally more abundant than elm in the immediate proximity of the moss (cf Polunin and Walters 1985, 75). Elm also tends to occur in Shropshire today on soils with a higher availability of phosphate and nitrogen, in comparison to the soils where lime often occurs (Sinker et al 1985), and if soil nutrient loss was associated with early prehistoric clearance activity (cf Sturludottir and Turner 1985) this could have caused lime to become more competitive than elm on some soils. There is limited evidence in B1, in the form of the falling Alnus curve, that some alder was cleared from damper soils, Cyperaceae occurs more regularly above 214cm and a peak in Rosaceae occurs at the same time as Alnus declines, possibly indicating a localised increase in the abundance of rosaceous mire herbs, for example, Potentilla spp. Above 214cm in the centre of Boreatton, Alnus values recover. Tilia, however and, initially Ulmus are reduced above 214cm pointing to a relative intensification in the clearance of some broadleaved trees. This phase, B2, is also thought to be indentifiable at Berth Pool and New Pool, where it appears to date to the later Neolithic period.

3.1.2 Phase B2. The late Neolithic period

Introduction

Reductions in Ulmus and Tilia occur at Boreatton Moss, New Pool and Berth Pool in horizons dated by radiocarbon and extrapolated dates and by biostratigraphic correlation to c. 2000 bc. Prior to this clearance phase progressive reductions in Quercus and limited increases in Gramineae are evident at New Pool and Berth Pool. Reductions in Tilia are evidence at Boreatton Moss. The chronological limits of B2 are uncertain, It ends, by definition, c. 2000 b.c., but it is not known if the entire phase is included on the diagrams from Berth Pool and New Pool. The Quercus reduction at 264cm at Berth Pool (II) dates to C. 2700 bc (Figure 8) but it is not known if this Quercus reduction correlates to the slight lowering of Quercus c. 212cm at the centre of Boreatton Moss.

Main characteristics

Boreatton Moss (centre) 214cm to 204cm

Tilia is reduced and Alnus increases, Hedera occurs at lower frequencies, compared to B1 and Frangula and Viscum appear. Continuous curves for Gramineae and Plantago lanceolata persist and Liguliflorae appears for the first time, Mercurialis appears and Pteridium occurs at more than 1% in two samples. Changes in pollen content appear to be relatively minor in B1 and B2, no numerical zonation splits occur in these phases.

Berth Pool II Below 244cm

Quercus decreases above 268cm, Ulmus increases late in the phase and a slight reduction in Tilia occurs at 256cm. A rise in Alnus occurs above 268cm and Taxus increases where Quercus frequencies are reduced. Gramineae increases at 252cm, or c. 2400 bc, herb pollen diversity is low, although Tubuliflorae, Umbelliferae and Urtica could be derived from small clearings. Numerical zonation splits occur between 244cm and 248cm, where Alnus is reduced and Gramineae increases.

New Pool Below 80cm

Pinus increases slightly and a marginal reduction in Tilia occurs. A marked reduction in Quercus is seen and Corylus/Myrica increases. A slight rise in Gramineae occurs, herb diversity is low, types occurring include Plantago lanceolata, Urtica and Mercurialis. Pteridium is also recorded. The third zone split in SPLITLSQ occurs between 84cm and 86cm and zone splits occur in both statistics between 82cm and 84cm, where the Quercus reduction is associated with increases in Betula and Corylus/Myrica.

3.1.3 Inter-site contrasts in Phase B2

Betula frequencies in B2 are higher at New Pool, which is the smaller of the three sites and is probably representative of a very restricted pollen source area (cf Tauber 1965, Jacobson and Bradshaw 1981, Prentice 1985). Birch could be locally common close to New Pool. Pinus occurs at all three sites but, given the size of New Pool, the slightly higher Pinus frequencies there could represent isolated pines growing locally, perhaps surviving with birch on peat surfaces. Ulmus frequencies are comparable between the three sites but Tilia frequencies are clearly higher at New Pool and Boreatton. Although Ericaceae is included in the main pollen sum at Berth Pool, but not at New Pool or Boreatton, it occurs in only one sample, at less than 1%, below 250cm at Berth Pool, three or herb pollen percentages at Berth have thus not been supressed by the inclusion of Ericaceae. It is possible that the pollen spectra at Berth Pool are effectively under-estimating the importance of lime in the local vegetation, not simply because Tilia is generally under-represented in pollen spectra (Andersen 1970) but also because lime probably did not become established on the wetter peaty soils which surround Berth Pool (cf Godwin 1975). Tilia pollen is produced mainly in late spring and early summer (Godwin 1975, 43), when other trees are in leaf. As a relatively large pollen grain, it is potentially susceptible to preferential filtering in below-canopy airstreams (Tauber 1967b, 137). A fringing alder belt around the shores of Berth Pool could be acting to filter Tilia pollen. Around the shores of Berth Pool today the well drained brown earth soils are separated from the pool margin by, in most places, at least a 50m wide belt of peat deposits (Figure 5). Tilia pollen grains can tend to stick together in clusters and are generally not well dispersed beyond c. 50m of their source (Pigott and Huntley 1980). Brown earth soils slope down to the margins of both Boreatton Moss and New Pool. Lime can grow on damp as well as drier soils in Shropshire today (Sinker et al 1985) and it is thought probable that lime was able to grow on the brown earth soils adjacent to the edges of New Pool and Boreatton. Potentially, Tilia pollen could be dispersed to the centre of these two sites more efficiently, in comparision to Berth Pool, where a wider and more complete fringing alder belt can be postulated. Alder was probably locally abundant around parts of Boreatton Moss, particularly around the northern margin of the site where the land slopes less steeply towards the peat margin, along the western edge of the Moss. However, the ground rises to 10m above the moss surface within 50m of the moss edge and alder probably did not compete well with other trees on these sloping, well-drained sandy soils.

New Pool, at only 100m or so in diameter is almost certainly dominated by the pollen from taxa growing within c. 200m of its margin (cf Tauber 1977) and yet Alnus, which is normally over-represented in pollen diagrams (cf. Andersen 1970) fluctuates between only c. 25-30% in B2 at New Pool, compared to frequencies between c. 30% and 40% at Berth Pool and Boreatton. If wide tracts of alder surrounded New Pool, and the taxon was also frequent on the peat surface of the site, higher Alnus frequencies would be expected, particularly in the light of the fact that locally abundant taxa are over-represented in the pollen record to a greater extent at smaller sites as opposed to larger sites; the correction factors for individual pollen types will vary according to site size (Bradshaw and Webb 1985). Alder does not therefore appear to have been particularly abundant in the vicinity of New Pool in B2.

Quercus appears to decline slightly in early B2 at Boreatton Moss, but more marked declines in Quercus are evident at Berth Pool and New Pool. Detailed inter-site comparisions are problematic because of uncertainty surrounding the chronology of B2, the upper horizons of the phase can be identified at all three sites but the lower boundary of the phase is not fixed at New Pool or Berth Pool. Extrapolation of correlated dates at Berth Pool, however, suggests that the reduced Quercus frequency at 256cm dates to 2500 to 2600 bc. At New Pool the 82cm Quercus minimum precedes a 2000 bc increase in Quercus and at Boreatton Moss the lower Quercus values, c. 210cm, occur after an Ulmus decline dated by estimated acculation rates to c. 3000 bc and prior to a 2000 bc reduction in Tilia (phase B3).

At New Pool, a possible increase in hazel abundance, or at least enhanced flowering of hazel is suggested by the rise in Corylus/Myrica which is associated with the Quercus decline. A very slight increase in Gramineae also occurs in these horizons and Plantago lanceolata and *Pteridium* occur at the 82cm *Quercus* minimum. The pollen spectra from a site the size of New Pool would be expected to be mainly local in character (Jacobson and Bradshaw 1981) and therefore the creation of very small clearings, perhaps involving the felling of only a few individual trees, can be postulated. It could be argued that a larger cleared area is present at some distance from the site (*cf* Oldfield 1970), although the spectra from Boreatton and Berth Pool suggest that the brown earth soil belts at least around Baschurch were mainly wooded throughout the Neolithic period. *Fraxinus* occurs at all three sites in B2, suggesting that ash had increased in abundance in response to the present of limited openings in the high woodland canopy (*cf* Godwin 1975).

A marked contrast between Berth Pool and the two peat basins occurs in respect of *Taxus*. An increase in *Taxus* is clearly associated with the B2 *Quercus* reduction at Berth Pool, slightly lower *Tilia* frequencies occur at 252cm and 256cm at Berth Pool (II) and it would appear that yew is increasing in abundance in response to reductions in the canopy cover of oak and possibly lime. Yew has a wide ecological tolerance (Godwin 1975) and could be increasing in abundance both on drier and wetter soils. *Alnus* declines in late B2, some clearing of alder could have permitted yew to colonise the peaty soils close to Berth Pool. *Taxus* could tend to be over-represented in pollen spectra (Andersen 1970, 1973), it also produces its pollen very early in the growing season (Godwin 1975); whilst yew cannot be said to be abundant around Berth Pool in B2, the indications are that it has expanded into areas formerly occupied by oak, and possibly lime and alder. Yew is locally frequent as a native tree in parts of Shropshire (Sinker et al 1985) and can be shade tolerant, whilst there are indications at Berth Pool that yew is acting as a coloniser of clearings, apparently more so than birch or ash. *Taxus* does not occur regularly until mid B5 at Boreatton Moss and is only recorded twice at New Pool, in B3/B4 and B5/B6. Yew could initially have been more frequent in the woodland closer to Berth Pool, and simply increased in abundance as oak was felled; close to New Pool, clearings could have been very restricted. Rises in *Betula* and *Corylus/Myrica* could point to the colonisation of small cleared patches by birch and hazel whereas at Boreatton the continuous, if low, pollen curves for Granineae and *Plantago lanceolata* and the presence, in successive samples, of *Pteridium* suggest that small clearings were created and kept open.

At Berth Pool, Gramineae does not increase until late B2, Plantago lanceolata and Pteridium are not present and Gramineae itself is absent at 260cm, it appears, therefore, that any small clearings opened up in the woodland closer to Berth Pool were subject to encroachment by yew and possibly hazel. It is also possible that any clearings which were created were confined to the crests of the sand and gravel ridges which run to the south and east of Berth Pool, if these small clearings were up to 200m or so away from the pool, they might not register in the pollen spectra at the site itself; contrasts between Berth Pool and Birchgrove Pool in phase B11 (Chapter 6) suggest that the dominant pollen source area of Berth Pool is more restricted than would theoretically be expected. In the case of yew, Taxus pollen would be produced more abundantly and at a higher level in the vegetation canopy than herb pollen, and the combination of high Taxus and low herb pollen values could be acting to overstate the importance of yew in the vegetation and be under-representing the importance of small clearings. Clearings, albeit restricted, do appear to have been present in some locations in the pollen source area of Berth Pool, Artemisia occurs prior to the decline in Quercus and Tubuliflorae and Rumex acet also occur. Amongst the other herb types recorded, Rosaceae, Ranunculaceae and Filipendula could be derived from plants growing on wetter soils, not necessarily in clearings. This could also be true of Cyperaceae. Umbelliferae and Urtica could be derived from plants growing in small clearings.

The occurrence of Potamogeton and Nymphaea suggest that floating-leaf macrophytes had successfully colonised marginal areas of Berth Pool. The occurrance of Typha latifolia, reedmace, suggests that emergent stands were present, Sparganium/Typha occurs regularly above levels where Alnus frequencies are reduced c. 250cm. Lesser reedmace or burr-reed could be colonising wetter fen areas from where alder had been partly cleared. Indeterminate/unidentified pollen occurs more frequently from the latter stages of B2 onwards. This could point to the mobilisation of degraded pollen in topsoils, as woodland is cleared (cf Oldfield et al 1985b). At each of the Baschurch Pools, the proportion of indeterminate/unidentified pollen tends to increase as the pollen evidence points to an intensification in clearance activity.

Amongst the three sites, the highest Plantago lanceolata frequencies occur at Boreatton Moss, Liguliflorae and Rumex acet also occur in mid B2. The Rosaceae peak ends at the B1/B2 transition, this could be linked to the rise in Alnus, possibly pointing to a re-expansion of alder in some wetter habitats. Mercurialis appeared in B1 and occurs again in B2. Dog's mercury, M. perennis, tends to colonise drier soils (Sinker et al 1985, Martin 1968) and can tolerate shading (Sinker et al 1985) but tends not to become abundant unless the shrub understorey is cleared (Wardle 1959). In contrast to Berth Pool and New Pool, Pteridium occurs throughout B2 at Boreatton, and at 1-2% in two samples. Woodland clearance tends to aid the dispersal of bracken spores (Beales 1980); Pteridium increases in frequency during subsequent clearance phases at Boreatton. The contrasts between the three sites suggest that lime grew closer to New Pool and Boreatton, in comparision to Berth Pool, and in terms of the location of clearance activity land close to Boreatton appears to be preferred.

3.1.4 Sediment loss on ignition: Berth Pool (Figure 13)

Sediment loss on ignition is 49.2% at 258cm to 260cm in core II from Berth Pool. In comparision to later phases (Chapter 7, below) a relatively high proportion of organic material is present in the sediment although it is probable that some erosion of woodland topsoils is occurring in the pool catchment. No samples have been analysed below 260cm however and it is thus not possible to compare L.O.I in B2 with ignition loss in earlier sediments, for example sediment deposited during the pre-elm decline period.

3.1.5 Archaeological evidence

Archaeological evidence from the Neolithic period in Shropshire suggests that the Severn Valley was used as a highway at this time; axe-trading routes from Wales, the Lake District, Northern Ireland, Cornwall and the chalklands are thought to have converged in an area between Shrewsbury and Buildwas (Chitty 1956).

A radiocarbon date of 2730±80 bc (HAR - 3968) was obtained from a pit at a ceramic Neolithic site at Bromfield in south Shropshire (Stanford 1982), this date compares favourably with the extrapolated date of c. 2700 bc for the Quercus decline in B2 at Berth Pool.

Elsewhere in the Marches, Sharpstone Hill, near Shrewsbury and The Breiddin (Musson 1976) have Neolithic pottery. Neolithic flint scatters suggest that, in the lowlands, easily worked soils were selected for occupation and farming, probably soils on river terraces or on low hills near to water sources (Limbrey 1987). Hilly ground a kilometre or so to the north west of Boreatton Moss, overlooking the River Perry (Figure 2) could therefore have provided a suitable location for Neolithic settlement, particualrly since the area is characterised predominantly by the presence of belts of light, sandy brown earth soils developed on fluvioglacial sands and gravels. Occupation of Shropshire in the Neolithic period is thus confirmed, but could have been concentrated around semi-permanent settlements in favoured localities, which could well have been situated away from the valley floors and low lying areas where the pollen sites are mainly located (Limbrey 1987).

3.1.6 Summary: Phases B1 and B2

Human impact on the woodlands around Baschurch and New Pool was obviously limited, in terms of the woodland area affected, although changes in species composition are associated with the appearance in the pollen record of Gramineae and open habitat indicators. Curves for Gramineae begin at Boreatton Moss and Berth Pool in the Neolithic period. The more frequent occurrence of indeterminate/ unidentified pollen in mid B2 at Berth Pool could point to some topsoil inwashing, sediment loss on ignition is c. 50% at 260cm at Berth Pool (Figure 13),a value comparable to Crose Mere in horizons radiocarbon dated to the Neolithic period. It is not until Saxon times that the sediments at Berth Pool become mainly inorganic (Chapter 7). The Ulmus decline at Crose Mere marks the division between pollen zones CMCP7a and CMCP7b at that site (Beales 1980), Fraxinus occurs more regularly above this horizon, but Gramineae freqeuncies are very low and herb pollen, including Plantago lanceolata occurs only intermittently. Crose Mere is 15.2 ha in area today, and could have been slightly larger before the advent of extensive drainage activity in the Victorian period (Hardy 1939), it is therefore probably representative of a pollen source area at least several square kilometres in extent (cf. Jacobson and Bradshaw 1981). This pollen source area would include tracts of brown earth soils on sand and gravel ridges which rise to the north and south shores of the mere, Plantago *lanceolata* is a well dispersed pollen type (Caseldine 1981) and its poor representation at Crose Mere throughout most of CMCP7b suggests that large or even moderately-sized clearances were not made within the woodlands, even those on well-drained soils, around Crose Mere. An *Ulmus* fall occurs at c. 300cm in the stratigraphy of Whatall Moss (Hardy 1939), which is separated form Crose Mere by a sand and gravel ridge c. 50-100m wide. Details of N.A.P. are not given by Hardy; an increase in Gramineae occurs above 300cm but Ericaceae pollen increases at the same time, possibly pointing to grass and heather colonisation of drying-out peat surfaces (Hardy 1939, 389). Boreatton Moss, at c. 7.1 ha in extent should be representative of a pollen source area at least one square km. in extent (*cf* Jacobson and Bradshaw 1981) although any tree cover on the moss could act to reduce the deposition of pollen in above-canopy airstreams (*cf* Tauber 1965). In comparison to the pollen source areas of Berth Pool and New Pool, and also Crose Mere, the pollen source area of Boreatton thus appears to have included areas which were preferentially cleared in the Neolithic period. Human impact on the woodland around Boreatton Moss appears to intensify c. 2000 bc. This clearance phase, B3, can also be identified at Berth Pool and New Pool, there are further indications that the woodlands closer to Boreatton were preferentially, although not extensively cleared.

3.2 Phase B3: Small scale clearances c. 2000 bc

Introduction

This phase is identifiable at Boreatton Moss and New Pool, and can be tentatively identified at Berth Pool. Man appears to be actively altering the composition of the woodlands around the sites, extensive clearances do not, however, appear to have been created.

Main characteristics

Boreatton Moss (centre) 204cm to 192cm

Alnus, *Ulmus* and *Tilia* are reduced, *Betula* and *Pinus* increase and *Fagus* is recorded for the first time on the diagram. *Corylus/Myrica* values are reduced and *Salix* and *Hedera* occur more frequently. Gramineae increases and *Secale* is recorded. An increase in the diversity of herb pollen types occurs and *Pteridium* is recorded at more than 1%. *Hydrocotyle* and *Drosera* occur and *Sphagnum* frequencies increase.

New Pool c. 80cm, upper boundary uncertain

Ulmus declines and *Tilia* is reduced, a slight reduction in *Alnus* occurs but *Betula* and *Pinus* increase. Gramineae and *Plantago* increase where the initial *Betula* increase gives way to a decline. The radiocarbon date of 3950±50 bp (SRR-2834) suggests that the fall-off in *Betula* frequencies and the associated increase in Gramineae dates to c. 2000 bc.

Berth Pool II c. 244cm to 240cm, upper boundary not precisely fixed.

Reductions in *Ulmus* and *Tilia* occur, a slight rise in *Betula* is detectable and *Quercus* increases, a marked reduction in *Taxus* occurs, *Corylus/Myrica* declines and slight increases in *Salix* occur. *Plantago lanceolata* and *Pteridium* appear for the first time on the diagram. Extrapolation of the age/depth profile at Berth Pool (Figure 8) points to a date of c. 2100 bc at 240cm.

3.2.1 Vegetational changes in phase B3

The removal of elm and lime from the woodland is indicated, with the colonisers birch and pine increasing in aboundance as light conditions improve within the woodland. Alterations in woodland structure could have aided the establishment of beech. Fagus appears at 236cm at Berth Pool, a horizon with an extrapolated dated of c. 2000 b.c., whilst it is absent at New Pool it occurs in B3 at Boreatton in horizons which can be correlated, on biostratigraphic grounds, to the radiocarbon dated horizons at 2000 b.c. at New Pool. Alnus reductions are in evidence at all three sites, clearance activity may have encroached onto damper soils, reductions in Corylus/Myrica could point to the clearance of some understorey hazel. The significance of the pollen frequency changes in B3 at Boreatton Moss is exemplified by the fact that numerical zone splits are made in both statistics in early B3, early zone splits are also made at the onset of B3-B4 at New Pool - the first split in SPLITLSQ is made between 79cm and 80cm - zone splits do not however occur in B3 to B4 in Berth Pool II.

There are several similarities in the sequence of pollen frequency changes beginning at 204cm at the centre of Boreatton Moss and 80cm at New Pool; initially Ulmus and Tilia decline, Betula then peaks as Corylus/Myrica declines, finally, Betula declines and non arboreal pollen representation improved further. The B3 Ulmus/Tilia reductions are not precisely dated at Boreatton Moss, but are stratified some 20cm below levels radiocarbon dated to 1840 bc, the degree of biostratigraphic correlation between Boreatton Moss and New Pool, in respect of the levels dated to 2000 bc at New Pool is such that the evidence at both sites is assumed to reflect human impact at the end of the 3rd millennium bc and the start of the 2nd millennium bc.

3.2.2 Phase B3. Inter-site comparisions: Boreatton Moss and New Pool

The biostratigraphic and assumed chronological correlations between Boreatton Moss (centre) and New Pool c. 2100 bc to 2000 bc have been outlined above. Inter-site variations in pollen frequencies occur which could be due to any one of, or a combination of several factors. There could be a genuine spatial variation in species abundance, the intensity of woodland clearance could vary across the area or the sites could simply be representative of variable pollen source areas.

The increase in Betula at 200cm at the centre of Boreatton Moss and 82cm at New Pool is thought to be due to an expansion of birch within the woodland as a result of newly created openings in the high forest canopy; improved light conditions within small clearings would favour birch, which is an effective coloniser of forest clearings. Sharp rises in Betula can point to the use of fire in Neolithic clearance activity (Godwin 1975, 252). At New Pool, Betula begins to rise prior to the Ulmus reduction, at both sites, however, Betula peaks at or above the horizons where Ulmus is temporarily reduced to less than 1%. Quercus frequencies are reduced prior to the Betula peak at New Pool, but do not show a clear decline in late B2 or early B3 at Boreatton Moss, it is possible that more oak was removed from the woodland in the vicinity of New Pool. This inferred removal of oak is not paralleled by evidence for an expansion of pasture in the pollen source area of New Pool and it could be, in the first instance, that the renewed clearance activity was on a very small scale. New Pool today is only c. 100m across with brown earth soils adjacent to its margin. The stratigraphy of the site shows that it was developing as a peat bog c. 2000 bc, and it is thought that it would have been representing a more restricted pollen source area than the 8.1 ha Boreatton Moss, at this time. Under these circumstances, small clearings several hundred metres away from the site would not be well represented in the pollen diagram. Gramineae is recorded at c. 1% at the Quercus reduction, and Plantago lanceolata occurs at less than 1% in association with the lowest Quercus frequency.

If the decline in Quercus at 82cm reflected a widespread clearance of oak, higher grass and weed frequencies might be expected although a small scale clearance close to the site, perhaps only involving a few trees, could be responsible. Corylus/Myrica frequencies increase as Quercus is reduced, suggesting that the expansion and enhanced flowering of hazel is occurring in the shrub layer as light conditions are improved by the clearing of oak. Betula frequencies begin to increase in parallel with the Quercus reduction, suggesting, in association with the Corylus/Myrica increase, that no attempt is being made to keep clearings free of encroaching shrubs. Occupation of the land therefore appears to be only transient, a fact which would account for the lack of good evidence at New Pool for the maintenance of any open pasture ca. 2200 to 2100 bc.

No clear Quercus reduction is seen at Boreatton Moss prior to the Betula peak, but reductions in the other arboreal taxa are evident. Initially, only Gramineae and Plantago lanceolata frequencies increase at 202cm; no other open habitat indicators are present. Betula and Pinus increase after these primary arboreal reductions, but then decline themselves as Gramineae and Plantago lanceolata frequencies increase further and other open habitat indicators appear. There is evidence that the clearance of woodland was selective; Quercus frequencies tend to increase at both Boreatton Moss and New Pool at c. 2000 bc whereas Ulmus and Tilia decline. Declines in Corylus/Myrica in association with grass and weed increases at both sites probably reflect the clearance of part of the shrub understorey which was allowed to expand during the earliest phase of the renewed clearance.

The Quercus increases could be accounted for solely by the enhanced flowering of oak under improved insolation and pollen dispersal conditions. It is also possible that, if elm and lime were being removed, oak was naturally succeeding birch in locations denuded of elm and lime. The inter-site contrast in Quercus frequencies has been cited as one possible indication of a spatial variation in the intensity of clearance, as it affected individual taxa. It can be seen that Betula frequencies at their maximum expansion, 79cm at New Pool and 199cm at Boreatton Moss, are twice as high at New Pool. The greater reduction in Quercus frequencies at New Pool is one possible explanation for this. If the reduction in Quercus had been a regional effect, it would be expected to appear also at the much larger site of Boreatton Moss. Since it does not appear at Boreatton, it could simply be a local effect at New Pool, enhanced by the smaller size of the site, and leading to an abundant, but localised,source of Betula in small clearings.

Tilia frequencies are reduced to lower levels at Boreatton Moss. Two explanations could be advanced for this effect: Firstly, a greater number of lime trees were partly cut or completely felled in the area around Boreatton Moss, or alternatively, locally produced Tilia pollen is comparatively well represented at the centre of New Pool. The core site at New Pool is less than 50m from the brown earth slopes surrounding the site, whereas the central core at Boreatton is over 80m from the edge. At these distances from the single point source of Tilia, higher Tilia frequencies would be expected at the site within 50m of a potential pollen source (Pigott and Huntley 1980). At both sites Ulmus frequencies decline to <1%, just before the Betula peak at Boreatton, and at the Betula peak at New Pool. The cutting or felling of elm would be expected to encourage the growth of colonising species such as birch or pine, particularly if only parts of the cleared tracts of woodland were deliberately maintained as open pasture or arable plots. Pinus frequencies clearly do increase at both sites where Ulmus and Tilia decline. Evidence at both sites, particuarly Boreatton, shows that Betula frequencies declined c. 2000 b.c. in association with the increased diversity of open habitat indicators.

The evidence appears to show that clearance activity was more intensive in the pollen source area of Boreatton Moss at c. 2000 bc.

At and above 200cm at the centre of Boreatton Moss, a Gramineae increase occurs in association with increases in Plantago lanceolata. Between 200cm and 195cm, after which Gramineae and Plantago lanceolata decline, the other open habitate indicators Tubuliflorae, Liguliflorae, Artemisia, Chenopodiaceae, Plantago media/major and Rumex acet type are all recorded. The presence of Urtica at this time could reflect an increasing abundance of the common nettle, in response to the presence of disturbed ground around human settlements.

The appearance of Secale pollen at c. 2000 bc is interesting. Previously published work suggested that rye was a Roman introduction into Britain (Helbaek 1964, Godwin 1975). More recently, Waton (1982) recorded a continuous curve for Secale pollen in the later Bronze Age at Winchester. Chambers and Jones (1984) have now reassessed the antiquity of rye in Britain. Pollen records of Secale from Llangorse lake date to c. 3500 bp (Chambers and Jones 1984); these pollen records call into question the view that Secale was an Iron Age or Roman introduction in Britain and point clearly to its presence in the earlier Bronze Age. The record of Secale at Boreatton Moss at 198-200cm points to its presence in Britain at the end of the 3rd millennium bc or the start of the 2nd millennium bc. Secale is not recorded at New Pool at the radiocarbon dated horizon at 3950±50 bp but Gramineae and Plantago lanceolata increase in frequency and Liguliflorae and Rumex acet type are recorded, as they are at Boreatton Moss at the equivalent levels.

As the larger of the two sites Boreatton Moss possibly represents more of a regional picture whilst the smaller New Pool is more responsive to localised changes in the vegetation. Compared to the Ulmus decline levels at Boreatton Moss, an increased level of human activity is indicated. There is some evidence in the pollen diagram at Boreatton Moss that clearance activity occurred in close proximity to the Moss. At 200cm, and immediately above Hydrocotyle vulgaris, marsh pennywort, is recorded for the first time, Cyperaceae, sedge, frequencies increase, and at 195cm Sphagnum spores become more abundant. Increasing wetness at the margin, and on the surface of the moss could be responsible for the increased frequencies of these taxa. Such a change in the hydrological conditions on the moss could result from an increased level of runoff at the margin due to vegetation clearance. It should be recalled that there is some uncertainty as to whether or not Boreatton Moss is a raised bog (2.2.2). There is evidence in the marginal stratigraphy (Figure 14)that a channel has been dug around the moss in an attempt to drain it. Drainage ditches are also present on the surface of the moss. Today, there appears to be a lagg zone around the moss, giving it the appearance of a raised bog. However, this 'lagg' could simply be the remains of a cut channel, abandoned when efforts to drain the moss failed. Early clearances could therefore have led to increasing runoff to either the edge, or the entire moss surface. Subsequent evidence (3.4.5) suggests that the entire surface was affected by increasing runoff. A fine inorganic fraction was noted in the peat at 199cm and 200cm in the central core, this could derive from either local aeolian erosion or from runoff at the moss margin.

The pollen evidence is thus indicative of an increase in human activity in the area in the late 3rd millennium bc or early 2nd millennium bc. The date of c. 2000 bc estimated for this vegetation change is highly significant in archaeological terms since it is generally taken to mark the onset of the earlier Bronze Age in Britain, when metal-working became established (Megaw & Simpson 1979).

3.2.3 Inter-site comparisions: Boreatton Moss, New Pool and Berth Pool

Extrapolated dates at Berth Pool, based upon correlations with actual C14 dates at Fenemere, assign an age of c. 4080 bp / 2130 bc to the counted horizon at 240cm at this site (Figure 8)

At this horizon, Ulmus frequencies are reduced, Tilia frequencies show evidence of a gradual decline and Quercus frequencies increase. Taxus and Corylus/Myrica frequencies are reduced, but Salix frequencies show small increases. A slight increase in Betula occurs at 244cm where Ulmus declines. Plantago lanceolata, at more than 1% and Pteridium make their first appearance in the pollen diagram at this points.

The removal of some elm, lime and yew is indicated, with first birch and then oak expanding in the woodland. Some removal of hazel from the shrub understorey could be occurring and the presence of at least some open ground with grass, plantain and possibly bracken appears to exist in the pollen source area. Uncertainties surrounding dating necessarily reduce the confidence with which inter-site comparisons can be made, the similarity in the estimated date, at least between Berth Pool and New Pool, and the vegetational similarities between the latter two sites and Boreatton Moss do, however suggest that the same clearance phase is in evidence at all three sites. In comparison to Boreatton Moss and New Pool, Tilia and Betula frequencies are lower at Berth Pool. The fringing fen peat deposits around Berth Pool could have caused the nearest source of Tilia pollen to be further away from the site margin than at Boreatton Moss and New Pool, although Tilia is known from fen margin woods (Godwin 1975). In comparision to Boreatton Moss at the ?2100 bc Ulmus/Tilia reductions, open habitat indicators are neither as frequent or diverse in the Berth Pool pollen spectra, again, this could in part be due to the fact that any clearance activity was necessarily further removed from the open water surface of Berth Pool, in comparision to its potential proximity on the brown earths adjacent to Boreatton Moss and New Pool. At c. 240cm, total tree pollen at Berth Pool remains at c. 50-60% T.P. indicating, in common with Boreatton Moss and New Pool, that whereas changes in the species composition of the woodland occurred, there was no general, large scale woodland removal at this time.

The level of human activity could be, as defined by Turner (1964a), characterised by man "... simply using the produce of the forests". (Turner 1964a, 89). Reductions in the pollen frequencies of favoured species such as elm, lime and perhaps yew would occur, but other taxa not harvested for specific resources, such as leaves or bark, could expand their range; this appears to have been the case for oak during this phase of clearance activity.

3.2.4 Sediment loss on ignition: Berth Pool

Percentage L.O.I increases slightly at 240cm, compared to 260cm (Figure 13). The sediment appears to have temporarily become more organic. Conceivably, anthropogenic activity in the catchment area of the pool resulted in the limited inwashing of organic material from the uppermost layers of some catchment soils, in particular, the peats around the margins of the pool.

3.2.5 Archaeology and economy in phase B3

The estimated dates for the renewed clearance activity of phase B3 at the three sites would conventially designate it as 'Beaker clearance'. The current view of the establishment of metalworking in Britain equates it with the introduction from the Continent of Bell Beaker pottery. The earliest phase of introduction is dated to 2100 - 1950 bc (Harrison 1980). New burial traditions were established in Britain, and copper artefacts were introduced; a break with pre-existing Neolithic traditions is indicated.

The earliest appearance of Beaker material does not itself mark the start of the early Bronze Age proper; the second phase of Beaker introductions, ca. 1950 - 1700 bc, sees the appearance in Britain of tin bronze. Harrison (1980) notes that renewed forest clearance is seen in Britain during this second, or middle Beaker phase.

Walker's (1966) findings in the Cumberland lowland see further, post-Neolithic, clearance activity spreading throughout the area from c. 2000 bc. Tinsley and Grigson (1981) estimate c. 2500 bc as the date from which British Neolithic economics began to change as a result of infiltration from Continental peoples, although the introduction of metalworking is attributed to Celtic immigrants arriving early in the first half of the 2nd millennium bc. Megaw and Simpson (1979) identify several centres, or foci, of Beaker settlement. Palynological evidence from one of these centres, Yorkshire, suggests that clearance of Pennine woodlands by man led to heathland expansion c. 1930 bc/3880±100bp (Tinsley 1976). These clearances are linked, by this radiocarbon date, to the 'Beaker' occupation of the Vale of York. In another Beaker centre, charcoal from a ploughsoil with beaker sherds under South Street Long Borrow, Wiltshire, yielded a radiocarbon date of c.2000 bc (Megaw and Simpson 1979). The snail fauna at South Street indicated a land clearance phase followed by a phase of open land. There is evidence for this type of sequence at Boreatton Moss and New Pool, with initial arboreal reductions associated with a short lived shrub expansion which was then succeeded by evidence for the presence of pasture.

Evidence throughout the British Isles suggests that 'Celtic' fields were in use from at least the early 2nd millennium bc (Fowler 1983). Detailed evidence for Beaker clearances in Ireland (Pilcher and Smith 1979) has dates ranging from 2100 bc (4050±50bp) to 1830 bc (3780±70bp) at Ballynagilly, Co. Tyrone. The Beaker clearances at Ballynagilly have several vegetational similarities with those at Boreatton Moss, Berth Pool and New Pool. Reduced oak values are associated with high values for hazel, high birch pollen values also indicate interference in the woodland. Interestingly, the high birch values are dated to 2100 to 2000 bc, falling after 2000 bc, from which time Plantago lanceolata is more consistently recorded and the occurrence of Rumex and Urtica is taken to indicate the presence of disturbed land (Pilcher and Smith 1979). Slight increases in Urtica are clearly seen in B3 at Boreatton Moss. In terms of chronology and vegetational similarity the Ballynagilly clearances have clear parallels with those observed at least at Boreatton Moss and New Pool, although the small Urtica peak at 224cm at Berth Pool (II) could be significant.

Favourable locations for arable and pastoral activity occur in very close proximity to Boreatton Moss and New Pool; a sand and gravel ridge also rises to the south east of Berth Pool (Plate 14). The brown earth soils which surround Boreatton Moss and New Pool are naturally well drained (2.1.4) and have developed on raised sand and gravel ridges which are readily cultivatable (Crompton and Osmond 1954), the typical pattern of land use found in Shropshire today sees arable agriculture practised on the brown earth ridges with grazing land concentrated on the lower lying, damper soils (Crompton and Osmond 1954). The appearance of Secale in B3 at Boreatton need not point to the cultivation of rye, but could indicate its presence as a weed of other crops (cf Godwin 1975), the higher weed pollen frequencies at Boreatton, compared to the other two sites suggest that it was land close to Boreatton which was favoured by the late Neolithic/ early Bronze Age farmers. Harrison (1980, 12) shows that the Welsh Marches and the north west of Britain were peripheral to the main concentrations of Bell Beakers, it could be that the new economic impetus associated with the appearance in Britain of this pottery type was less keenly felt in the Marches but, nevertheless, man does appear to have been active in the Marches c.2000 bc (Stanford 1982) and to have further altered the structure of the post-elm decline woodland.

3.2.6 Summary: Phase B3

Correlations between Boreatton, New Pool, Berth Pool and Crose Mere (Beales 1980) c.2000 bc are difficult because uncertainly surrounds the accuracy of several radiocarbon dates at Crose Mere (Beales 1980, 156-157). Minor increases in Gramineae occur c.300cm at Crose Mere, 20cm or so above a Neolithic Ulmus decline; these levels could correlate approximately to B3 but, in general terms, the available evidence suggests that human impact in lowland Shropshire c.2000 bc was of minor importance as far as the total woodland cover was concerned. Changes in woodland composition are, however, detectable. The pollen diagram from Whixall Moss (Turner 1964a) does not extend back far enough into the past to cover the period c.2100 bc to 2000 bc. Generalised regional clearance and regeneration phases have been outlined for the Shropshire-Cheshire Plain by Beales and Birks (1973), partly on the basis of evidence from the Cheshire-Lancashire mosses (Birks 1963-4, 1965), the sampling interval used at these sites is however too broad to enable realistic comparisions to be made with Boreatton Moss, Berth Pool and New Pool. At Wem Moss, Shropshire (Slater 1972) no dating is available, the upper part of the pollen diagram is defined simply as "zone VIIb + VIII", and the sampling interval is too wide to allow realistic comparisons to be made with the sites in this study. The pollen diagrams from

Boreatton Moss, New Pool and Berth Pool thus represent a useful addition to the knowledge of early 2nd millennium environmental change in the Welsh Marches. At Boreatton Moss, B3 is followed by a short-lived regeneration phase, B4; this phase is less easy to define separately at New Pool and Berth Pool (II) but at Boreatton, New Pool, Berth Pool and Birchgrove Pool there is evidence for a renewed impetus in woodland clearance c.1700 bc, in phase B5.

3.3 Phase B4: Reductions in clearance activity after c.2000 bc

Introduction

Phase B4 is only designated separately at Boreatton Moss; at New Pool and Berth Pool the division between B3 and B4 is unclear, the lowermost sediments examined at Birchgrove Pool are thought to date to B4. An exhaustive discussion of B4 is not intended, it appears to be a relatively short lived phase with some evidence for continued human occupation. Inter-site comparisons are problematic, however, when phase correlation is uncertain.

Main characteristics

Boreatton Moss (centre) c.192cm to 185cm

Increases in *Quercus*, *Tilia* and *Alnus* occur, *Betula* declines and *Corylus/Myrica* reaches a peak. Gramineae and *Plantago lanceolata* decline and herb pollen diversity is reduced. Total herb and heath pollen declines; ZONATION splits occur at the upper and lower contacts of B4. The phase itself is thought to commence after c.2000 bc and to end c.1850 bc.

Boreatton Moss (margin). Below 196cm

The phase is defined by biostratigraphic correlation to the centre of the moss, 208cm at the margin is thought to correlate, approximately with 190cm at the centre.

Gramineae and herb pollen frequencies are low and *Corylus/Myrica* relatively high. In comparision to the central core, *Betula* and *Tilia* are relatively high, and *Quercus* correspondingly lower. Numerical zonation splits mark the upper boundary of the phase.

New Pool c.73cm to 72cm; division uncertain

Tilia continues to be progressively reduced, the rise in *Betula* could point to some birch colonisation in clearings and *Plantago lanceolata* is reduced to less than 1% at 72cm; the *Betula* increase at 72cm to 73cm occurs above levels radiocarbon dated to 2000 bc.

Berth Pool II c.232cm, division uncertain

The age/depth profile for Berth II (Figure 8) gives a date of c.1900 bc for 232cm. Quercus and Corylus/Myrica increase, Gramineae does not decline and Plantago lanceolata occurs at 1-2%. Cyperaceae increases slightly and aquatic pollen types diversify.

Birchgrove Pool c.344cm

The age/depth profile for Birchgrove Pool (Figure 12) gives a date of c.1900 bc. for 344cm. Slight increases in Ulmus, Quercus and Corylus/Myrica are evident, Gramineae occurs at less than 1% and herb pollen diversity is poor.

3.3.1 Inter-site and Intra-site variability in phase B4

It is reasonable to define B4 at Boreatton Moss as a regeneration phase, although decreases in Betula and increases in Corylus/Myrica mean that, in relative terms, total tree pollen actually declines in B4 at the centre of Boreatton. The central core at Boreatton is probably representative of a wider pollen source area than the marginal core (cf Edwards 1982), across this wider source area, oak appears to be taking advantage of reductions in lime although limited increases in Tilia pollen occur at B4 at the centre of the moss. Prior to the B5 Gramineae increases at the margin of Boreatton, Tilia and Betula frequencies tend to be higher than they are at the centre, Quercus and Alnus frequencies are also lower at the margin in B4. Tilia pollen is not generally well dispersed from its source (Pigott and Huntley 1980) and the higher Tilia frequencies at the margin could suggest that lime was relatively abundant close to the western edge of the moss, this could also be true of birch whereas alder might have been less abundant close to the western edge of the moss, in comparison to other parts of the periphery. Fraxinus occurs at more than 1% in both cores in B4; a light demanding taxon, ash would tend to increase in abundance within the woodland, providing human impact remained at moderate levels and wholesale woodland clearance did not occur.

Corylus/Myrica frequencies were reduced in B3 but recover in B4, possibly pointing to the re-establishment of hazel as an understorey shrub. Salix declines in abundance in both cores in B4, suggesting that willow was shaded out as woodland regrowth occurred. If the assumed correlation between the edge and centre of Boreatton is correct, Gramineae frequencies appear to be higher at the margin in B4, Plantago lanceolata also appear to occur at higher frequencies at the margin, whilst Liguliflorae is recorded at the margin but not at the centre. Plantago lanceolata is a well dispersed pollen type (Caseldine 1981) and its higher frequencies at the margin suggest that it is being derived from a very restricted cleared enclave close to the western edge of the moss. Man thus appears to have remained active close to Boreatton Moss in B4, although an alternative explanation for the relatively high Gramineae and Plantago lanceolata values at the edge of the moss could be that, locally, some grazing by herbivores maintained open areas (cf Buckland and Edwards 1984) which had their origins in B3. Herb pollen representation in mid B4 at the centre of Boreatton is generally low. Apart from Gramineae, only Plantago lanceolata and Cyperceae, both at less than 1%, occur at 188cm; in both cores, Pteridium frequencies are minimal in B4, the representation of this spore type tends to increase in the clearance phases B3 and B5. In the woodland around Boreatton, therefore, there appears to be a reduction in the availability of habitats suitable for herb colonisation in B4, there is evidence for lime regrowth and oak appears to have increased in abundance.

At New Pool, the 2000 bc Betula reduction was accompanied by an increase in Tilia, this appears to be in contrast to the behaviour of the Tilia pollen curve at Boreatton. New Pool is a small site, and its pollen source area is probably relatively localised (Tauber 1965, Jacobson and Bradshaw 1981, Prentice 1985), the 2000 bc Tilia increase at New Pool might thus involve regrowth or enhanced flowering of only a few individuals of lime located in very close proximity to the edge of the site. After 2000 bc at New Pool Tilia is progressively reduced in frequency; in contrast to Boreatton, Corylus/Myrica does not increase in frequency in horizons between the B3 Ulmus reduction and the B5 Tilia decline at New Pool. Continuing human activity after 2000 bc at New Pool could thus be responsible for the progressive removal of lime and the suppression of hazel in the understorey. Although Ulmus and Tilia decline in frequency at and after 2000 bc at New Pool, Quercus frequencies remain high, perhaps indicating that elm and lime were being selectively felled; further increases in Quercus are apparent above the B5 Tilia decline at New Pool. Gramineae frequencies between 70cm and 75cm at New Pool remain relatively low, but Liguliflorae and Plantago lanceolata continue to occur. Succisa, Umbelliferae, Urtica and Hypericum perforatum type all occur between 70cm and 75cm and Pteridium continues to appear. A simple B3-B4-B5 division cannot thus be made at New Pool. Between 2000 bc and 1600 bc Ulmus and Tilia continue to be reduced and an albeit limited herb flora persists in the vicinity of the site. The clearer regeneration phase at Boreatton could suggest that an actual settlement site close to the moss was abandoned c.1900 bc, whilst elsewhere in the area man continued to exploit woodland resources.

The age/depth profile for Birchgrove Pool suggests that the pollen spectra below 340cm date to c.1900 bc. Human impact on the woodland appears to be slight at this time around Birchgrove Pool. Gramineae occurs at less than 1% and only Tubuliflorae appears amongst the open habitat indicators and other herb pollen is poorly represented. Rosaceae and Ranulculaceae pollen could be derived from locally growing herbs in fen or other damp habitats. Continuous curves for Ulmus and Tilia are present and Fraxinus occurs, suggesting that some disturbance of the woodland has already taken place (Godwin 1975). At 340cm and 344cm, total herb and heath pollen amounts to only c.1% of total determinable land pollen, human impact in the woodland close to Birchgrove Pool appears to have been minimal or non-existent in B4.

In Berth Pool II, a date of c.1900 bc can be assigned to 232cm. As as New Pool, Tilia appears to be progressively reduced at Berth Pool in B3-B4, in common with New Pool and Boreatton, Quercus increases accompany the reductions in Tilia. Taxus recovers slightly at 232cm and Corylus/Myrica also increases. Some shrub or tree regrowth could be in evidence although Gramineae tends to increase and Plantago lanceolata occurs at 1-2% at 232cm; the diversity of herb pollen is very limited but Pteridium does occur. The diversification of aquatic pollen types between 230cm and 240cm could be linked to reductions in Alnus. If man was active in the woodlands around Berth Pool, and removed some alder trees from partially flooded areas, Nuphar, Nymphaea and Potamogeton could have become established. Yew can grow in fen woods (Godwin 1975, 115) and the possibility exists that the Taxus decline in B3 at Berth Pool reflects in part the removal of Taxus from fen habitats, perhaps close to the pool margins where any opening out of the tree canopy could favour the establishment of water lilies or other floating-leaf macrophytes such as Potamogeton spp.

Locally, man's impact, c.1900 bc, appears to have been greater closer to Berth Pool than to Birchgrove. Human impact in the area c.1900 bc was thus relatively slight, and appears to have been spatially variable. The Quercus pollen increases at Berth Pool and Boreatton could reflect enhanced flowering of oak as elm and lime were cleared but could equally indicate an increase in oak abundance at the expense of the latter two taxa. Elm and lime are both thought to have been selectively utilised by prehistoric peoples (Godwin 1975).

3.3.2 Archaeological evidence

B4 represents only a short period, dating to the earlier stages of the early Bronze Age. B4 falls within the Mount Pleasant Period of the early Bronze Age (Burgess 1980), a time when the Beaker pottery tradition and the first bronze industries had become established in Britain (Burgess 1980, Bradley 1984, Megaw and Simpson 1979). Domestic Beaker pottery was found at Bromfield in south Shropshire (Stanford 1982) but Beaker pottery is generally sparsely distributed in Wales and the Marches (Stanford 1982, 288; Harrison 1980). An early Bronze Age stone axe-mould was found near Longden Common, south of Shrewsbury in 1961 (Thomas 1972). An early Bronze Age metalworking industry could well have been present in Shropshire (Thomas 1972). Late Neolithic and early Bronze Age routeways have been identified on hill crests in the region, for example, the Clun-Clee ridgeway (Chitty 1963). The distribution of field monuments suggests that traffic in the earlier Bronze Age moved largely along the ridgeways (Chitty 1956) and it is possible, but in the absence of actual settlement evidence by no means certain, that the lowlands were peripheral to the main foci of human activity in the early Bronze Age.

3.3.3 Summary: phase B4

B4 is a short phase, not separately delimited at the four sites in question; inter- and intra-site comparisons have thus been limited in scope but serve to show that human groups were active in the Baschurch/New Pool areas c.1900 bc. Conceivably, clearances closer to Boreatton Moss were abandoned at this time but woodland clearance and/or exploitation is indicated in the pollen spectra from New Pool and Berth Pool. Human impact appears to become more intense c.1800 bc. Slightly larger woodland clearances are in evidence and further *Tilia* declines occur at Boreatton, New Pool Berth Pool and Birchgrove Pool.

3.4 Phase B5: An early Bronze Age *Tilia* decline

Introduction

A phase of intensified woodland clearance begins c.1800 bc. This activity culminates in the reduction of *Tilia* pollen to less than 1% for the first time on the diagrams for Boreatton Moss, New Pool and Berth Pool; radiocarbon dates suggest that this *Tilia* decline occurred c.1600 bc to 1700 bc. In common with B3 there are indications that the land close to Boreatton Moss was a favoured location for human settlement.

Main characteristics

Boreatton Moss (centre). 185cm to 166cm

Quercus frequencies are reduced and the *Ulmus* curve becomes broken. *Corylus/Myrica* frequencies are reduced. Gramineae, cereal and open habitat indicator pollen increases in frequency, other herb pollen types diversify and *Pteridium* increases. *Tilia* is ultimately reduced to less than 1%; further increases in Gramineae and *Plantago lanceolata* are associated with reductions in cereal pollen, *Taxus* appears for the first time in mid B5. Cyperaceae, *Hydrocotyle*, *Sphagnum* and *Scheuchzeria* increase in frequency, suggesting that hydrological conditions on the moss changed as a result of local clearance activity.

Boreatton Moss (margin). c.196cm to 178cm

Betula, *Tilia*, *Alnus* and *Corylus/Myrica* frequencies are reduced. Gramineae, cereal and open habitat indicator representation increases and *Pteridium* increases. Cyperaceae, *Hydrocotyle*, *Sphagnum* and *Scheuchzeria* occur. In both cores from Boreatton, numerical zonation splits mark the B4/B5 transition and the B5 *Tilia* decline; the first zone split in SPLITINF is placed at the 173cm *Tilia* decline in the centre of the moss.

Berth Pool II. c.232cm to 220cm - c.1900bc to 1700bc

Tilia and *Taxus* decline to less than 1%, and *Corylus/Myrica* declines. Gramineae increases and, in common with Boreatton Moss, cereal and

Secale pollen occur. *Tubuliflorae* and *Plantago* occur and *Rumex acet* appears for the first time. Herb pollen diversity is relatively low but *Pteridium* appears. Total tree pollen actually increases at 224cm. This appears to be due mainly to a combination of increases in *Ulmus*, *Quercus* and *Fraxinus* and a decline in *Corylus/Myrica.* Minor ZONATION splits occur between 216 cm and 220 cm where *Tilia* declines to less than 1%.

Birchgrove Pool. c.340cm to 328cm - c.1800bc to 1600bc

Tilia and *Taxus* decline at 332cm, but, initially, *Taxus* increases at 340cm where *Alnus* is temporarily reduced. A marked reduction in *Corylus/Myrica* occurs and Gramineae increases; small peaks in *Plantago lanceolata* and *Urtica* occur at 336cm and 332cm respectively, *Pteridium* occurs in consecutive samples above 336cm. Aquatic pollen diversity improved slightly, above 340cm. Numerical zone splits occur between 332cm and 336cm.

New Pool. c.70cm

Betula and *Tilia* decline, *Quercus* and *Alnus* tend to increase and *Fraxinus* increases, a rise in *Corylus/Myrica* also occurs. *Salix* increases, Gramineae increases slightly and *Plantago lanceolata* peaks at the *Tilia* decline horizon. The division between B3/B4 and B5/B6 is approximated but the radiocarbon dates for the *Tilia* declines at 68cm at New Pool and 173cm at Boreatton Moss are only 10 radiocarbon years apart at one standard deviation. ZONATION splits occur between 70cm and 71cm.

3.4.1 Inter-site variability in phase B5

Particular emphasis is placed upon the pollen spectra from Boreatton Moss, where there is clear evidence for arable agriculture in phase B5. At the start of this project, the "*Tilia* decline" horizon (*cf* Turner 1964a) was sought as a biostratigraphic marker, in order to assist the definition of a relatively restricted time span in the vegetational history of the area which could then be examined in detail. Three samples were submitted for radiocarbon dating which related to *Tilia* declines at Boreatton Moss and New Pool. Initially it was thought that these declines dated to the later Bronze Age, c.1200bc to 1300bc, the date obtained for the *Tilia* decline observed by Turner (1964a, 1965) at Whixall Moss. Dating showed that the *Tilia* declines at 68cm at New Pool and 173cm at Boreatton Moss were early Bronze Age phenomena:

Boreatton Moss (centre) 162cm to 172cm: Continuous *Tilia* curve ends:- 3660±50 bp (SRR - 2831); 1710bc.

New Pool 66cm to 69cm: *Tilia* declines to less than 1%:- 3550±50bp (SRR - 2833); 1600bc.

Although Beales (1980) obtained a radiocarbon date of 3714±129bp (Q - 1234) for a horizon immediately above a *Tilia* decline at Crose Mere, there are excellent biostratigraphic grounds for correlating this decline with the *Tilia* decline at Whixall Moss dated to 1288±115bc (Q -467, Turner 1964a, 85) and the *Tilia* decline at the B6/B7 boundary at Fenemere, dated to 1240±60bc (SRR - 2923). There are thus two *Tilia* declines in lowland Shropshire, one in the earlier, and one in the later Bronze Age. This section will first examine the B5 clearance activity at Boreatton Moss, where clearance activity appears to be concentrated. Boreatton will then be compared with New Pool and finally Berth Pool and Birchgrove Pool will be compared to the two mosses.

3.4.2 Boreatton Moss (centre): Early Bronze Age arable agriculture; 185cm to 173cm

The occurrence of a continuous curve for undifferentiated cereal pollen between 176cm and 183cm, combined with the continuous presence of *Secale* pollen between 173cm and 185cm suggests that some crop growing was occurring in close proximity to the edge of the moss, although rye itself is probably occurring as a weed of other crops (cf Godwin 1975); cereal pollen is known to be poorly dispersed from its source by the wind (Vuorela 1977). The relatively high tree pollen frequencies, at least in early B5 at the centre of Boreatton, suggest that the land around the site was predominantly wooded. Boreatton, at c.7.1 ha, is theoretically large enough to receive much of its pollen from areas several hundred metres or more from its margin (*cf.* Jacobson and Bradshaw 1981), although if the moss was partially or wholly covered in trees regional pollen could tend to overshoot the site (cf Tauber 1967b). The presence of a relatively closed woodland is not conducive to the efficient lateral transfer of non-arboreal pollen (Vuorela 1973). It is therefore unlikely that the cereal pollen deposited at the centre of Boreatton Moss has travelled very far. A number of workers have attempted to derive indexes from the pollen spectra which indicate whether arable or pastoral agriculture was practiced in the pollen source area of a site. This work has been reviewed by Maguire (1983) and Maguire et al (1983) where it is concluded that trends in the Arable:Pastoral indexes of several workers are reasonably similar, when the indexes are calculated for a single data set. Inevitably there are problems with these indexes, since there is assumed to be a lack of contemporary weed communities which are analogous to prehistoric communities (Behre 1981). The index taxa may have variable dispersal efficiencies, for example, *Plantago lanceolata* could be over-represented (Edwards 1979). Given that *Plantago lanceolata* is efficiently dispersed (Caseldine 1981) it could however be reasonable to infer arable agriculture where relatively high cereal pollen frequencies are associated with low or moderate *Plantago* frequencies (cf Turner 1964). The Arable:Pastoral index derived by Turner (1964) has been selectively used in this project although more stress is placed in trends in the index, rather than absolute values (Maguire et al 1983). Turner's (1964) A:P index is calculated as follows: The total number of *Plantago* pollen grains is divided by the total number of *Plantago* grains plus the total number of Compositae (undiff), cereal, Cruciferae, *Artemisia* and Chenopodiaceae, the resultant fraction is multiplied by 100 to give a percentage. Turner (1964) found that in an arable region in Norfolk the index tended to be less than 15%, in a pastoral region in Wales, the index tended to be more than 50%. Maguire et al (1983) suggested that where a downward trend in the ratio was observed, with values of 30% or less in evidence, a trend towards arable agriculture was indicated. Turner's (1964) ratio has been calculated for the samples between 171cm and 187cm inclusive at the centre of Boreatton Moss. The frequencies of total cereal pollen are also shown, as percentages of total pollen, land pollen (excluding Coryloid, Cyperaceae and Ericaceae) and total non-arboreal pollen (cf Vuorela 1977):

Depth (cm)	A:P ratio	Total cereal pollen % TP	% LP	% N.A.P*
171				
172				
173	71.4	+	+	1.6
174	32.1	1.5	3.0	10.4
175	58.3	+	+	+
176	11.7	+	1.7	5.7
177	35.0	2.3	4.9	10.9
178	37.5	1.0	1.9	5.5
179	35.4	1.4	2.8	7.7
180	31.0	1.5	2.8	10.4
181	41.4	1.0	2.1	5.0
182	17.1	1.8	3.5	10.2
183	28.5	1.2	2.5	8.3
184	45.4	+	+	+
185	50.0	+	+	+
186	33.3	+	+	+
187	No index taxa present			

* N.A.P includes only identified herb taxa. + less than 1%

It is stressed by Maguire et al (1983) that the trend in the ratio, rather than individual values, is probably the best indication of whether there is a move towards, or away from one particular type of land use. An attempt has been made to identify a general trend in the Arable:Pastoral ratio at Boreatton Moss using a 3- sample running mean (Figure 17). In general terms, the Arable:Pastoral ratio decreases as the cereal total increases as a percentage of non-arboreal pollen. It is not suggested here that Secale, the only cereal type identified to species level, was being cultivated, although it could still derive from crop stands where it existed as a weed. Secale pollen is dispersed more widely than the pollen of other cereals, and could even be comparatively over-represented in pollen diagrams (Chambers and Jones 1984), for this reason it could be significant that, at the levels under discussion at Boreatton Moss, Secale frequencies are lower than cereal pollen (Undiff) in several samples. This could suggest that Secale was only an occasional weed amongst other crops.

Maguire et al (1983) show that of several Arable:Pastoral ratios derived from different authors most exhibit very similar trends when plotted together on the same diagram. Maguire et al (1983) are of the opinion that Arable:Pastoral ratios of 30% or less are reasonable indicators of a trend towards arable land use. In association with pollen evidence for arboreal reductions, the trend in the Arable: Pastoral curve at Boreatton Moss (Figure 17) is taken to indicate the establishment of some crop growing in the pollen source area of Boreatton Moss in the early Bronze Age. Given the generally poor dispersal of the larger cereal pollen grains, cereal totals of up to 10% N.A.P. 80-90m from the nearest potential source point to the close proxmity to the moss of the clearance activity. At this point the question of the location and extent of the clearance activity can be explored further by comparing the pollen diagram from the centre of the moss with that from the margin.

3.4.3 Intra-site variability: The margin and centre of Boreatton Moss, phase B5

3.4.3.1 Arable activity

Theoretically, the evidence for clearance at 173cm to 185cm at Boreatton Moss (central) could be interpreted in a number of ways, for example:-

(i) Clearance of low, but equal intensity over the whole of the pollen source area.

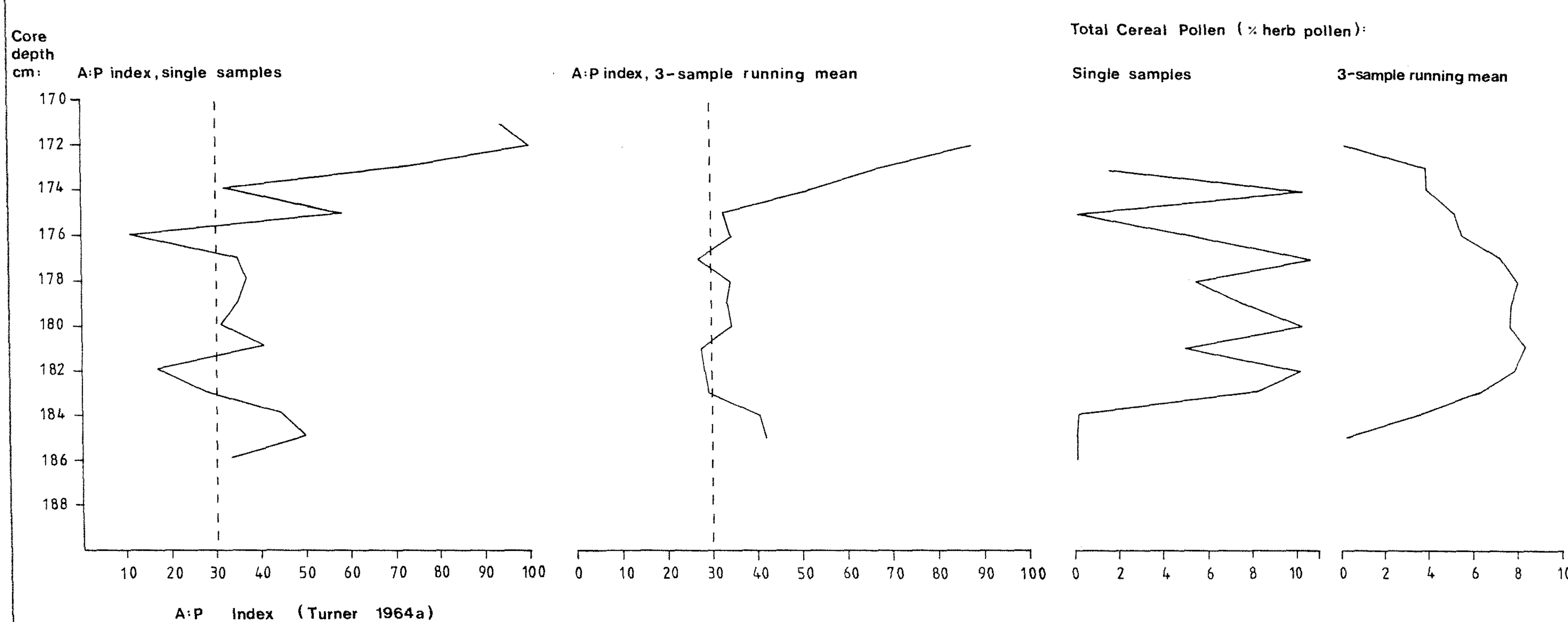
(ii) 2-3 discrete clearances of greater intensity at unknown locations within an otherwise wooded pollen source area.

(iii) One large clearing, whose intensity is underestimated by a central core.

The inference of the scale, and distance from the sampling point of clearance activity has been critically reviewed by Edwards (1982).

On the basis of Tauber's(1965) conclusions about local and regional pollen sources Turner (1970) attempted to be more precise about the location and extent of clearance activity around a moss by selecting sampling sites at an increasing distance away from the moss edge.

Fig 17 Boreatton Moss (centre). Arable: Pastoral Index and Cereal Pollen in Phase B5



In theory, a central core would be expected to represent the level of clearance in the region around the site, whereas a more marginal core would be expected to show up localised variations in clearance intensity. Partly on the basis of Tinsley and Smith's (1974) work on surface pollen studies across woodland edges, Edwards (1982) considers that Turner (1970) did not sample near enough to the margins of Bloak and Kennox Moss to accurately reflect local effects. Edwards (1982) recommends that marginal profiles should be taken from within 30m of the edge of a site. The marginal core at Boreatton Moss was taken 22m from the dry land around the moss. Correlation between the marginal and central cores is probable at the following depths:-

Centre	Margin
190cm	208cm
173cm	180cm

This correlation is based on similarities in the frequencies of several pollen types:-

(i) *Ulmus*. *Ulmus* is recorded at less than 5% at these levels at the margin and centre, and declines to less than 1% at 182cm (margin) and 173cm (centre).

(ii) *Tilia*. *Tilia* declines to less than 1% at 180cm (margin) and is temporarily absent from the pollen record above this level. The same sequence is seen at 173cm (centre).

(iii) *Corylus/Myrica*. Coryloid frequencies exceed 50% of total pollen at 190cm (centre) and 208cm (margin). Frequencies decline to c.30% at 192cm (margin) and c.40% at 182cm (centre). Frequencies then increase slightly at 182cm (margin) and 176cm (centre) before declining further at the *Tilia* decline at 180cm (margin) and 173cm (centre).

(iv) *Gramineae*. Gramineae frequencies are initially low, but increase to peaks at 188-196cm (margin) and 177-185cm (centre). Frequencies then decline at 182cm (margin) and 176cm (centre) before peaking sharply in association with the *Tilia* decline at 180cm (margin) and 173cm (centre).

(v) Cereal and open habitat indicator representation increases in association with the Gramineae peaks.

(vi) Pteridium. Pteridium frequencies increase as Gramineae values begin to rise.

Numerical ZONATION boundaries indicate the significance in these changes in the pollen content of the peat at 190-191cm (centre) and at 200-204cm and 196-200cm (margin).

When the point of correlation between two cores is approximately, rather than precisely fixed, problems will arise in the interpretation of intra-site pollen frequency contrasts. If the onset of the Gramineae rise is taken to occur at 200cm at the margin, then Betula representation is apparently greater at the margin; 10% in comparison to 3% at the Gramineae rise at 185cm in the central core. This assumes contemporaneity in the onset of the Gramineae rise, Gramineae however could be increased earlier, from a higher minimum frequency at the margin. Alternatively, if the true onset of the Gramineae rise at the margin is taken to occur at 196cm, then Betula frequencies are very similar between the margin and centre. The preferred explanation is that, at the margin, Gramineae frequencies are slightly higher than at the centre, it should be noted that cereal (undiff) pollen increases to more than 1% at the same biostratigraphical level in both cores, where Betula has declined to 3-4% and Gramineae begins to attain its highest values.

If this inferred correlation is correct, it follows that the brief Coryloid peak at 185cm at the centre is not represented at the margin at the point where cereal frequencies increase. The wider sampling interval in the marginal core could be responsible for this effect. If the approximate correlation between the cores is taken to be as follows :

190cm (centre) - 208cm (margin),

it is apparent that the marked decline in Quercus at 185cm at the centre is not shown in equal magnitude at the margin. The question of the apparent contrast in Betula frequencies at the onset of the Gramineae rise has already been mentioned, and the onset of the

Gramineae rise at 196cm at the margin has been correlated , as at the centre, with Betula values of only 3-4%. This suggests that Betula representation at the margin was no higher than the centre at the onset of the Gramineae rise. However, it is apparent that, in association with the lower, pre-increase values of Gramineae Betula representation is greater at the margin, c.12-13% as opposed to c.7-8% at the centre. Tilia representation is also apparently higher at the margin, in association with the pre-increase Gramineae values of 1-2% at the centre and 4-5% at the margin. Betula pollen could have a local source close to the marginal core, in this case, higher Betula frequencies would be expected at the moss edge, in comparision with the centre; this has been demonstrated by Caseldine (1981) at a moss with a fringing birch woodland. Also, in terms of pollen dispersal and representation, higher Tilia frequencies would be expected in a marginal core, in this case potentially less than 30m from the nearest lime trees (Pigott and Huntley 1980). At a greater distance from the edge, 85m in the case of the central core, less Tilia pollen might be expected. Birch and lime could therefore be important contributors to the pollen input at the edge of Boreatton Moss but less so at the centre. Under these circumstances the relative representation of Quercus pollen could be greater towards the centre of Boreatton Moss, particularly if oak was more abundant in the woodland than birch, away from the margin of the moss. At the centre of Boreatton Moss a high proportion of the Quercus pollen would theoretically be derived from extralocal or regional sources (Jacobson and Bradshaw 1981) and its relative representation would therefore increase away from the margin as the influence of locally produced pollen declined. Alnus frequencies are quite similar between the edge and centre of the moss, but tend to be slightly higher at the centre, this could suggest that birch, rather than alder was more common at the edge of the moss. It is possible that some birch grew on the moss, although the fact that Betula declines where there is evidence for clearance suggests that it did have some terrestrial pollen sources.

On the basis of the correlations so far outlined, it is thought probable that the small reduction in Quercus at 196cm at the margin corresponds to the more substantial Quercus reduction at 185cm at the centre. In both cores, this Quercus reduction is marked by an increase in Cerealia representation to more than 1%, and also an increase in Pteridium to more than 1%. The non-arboreal pollen frequency increases which occur after the Quercus decline indicate an expansion of open land, and better pollen dispersal conditions for herb taxa.

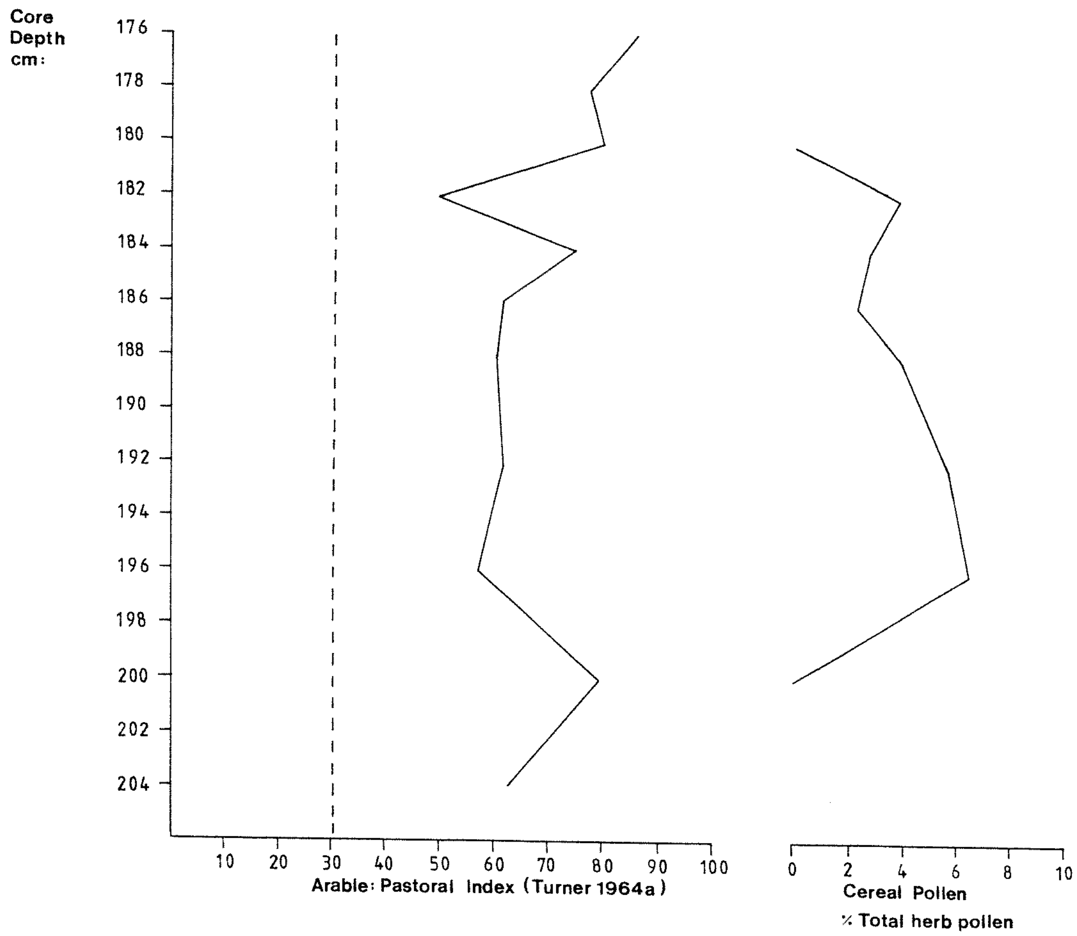
Gramineae frequencies increase to c.25% at the margin, compared to c.15% at the centre, although the proportional increases are similar in both cores:

Minimum Gramineae values		Maximum values		Increase	
Margin	Centre	Margin	Centre	Margin	Centre
c. 4%	c. 2%	c. 25%	c.15%	6.3	7.5

A distance decay effect in Gramineae frequencies could be evidence here. Amongst the other open habitat indicators, Plantago lanceolata reaches c.6% at the margin compared to c.5% or less at the centre in association with the Gramineae increases. It is interesting to note that Tubuliflorae, which is consistently recorded at c.2-5% at the centre in association with the Gramineae peak, occurs at less than 1% in three samples from the Gramineae peak at the margin. This contrast in the representation of open habitat indicators, combined with the lower total cereal frequencies at the margin (Figure 18) result in an important contrast in the Arable:Pastoral indices derived from the two cores (Figures 17 and 18). The Arable:Pastoral index at the centre of the moss can be interpreted as showing a trend towards arable agriculture (Maguire et al 1983), since the index declines to c.30% and below. At the edge, however, the index exceeds 60% in all but two samples, the lowest value being 50%. With the wider sampling interval, it is possible that one or two high cereal frequencies could have been missed at the margin, but cereal frequencies only exceed 5% N.A.P in two samples at the margin in contrast to the running mean at the centre which exceeds 6% N.A.P in association with Arable:Pastoral indexes of c.30%.

The differences between the margin and the centre, clearly important if an attempt is made to infer land use type, could reflect, in part, genuine spatial variations in clearance type around the margin of the moss, or simply the effect of pollen transfer processes on the recruitment of pollen to different parts of the moss. Theoretically, a site the size of Boreatton Moss, c.200m in diameter would be expected to receive a relatively high proportion of its pollen from

Fig 18 Boreatton Moss (margin). Arable: Pastoral Index and Cereal Pollen in Phase B5



the trunk space of the woodland within a few hundred metres of the site. Although some woodland clearance is in evidence at this time, a high proportion of woodland cover is still indicated, and it therefore may be constructive to think in terms of above- and below-canopy pollen transfer to the moss. Theoretical models (Tauber 1965, 1977) suggest that trunk space transfer is an important component in the pollen input to a site although some studies (Andersen 1973, 1974a) show that lateral transfer of pollen below a closed canopy is restricted, certainly to less than the "several hundred metres" thought to encompass the extralocal pollen source (Jacobson and Bradshaw 1981). Caseldine (1981) estimated that at Bankhead Moss, Fife, which is 150 x 80m in extent, up to 55% of the grass pollen at the bog centre was derived from above-canopy transfer although in this case large tracts of open land beyond a fringing woodland provided a potentially dominant non-arboreal pollen source within 20-30m of the bog edge.

If clearance activity was indeed separated from many bogs and lakes by unfelled fringing trees (Caseldine 1981), and a considerable proportion of the non arboreal pollen was derived from above-canopy transfer, it is theoretically possible that the representation of some non-arboreal taxa, those present outside a fringing woodland, would increase beyond a 20-30m marginal zone on the moss. This improved representation might only be relative, rather than absolute, and be a function of the reduced influence of locally produced pollen along a transect from edge to centre of the moss. At Bankhead Moss (Caseldine 1981) there is evidence, in Transect A, that Gramineae Cerealia, Plantago lanceolata, Rumex acet and Leguminosae frequencies increased towards the centre of the moss. In Transect B, the Tubuliflorae frequency was highest towards the centre of the moss, and in Transect C, Cerealia, Plantago lanceolata and Tubuliflorae frequencies were all higher 30m or more out from the edge of the moss. In part this effect might be attributable to relative declines in Betula frequencies away from the fringing woodland, although amongst other non-arboreal taxa Artemisia, Plantago m/m and Caryophyllaceae are not recorded within 20m of the moss edge.

Marginal cores within 30m of the edge of a moss might therefore be expected to indicate the presence of clearances existing at one locality at the moss edge, providing no substantial belt of fringing woodland was left unfelled. If non-arboreal pollen is transferred from source areas outside a fringing tree belt (Caseldine 1981), and is transferred in high proportions above the canopy it will behave, in a sense, as regional rather than local pollen, and its relative representation across a peat surface will vary accordingly.

The evidence expressed in the marginal and central cores at Boreatton Moss is therefore equivocal; Gramineae frequencies certainly exhibit a distance-decay effect away from the margin, but no such effect is seen in the case of cereal pollen.

It is possible that some broken ground, characterised by Gramineae and Plantago existed closer to the moss edge than any cultivated plots; this might explain the variation in the Arable:Pastoral indices, assuming that some index taxa were transferred from beyond a fringing woodland and therefore relatively under-represented at the immediate margin of the site.

In summary the comparision of cores between the edge and centre of Boreatton Moss, over a time span where some crop-growing is indicated, has shown that many variations can exist which will complicate the inference of the nature and proximity of clearance activity. Further work, involving the relative and absolute pollen analysis of cores sited no more than 10m apart across the marginal, intermediate and central zones of peat mosses would possibly resolve some of the uncertainties about pollen source area and transfer processes.

3.4.3.2 The B5 Tilia decline at Boreatton Moss

Margin: 180cm

Centre: 173cm

In both cores, Tilia and Ulmus decline to less than 1%, Quercus frequencies increase slightly, Taxus appears in the pollen record and, particularly evident at the margin, Fraxinus frequencies increase. Gramineae frequencies decline slightly, as cerealia frequencies are reduced, but then increase sharply at the Tilia decline. The frequency of cereals and some open habitat indicators appears to decline at the same level at which Tilia declines. Plantago lanceolata however increases slightly at the Tilia decline. The Arable:Pastoral index (Turner 1964a) in the centre increases to well above 50% at the time of the Tilia decline, and there is therefore some evidence that the Tilia decline occurred as a result of a change in land use immediately following the arable phase, rather than as a direct result of this phase. Corylus/Myrica frequencies decline in association with Tilia and Ulmus, possibly suggesting that both trees and shrubs were cleared in the area around the moss to allow for grassland expansion. The Corylus/Myrica decline is short-lived; Gramineae and Plantago lanceolata decline and the diversity of open habitat indicators is further reduced at 165cm at the centre, where Coryloid frequencies increase again. The inference drawn from these pollen frequency changes is that the arable phase was followed by a short lived expansion in pasture, during which most of the elm and lime trees were removed from the vicinity of the moss, and this grassland expansion was in turn succeeded by some tree and shrub regeneration involving oak, ash, yew and possibly hazel (Phase B6, below).

Apart from reductions in the main open habitat indicators at 165cm at the centre of the moss, the frequency of occurrence of other herb taxa decreases, for example, Campanulaceae, Leguminosae, Rumex undiff. and Mercurialis. The "post-arable" section of phase B5, characterised by a brief Gramineae increase and the probable elimination of elm and lime from land around the moss has a radiocarbon date of 3660bp/1710bc. A Tilia decline at New Pool has a radiocarbon date of 3550bp/1600bc, only 10 radiocarbon years younger than the Boreatton Moss Tilia decline date when the two dates are compared at one standard deviation:-

Boreatton Moss	3610 - 3710bp
New Pool	3500 - 3600bp

Inter-site comparisons between Boreatton Moss and New Pool suggest variations existed between the sites in terms of the nature and extent of inferred clearance activity.

3.4.4 Boreatton Moss and New Pool: Inter-site contrasts in phase B5

In comparison to Boreatton Moss, New Pool shows less evidence for clearance and farming in the early Bronze Age. Above the radiocarbon dated horizon at 3950±50bp at New Pool, reductions in Ulmus and Tilia pollen occur in association with very small increases in Gramineae and Plantago lanceolata, with both the latter types recorded at less than 5%. Amongst the other herb types, Unbelliferae, Urtica and Hypericum perforatum type are recorded more often above 73cm, but with the exception of Urtica at 70cm, all at less than 1%. Total herb pollen between 2000bc and 1600bc at New Pool amounts to only 4-6% T.P, compared with 20% at the centre of Boreatton Moss and 30% at the margin at c.1800bc.

Following the radiocarbon dated horizon at 3950±50bp at New Pool, some thinning of the woodland is indicated, with Fraxinus pollen recorded at more than 1%, and an increase in the frequency of Salix. This could indicate an increase in the abundance of willow, or perhaps simply the development of improved pollen dispersal conditions as some of the main forest trees are felled. At 70-71cm, where Salix increases slightly, Ilex first appears and Sambucus and Crataegus are recorded, indicating a diversification in the shrub flora, although, as in the case of Salix, the felling of trees in the vicinity of New Pool could be leading to the improved pollen dispersal of taxa already present in the vegetation. Neither Boreatton Moss or New Pool show evidence for wholesale forest clearance in the first half of the 2nd millennium bc, although unlike Boreatton, New Pool has no evidence for a period of crop growing ca. 1800bc. One explanation for this pattern could be that a genuine variation occurred in the intensity of human activity in the vicinity of these two sites. With a diameter of up to 150m, and c.1.2 ha in extent (2.2.2), New Pool could theoretically receive over half its pollen from several hundred metres away from the site edge, and perhaps 10% of its pollen from several kilometres or more away (Jacobson & Bradshaw 1981). If an extensive clearance some distance from Boreatton Moss had given rise to the herb and cereal increases seen at that site at c.1800bc, and some of these types were therefore derived from the regional pollen input, then they might be expected to appear at New Pool even if no clearance activity were occurring near to that site. There might therefore be problems in deciding whether the low frequency of herb taxa recorded at a given site reflects the presence of small scale clearances near to that site or larger clearances further away. This problem was identified by Oldfield (1970) in respect of pollen source strength and distance and will inevitably give rise to uncertainty as to whether the low herb pollen frequencies at New Pool reflect activity within or outside the extralocal pollen source area of the site.

An uncertainty about the precise source of the low herb frequencies at New Pool need not necessarily rule out the possibility of inferring a low level of clearance activity close to that site. If the frequencies of herb taxa represent a distant source, it is axiomatic that no clearance is occurring in the immediate locality, and if they represent a local source it does not appear, given the potential for good local representation at New Pool, to be a particularly extensive source. If it is established, by reference to a number of sites in a given region, that that region was largely forested at a particular time, then it becomes more likely that inter-site contrasts in the registration of clearance activity are due to contrasts which are local to the sites themselves. One further complicating factor is the extent to which highly localised arboreal pollen sources will affect the relative abundance of non-arboreal pollen at the centre of sites of contrasting size. Betula and Quercus frequencies are higher at New Pool than at Boreatton Moss (centre) at the 1700/1600bc Tilia declines, this could be because the central core at New Pool, the smaller site, is more representative of local arboreal pollen inputs than Boreatton Moss, and less representative of non-arboreal pollen which might be derived in part from areas separated from both mosses by fringing woodland.

The possibility of trees growing on the moss surfaces of Boreatton and New Pool at the time of accummulation of the deposits under study cannot be overlooked.

Increases and decreases in Betula and Alnus frequencies occur during phases of clearance and regeneration at New Pool and Boreatton Moss, suggesting terrestrial sources for at least some of the pollen from these two species which would be capable of colonising at least the margins of the two sites.

No bark or leaf remains were found in the peat covering the time period of study at either site, but as long as there is some uncertainty as to whether either or both of the sites were tree-covered in the Bronze Age, the influence of site size on the pollen deposition is subject to the proviso that, in reality, the extent of the open moss areas is unknown during the time period of study (2.2.2).

Ideally, inter-site contrasts should only be assessed in terms of genuine vegetational differences when it is known for certain that, at the time of interest, the sites were of precisely the same extent and depositional type. On the basis of the evidence from Boreatton Moss and New Pool it appears that woodland clearance in the area in the earlier Bronze Age was of a relatively low intensity, possibly with selective clearance of elm and lime over wide areas, but with more permanent clearings and some arable activity in restricted localities where soil conditions were especially favourable.

At 68cm at New Pool, where Tilia declines to <1% at 1600bc, total herb pollen stands at c.7%. This contrasts with Boreatton Moss where, at the point at which Tilia declines to less than 1%, total herb pollen reaches c.35% at the centre and at the margin. This feature at Boreatton has been interpreted as indicating some grassland expansion. Although the herb increase at Boreatton is made up predominantly of Gramineae, Plantago lanceolata and Rumex acet type also increase at 173cm, this is important since it would be unsafe to infer grassland expansion purely on the basis of increases in Gramineae, since Graminaceous species could also be growing on the moss itself. There is no evidence for a similar grassland expansion at New Pool at the Tilia decline, just as there was no evidence for arable farming prior to the decline. Also in contrast between the two sites, Corylus/Myrica frequencies decrease at the Tilia decline at Boreatton, whereas they increase immediately above the Tilia decline at New Pool before declining slightly at 66cm. Some clearance of the shrub understorey is therefore indicated at Boreatton Moss at the point where Tilia declines, in contrast to New Pool where Salix and Corylus/Myrica frequencies increase at 69-70cm where Tilia declines. Although at New Pool there is no clear Gramineae peak at 68cm, the Tilia decline, Liguliflorae, Rumex acet and Plantago m/m occur in association with a rise in Plantago lanceolata to c.5%. This compares with a Plantago lanceolata frequency at the Tilia decline at Boreatton Moss (centre) of c.6%, declining to less than 5& above 170cm. The clearest difference between the two sites at and immediately above these early Bronze Age Tilia declines appears, in terms of the herb frequencies, to concern the representation of Gramineae. This could, as mentioned above, reflect grasses on the moss surface at Boreatton, although Plantago lancolata and other open habitat indicators all decline in frequency in close association with Gramineae reductions, implying that a substantial proportion of the grass pollen is in fact derived from terrestrial herb communities. Whereas Tilia continues to be recorded in consecutive samples above the 69cm decline at New Pool, and Ulmus is present at these horizons at more than 1%, at the centre of Boreatton Moss Ulmus is absent in two consecutive 1cm samples following the Tilia decline and the latter type is not recorded in the next five consecutive samples.

The possibility exists that these two important forest taxa were completely removed from the immediate proximity of Boreatton Moss in the early Bronze Age. There is evidence, both stratigraphic and palynological, that this inferred removal of trees from areas very close to the site had direct consequences for the hydrology of the moss itself.

3.4.5 Hydrological changes at Boreatton Moss in phase B5

During the earlier postulated interference phase, B3, at c.200cm in the centre of Boreatton Moss, the increase in the frequencies of Cyperaceae and Hydrocotyle pollen and Sphagnum spores was noted. It was thought that limited tree and shrub removal in the catchment area of the moss could have exposed the woodland soils to higher levels of direct rainfall and that this in turn led to increased runoff into the moss basin, The presence of Hydrocotyle in particular suggests that the nutrient status of the moss could have been slightly improved. Clearer evidence for hydrological changes and perhaps improved nutrient status is seen in association with the clearance activity at the Tilia decline at c.175cm.

A reduction in the degree of humification in the peat occurs at 173cm at the centre of Boreatton Moss. In the earlier stages of this project, when radiocarbon dates were applied for, it was thought that this humification change could reflect climatic influences, and peat samples were therefore dated, in the convential way, above and below this apparent recurrence in peat growth.

There is no stratigraphical evidence for a marked climatic deterioration in Britain, c.1700bc (Godwin 1975), and in any case there is considerable uncertainty as to whether Boreatton Moss has ever been ombrotrophic, as Sinker (1962) states, and therefore suitable for recording climatic change in the peat stratigraphy (cf Barber 1981, 1985).

Sphagnum leaves increase in abundance above 173cm, they include leaves of Sphagnum section Subsecunda cf Subsecundum, which is abundant, Sphagnum magellanicum and Sphagnum section squarrosa cf squarrosum. Subsecunda and squarrosa indicate base rich flushing (Smith 1980) and, together with the high frequencies of Hydrocotyle vulgaris at c.175cm, argue convincingly for the status of Boreatton Moss as a mesotrophic or transitional moss (cf Daniels 1978, Moore 1984a).

Hydrocotyle vulgaris is present at 1 - 6%T.P. from 177cm to 174cm, indicating localised improvements in the nutrient status at the centre of the moss, prior to the main humification change. Boreatton Moss, although it is in a basin, has no inflowing streams and therefore will derive at least some water from soil through-flow (Reynolds 1979). Water moves freely through the Baschurch series brown earths (2.1.5) and it is probable that woodland clearance tended to increase the amount of water moving through the soil (Lockwood 1983) causing a relative increase in the nutrient input to ground-water fed basins. The occurrence of Cyperaceae, during the arable phase, and at the Tilia decline could be evidence for the clearance of woodland from wetter soils, or possibly the increasing wetness of soils close to the edge of the moss, if indeed increases in runoff to the basin were occurring. There is also evidence, however, that production of sedge pollen varied across the surface of the moss itself. Cyperaceae frequencies are higher at the margin during the arable phase but substantially higher in the centre in the horizons immediately following the Tilia decline. Sedges, as a group, have varying preferences for different moisture conditions and are common on peat mosses in Shropshire (Sinker 1962, Sinker et al 1985) and so a precise interpretation of the increasing sedge pollen frequencies in these horizons is not thought possible. Similar problems exist with interpreting the sharp decline in Ericaceae pollen at the Tilia decline. This could reflect a change in the environment on the peat surface, with locally growing heath species eliminated by increasing waterlogging, although, today, Ericaceous species including Calluna and Oxycoccus grow on Boreatton despite evidence that water levels have risen in the recent past (Sinker 1962). Heath species could possibly have been cleared in association with an expansion of pasture at the Tilia decline horizon. There is no marked humification change at the Tilia decline at the margin and yet Ericaceae frequencies decline in that core as well, perhaps indicating that the Ericaceae decline represents terrestrial and not moss surface pollen sources.

Sphagnum spores show a clear increase in frequency above 173cm at the centre of the moss, and increase sharply at 180cm at the margin, the Tilia decline levels in both cores. The Sphagnum species themselves (2.2.2 and above) indicate nutrient rich flushing.

Further evidence for a change in the environment of accumulation in the peat is provided by the presence of Scheuchzeria pollen at more than 1% above 167cm at the centre, and at lower frequencies at c.175cm at the margin.

Scheuchzeria macrofossils also occur in the peat at these levels. Scheuchzeria commonly responds to the flooding of peat surfaces (Tallis & Birks 1965, Godwin 1975) and can be favoured by more eutrophic and mineral rich conditions (Casparie 1972).

At the centre of Boreatton Moss, Hydrocotyle pollen occurs at more than 1% in association with the Scheuchzeria pollen increases, a pattern which is not seen at the margin, perhaps indicating that nutrient inwashing was becoming concentrated towards the centre of the moss.

This evidence for hydrological and nutrient status changes is certainly coincident with evidence for tree removal and pasture expansion in the vicinity of the moss; whilst it might not be possible to link the two events with absolute certainty, it is nevertheless thought that the evidence is both detailed and coherent and points to human activity in the catchment of the moss in the early Bronze Age.

The radiocarbon dated pollen diagrams from Boreatton Moss and New Pool independently confirm an earlier Bronze Age Tilia decline in the Shropshire lowlands; the contrasts between the pollen spectra from the two sites suggest strongly that a spatial variation in the nature and intensity of the woodland exploitation occurred.

In addition to the evidence for early Bronze Age woodland clearance at these two mosses, similar evidence also exists at Berth Pool and Birchgrove Pool at the same time. The deposits analysed at Marton Pool and Fenemere are not thought to date back to the earlier Bronze Age and therefore these two sites cannot be discussed at this point.

3.4.6 Inter-site comparisons: phase B5

The clearest evidence for correlation is provided by the behaviour of the Tilia pollen curves at each of the four sites, and the dates, actual and extrapolated for the end of a continuous Tilia curve:-

(i)	Boreatton Moss (centre),	173cm.	1710bc (C14)
(ii)	New Pool,	68cm	1600bc (C14)
(iii)	Berth Pool (II),	224cm	c.1750bc (extrapolated)
(iv)	Birchgrove Pool,	332cm	c.1680bc (extrapolated - Tilia declines to c.1%)

A Tilia decline is thus clearly placed in the second quarter of the second millennium bc. When calibrated, using the curves in Pearson et al (1986), a radiocarbon date of 1710bc, or 3660bp could correspond to a calendar date between 2000BC and 2100BC; in calendar years, the B5 Tilia decline post-dates the Ulmus/Tilia reductions of B3 by some 500 years, since c.2100bc could correspond to a calendar date of c. 2580BC (Pearson et al 1986).

During phase B5 at Berth Pool and Birchgrove Pool, changes in the woodland composition are indicated. It is interesting to note that Secale occurs at c.3700bp at Berth Pool, the same time as it occurs in higher frequencies in the "arable phase" at Boreatton Moss, C14 dated to 3790$\pm$50bp. Berth Pool is only 1.25km from Boreatton Moss, and, at c.200m in diameter and 2.9 ha, it is theoretically large enough to receive some of its pollen from areas which are also contributing to the pollen input at Boreatton Moss. Grass and open habitat indicator frequencies are lower at Berth Pool, compared to Boreatton Moss, at c.3700bp, and the Plantago lanceolata frequency at Berth Pool is also lower than that recorded at New Pool at the same time. Although, theoretically, Berth Pool will be dominated more by pollen derived from within several hundred metres of its edge (Jacobson & Bradshaw 1987) than will Boreatton Moss, the contrasts in cereal and open habitat indicator frequencies between these four sites could be seen as evidence that more intensive woodland clearance and agricultural land use occurred in the proximity of Boreatton.

Apart from lime, yew also appears to have been affected by clearance activity at c.3600-3700bp at Berth Pool and Birchgrove Pool. Yew wood was put to a variety of uses by prehistoric peoples (Godwin 1975). The tree itself can occupy a wide variety of habitats, including fen peat. The Baschurch Pools are surrounded by tracts of fen peat which could theoretically have supported yew.

Alnus frequencies increase at Berth Pool after Taxus frequencies decline, and this could be explicable in terms of alder expanding in fen habitats from where yew had been selectively removed. Following the early Bronze Age Tilia declines at Berth Pool and Birchgrove Pool, Quercus frequencies decline in association with the continued representation of Gramineae and the occurrence of open habitat indicators.

The pollen diagrams from Berth Pool, Birchgrove Pool, Boreatton Moss and New Pool indicate a level of human activity which was sufficient to cause changes in the species composition of the woodlands, but which did not lead to the creation of extensive tracts of open land. At all four sites tree and shrub pollen, as a percentage of total pollen, was not substantially reduced at this time. Generally, the pollen frequencies of tree, shrub and herb taxa are similar between Berth Pool and Birchgrove Pool at this time. Both sites are similar in size and morphology today, but there is some uncertainty as to their precise extent in the Bronze Age (2.2). On the basis of their present morphology, both shelve in steeply from their margins and are surrounded by fen peat deposits, it is not thought that their permanent water surfaces were very much larger in the past although the peat deposits themselves were probably considerably wetter, as indicated by the need for causeway construction at The Berth (Plates 13 and 14).

Berth Pool and Birchgrove Pool are only 400m apart; given their probable sizes during this period, both sites would be expected to derive more than half their pollen from within several hundred metres of their margins (Jacobson & Bradshaw 1981).

Under these circumstances, where two sites of very similar size theoretically share some common pollen source areas, comparatively little variability between the sites would be expected, and this does appear to be the case for Berth Pool and Birchgrove Pool at this time. Potentially however both sites are small enough to receive up to 20% of their pollen from 20-30m of their margins (Jacobson & Bradshaw 1981) and it could be that in the case of Berth Pool the slightly greater reductions in Tilia and Taxus and the slightly higher Gramineae frequencies refer to very localised vegetaional contrasts between the two sites. When two sites are so similar in size, and yet in close proximity, more confidence can be attached to the inference of localised vegetational contrasts, since a differential site size effect would not be expected. Although there are contrasts between the four sites in terms of the intensity of the clearance activity which is indicated, the similarities, in terms of the tree and shrub taxa affected are such that the same method of clearance activity appears to be in evidence. At all four sites, the Tilia decline is associated with declines in Alnus and Corylus/Myrica. Quercus remains relatively high at the Tilia decline horizons at Berth and Birchgrove and increases slightly at the Tilia decline horizons at New Pool and Boreatton; Ulmus is only reduced at the Tilia decline horizon itself at Boreatton and the scope for grass and weed expansion is relatively limited at New Pool, Berth and Birchgrove. Clearance activity was thus widespread, but the clearances themselves not extensive, lime appears to have been selectively felled whereas oak and, in the main, elm do not appear to have been cleared, at least not in the latter stages of B5. Corylus and Myrica are not separated, but the reductions in Coryloid pollen could suggest that hazel encroachment into clearings was prevented, once the taxon had been removed from the understorey. Reductions in Alnus, common to all sites, could point to the limited removal of alder from wetter areas close to the site margins, possibly to aid access to the sites themselves for activities such as wildfowling, or fishing at the meres although fish remains are not commonly found at Bronze Age sites (Tinsley and Grigson 1981).

In some localities, for example close to Boreatton Moss, crop growing could have been an important economic activity. Elsewhere, however the indications are that only small clearings were created in the woodlands, and lime in particular was singled out for exploitation, allowing oak and probably also ash to become more abundant in the woodland. It is highly probable that lime was selectively utilised for leaf fodder, timber and bast fibre in the prehistoric period (Godwin 1975, 164), if it was particularly important in economic terms, it is conceivable that lime was over-exploited in some areas. Garbett (1981) suggests that elm was over-exploited as a resource in the Neolithic period, although Williams (1985) disputes the validity of the close-interval pollen sampling technique used by Garbett (1981, 576). The indications at Boreatton are that lime was eliminated from the woodlands around the site in the early Bronze Age and whilst Tilia frequencies recover to a certain extent at New Pool, Berth Pool and Birchgrove Pool in the final stages of the earlier Bronze Age (phase B6), frequencies remain below those seen in preceeding phases. Inter-site variability in pollen frequencies between New Pool, Berth Pool and Boreatton Moss in B3 suggested that Boreatton lay in an area which was particularly attractive to prehistoric cultures, this indication is re-enforced in B5. Contrasts between the sites during B5 suggest that local or extralocal pollen sources (Jacobson and Bradshaw 1981) are particularly important at each site.

3.4.7 Archaeological evidence

In support of the inference of human activity from the pollen spectra, there is evidence for human activity in Shropshire during the early Bronze Age (3.2.4), prehistoric routeways thought to have been in use in the earlier Bronze Age have been identified on ridge-crests in Shropshire (Chitty 1956, 1963) and could have carried traffic associated with local bronze industries (Thomas 1972). A radiocarbon date from an early cremation in the cemetery near Bromfield of 1556±178bc (Stanford 1982) compares favourably with the Tilia decline dates from Boreatton Moss and New Pool: 1710bc (3660±50bp) and 1600bc (3550±50bp). Excavations at The Breiddin uncovered a rectangular floor area with a radiocarbon date of 1550±100bc (Musson 1976), pointing to the occupation of that site in the earlier Bronze Age. The radiocarbon and extrapolated dates for the B5 Tilia decline suggest that it dates to the Overton Period of the earlier Bronze Age, c.1700-1450bc (Burgess 1980), a time when considerable social changes and changes in ceramic and funerary traditions are in evidence (Burgess 1980, 255; Bradley 1984).

Settlement patterns changed in the mid 2nd millennium bc, complex burials are often found adjacent to the newly settled areas (Bradley 1984, 90) and Fowler (1983) sees the middle of the 2nd millennium bc as being a crucial period in the development of systems of land allotment, and the development of animal husbandry. The new impetus in clearance activity seen in B5 thus occurs at a time when man is shown to have been active in upland as well as lowland Shropshire - the Bromfield cemetery lies at the same altitude as Boreatton Moss - and when settlement patterns were changing and clearance expanding throughout the country.

3.4.8 Summary: phase B5

In common with pollen diagrams from elsewhere in lowland Shropshire (Beales 1980, Slater 1972, Hardy 1939), the diagrams from the Baschurch area do not attest to the existence of extensive tracts of open land in the north Shropshire lowlands in the early Bronze Age. Man did however act to alter the species composition of the woodlands; clearance activity at Boreatton Moss probably affected the hydrology of that site. Beales and Birks (1973) assign an early or middle Bronze Age date to a regional clearance episode involving small forest clearances, C2, although Beales (1980) implies a later Bronze Age date for C2. Pollen evidence for progressive woodland opening is noted by Beales (1980) above 303cm in the spectra from Crose Mere. If a date of 3200bp is substituted for the radiocarbon date of $3714^{\pm}129$bp at 280cm at Crose Mere, and there are convincing biostratigraphic grounds for doing this (Chapter 4), a deposition rate of c.25 C14 yrs/cm can be calculated for Crose Mere for the sediment between the Neolithic *Ulmus* decline and the later Bronze Age *Tilia* decline at the end of CMCP7b. Using this deposition rate, which compares to a rate of 13.6 yrs/cm suggested for the same horizons by Beales (1980) a date of c.3700bp can be derived for the progressive woodland opening noted at 303cm. Above 303cm at Crose Mere *Tilia* declines very slightly, but not to less than 1%, Gramineae increases to slightly more than 1% and *Rumex acetosella* is continuously recorded. There are obvious similarities here with the spectra dating to c.3700bp at Berth and Birchgrove. Following phase B5, the intensity of the human impact traceable in the pollen spectra from the sites used in this study is temporarily reduced, before increasing again at the start of the later Bronze Age. During these subsequent phases, B6 and B7, pollen spectra from Fenemere and Marton Pool can be compared to those from the other sites.

CHAPTER 4

THE TRANSITION FROM THE EARLIER TO THE LATER BRONZE AGE

Introduction

A temporary reduction in clearance intensity follows phase B5, although human impact on the woodland continues to be detectable in the pollen diagrams. This reduction in clearance intensity, phase B6, is succeeded by evidence for land-use re-organisation, where small clearances are established and then temporarily abandoned. Two clearance and regeneration cycles are in evidence. Their regularity, in terms of intensity and duration, suggests that the same type of economic activity is in evidence throughout B7, a period of some 500 years.

4.1 Phase B6. Low-intensity clearance activity at the end of the earlier Bronze Age; c.1500-1600bc to c.1300bc

Main characteristics

Boreatton Moss (centre) 165cm to 158cm

Quercus increases, in comparison to B5, *Fraxinus* and *Corylus/Myrica* also increase. Gramineae is relatively low, but open habitat indicators continue to occur. Cyperaceae and *Scheuchzeria* are reduced but an increase in *Hydrocotyle* occurs at the B5/B6 transition and *Sphagnum* increases, after declining at the B5/B6 transition. No numerical zonation splits occur between mid B5 and the onset of B8-B10.

Boreatton Moss (margin) c.178cm to 174cm

Quercus and *Fraxinus* increase, increases in *Corylus/Myrica* and *Salix* also occur. Gramineae and *Plantago lanceolata* decline, Cyperaceae declines. In contrast to the centre, *Hydrocotyle* does not occur, *Scheuchzeria* appears only at the end of the phase and *Sphagnum* frequencies decline progressively. Total tree pollen increases and total herb and heath pollen declines to less than 10% of total determinable land pollen. Numerical zonation splits occur in both statistics between 174cm and 176cm, and 178cm and 180cm, at the upper and lower boundaries of the phase.

New Pool ? above 62cm

The division of B5 and B6 is uncertain at New Pool; at 63cm and above, Tilia, Alnus and Corylus/Myrica increase, herb pollen diversity is reduced at 62cm and Plantago lanceolata declines to less than 1% at 58cm. Total herb and heath pollen declines to less than 5% at 63cm and numerical zonation splits occur in both statistics between 62cm and 63cm.

Berth Pool (II) c.220cm to 205cm - c.1600bc to 1300bc

Extrapolated dates suggest that c.1400 to 1500bc marks the mid-point of B6; the possible B5/B6 transition at New Pool occurs c.3cm above a horizon radiocarbon dated to 1600bc.

Tilia, Taxus and Alnus frequencies increase but Quercus declines. Corylus/Myrica and Salix increase and Gramineae is reduced. Open habitat indicator diversity is low and a reduction in aquatic pollen diversity occurs where Alnus increases. Total herb and heath pollen declines to less than 5%; early numerical zone splits are made between 204cm and 208cm and 208cm to 212cm.

Birchgrove Pool c.324cm to 312cm - c.1500bc to 1300bc

Betula, Tilia and Fraxinus increase but Quercus declines. Corylus/Myrica increases, Gramineae declines initially but increases in mid B6, Plantago lanceolata also increases slightly. Numerical zone splits occur between 316cm and 320cm, and 320cm and 324cm.

Marton Pool below 376cm

The age/depth profile for Marton Pool, based on correlated dates, gives an age of c.1450bc for 400cm (Figure 11). Arboreal pollen totals are relatively high, Corylus/Myrica increases in mid B6 and a curve for Plantago lanceolata begins at 396cm and declines at 380cm, a continuous curve for Gramineae is recorded and cereal pollen appears at 388cm. Numerical zonation splits occur in both statistics between 380cm and 384cm, where a slight increase in Quercus is combined with reductions in Betula, Pinus, Corylus/Myrica and Plantago lanceolata.

Fenemere below 328cm

Extrapolation of the upper and lowermost radiocarbon dates at Fenemere gives a date of c.1450bc for 352cm. Arboreal pollen frequencies are closely similar to Marton Pool, B6 at Fenemere ends with a decline in Tilia, dated to 3190$\pm$60bp (SRR 2923) or 1240bc (Figure 9).

Quercus frequencies tend to decline during B6, Taxus also declines and short-lived peaks in Fraxinus occur at 328cm and 336cm. Cereal pollen appears late in the phase, Plantago lanceolata increases at 340cm and Pteridium occurs in successive samples above 348cm. Early numerical zone splits occur between 324cm and 328cm, where Tilia declines at the B6/B7 transition.

4.1.1 Inter-site variability in phase B6

B6 is the only phase to be represented at all six sites (Figure 16). It was initially thought that only one distinctive Tilia decline would be identified in the pollen spectra under study; the declines observed at Boreatton Moss and New Pool were thought to correspond to that identified at 326cm at Fenemere. The radiocarbon dates obtained, however, showed that the 326cm decline at Fenemere could be correlated, on chronological and biostratigraphic grounds to the 1288bc Tilia decline at Whixall Moss (Turner 1964a), the declines at New Pool and Boreatton proved to be earlier features. Time constraints prevented the extension of the Marton and Fenemere spectra back to c.1800bc, to enable comparisons to the four other sites during the time periods of B4 and B5. B6 to B11 are, however, represented at all four of the Baschurch Pools and in both cores from Boreatton. Inter- and intra-site comparisons are thus possible for the whole of the later Bronze Age and Iron Age periods at five sites.

During B6, Tilia increases in frequency at New Pool, Berth Pool and Birchgrove Pool, but not at Boreatton Moss where it occurs only twice at less than 1% at the centre and is absent from the main part of B6 at the margin; contrasts between the margin and centre of Boreatton in B4 suggested that lime was growing relatively close to the western edge of the moss at that time. The selective felling or cutting of lime could perhaps have continued close to Boreatton Moss throughout B6, alternatively, soil fertility loss could have occurred as lime was removed from the slopes around Boreatton in B5 (Chapter 3). Lime tends to prefer relatively fertile soils (Godwin 1975, Sinker et al 1985) and the Baschurch brown earths are liable to base depletion when cleared and farmed (Crompton and Osmond 1954). In some localities, the regrowth of lime could have been restricted by soil conditions although the indications in the pollen record are that clearance activity continued during B6. Tilia frequencies recover during B6 at New Pool, Berth Pool and Birchgrove Pool but frequencies are lower than those seen in B2 at New Pool and Berth and B4 at Birchgrove. Tilia frequencies are higher at Fenemere and Marton than at Berth Pool, the implication here is that lime is less abundant closer to Berth Pool than it is, on average, across the Baschurch areas as a whole; Berth Pool should theoretically be representative of a more restricted pollen source area, in comparison to the larger two pools (Tauber 1965, 1977, Jacobson and Bradshaw 1981, Prentice 1985).

Inter-site contrasts in the frequency of Pinus pollen suggest that Fenemere and Marton are indeed representative of relatively wide pollen source areas. Jacobson and Bradshaw (1981) suggest that closed basins c.5 ha or more in extent will receive most of their pollen from areas more than several hundred metres, that is, the pollen spectra will be regional in character. Fenemere is 9.4 ha in extent today and Marton 6.8 ha, their areas could have been slightly greater in the past, although their surfaces are not thought to have been permanently coalesced during the time period of B6 to B12 (2.2.1). Their pollen spectra should, theoretically, be regional in character, and should include pollen transported from, possibly, several kilometres or more away (Prentice 1985). Pinus pollen is continuously recorded prior to the B6/B7 Tilia decline at Marton Pool and Fenemere. Calculated as a percentage of total land pollen, the mean Pinus frequency (range at one standard deviation in brackets)is 3.1% (1.95 - 4.25%) at Fenemere and 3.3% (1.79 - 4.81%) at Marton Pool. In contrast, Pinus occurs at 0.1% T.L.P at 216cm and 0.4% T.L.P at 208cm in B6 at Berth Pool. If it is assumed that all the Pinus pollen is derived from sources several hundred metres or more away from all the sites, then this 'long distance' component appears to be substantially more abundant at the two larger sites. At Boreatton Moss, where the peat surface extends to c.7.1 ha, Pinus is infrequently recorded during B8-B10 at Boreatton, when Pinus maxima occur at Fenemere and Marton Pool (Chapter 5).

Godwin (1975) states that Pinus pollen is abundantly produced and well dispersed, a view shared by Bennett (1984). Extensive studies of the contemporary pollen rain in North America led Bradshaw and Webb (1985) to conclude that excellent dispersal was more important than high pollen productivity in accounting for the high Pinus frequencies observed at particular sites. The potential over-representation of Pinus pollen, even at considerable distances from the nearest potential source (Prentice 1978) leads Bennett (1984) to infer the presence of Pinus near a site only when its pollen frequencies exceed 20% of total pollen. On this basis, the Pinus frequencies at Marton and Fenemere are not high enough to indicate a local source of Pinus, particularly with Corylus/Myrica excluded from the main sum (cf. Bennett 1984). Boreatton Moss is only 2.5km from Marton and Fenemere and the three sites should, theoretically, have some common regional pollen sources. It is possible that a few, scattered pines occurred in the woodlands near the Baschurch pools, giving a relatively localised, but relatively weak source of Pinus pollen (cf. Oldfield 1970) but if this were the case, higher frequencies of Pinus should occur at Berth and Birchgrove, which are mainly representative of the local environment (cf. Prentice 1985).

The low representation of Pinus at Boreatton could, as one alternative, suggest that Pinus is not in fact always a well dispersed, regional type. Certainly at Marton and Fenemere, Pinus declines in early B7 where there is evidence for woodland clearance by man and this could suggest that Pinus was growing, as isolated individuals, relatively close to Marton and Fenemere, although this does not preclude the possibility that the Pinus expansion in B8 to B10 is a regional feature. Birch and pine cover Boreatton Moss today. Peat is not an optimum substrate for these taxa (cf. Bennett 1984, Sinker et al 1985) and the pollen productivity of birch or pine growing on Boreatton could be low but any trees which were present in the prehistoric period could act to restrict any open areas on Boreatton and limit the representation of pollen carried in above-canopy airstreams (cf. Tauber 1965, Jacobson and Bradshaw 1981). The lower frequencies of Scheuchzeria and Sphagnum and particularly Hydrocotyle at the margin of Boreatton Moss, in comparison to the centre, point to the occurrence of less waterlogged conditions in the more marginal peats, this could have aided colonisation by birch.

Above 60cm at New Pool, Betula frequencies are relatively high. In comparison to Boreatton moss and the Baschurch Pools, the low frequencies of Betula associated with the 1600bc Tilia decline at New Pool suggest that at least some of the pollen was derived from terrestrial sources, although, again, birch could have been present on the peat surface at New Pool. The high Betula frequencies at New Pool could point to a local abundance of birch, particularly as a colonising taxon in previously cleared areas, or areas undergoing continuous, if limited clearance. The brown earth soils around New Pool belong to the Newport Series (Crompton and Osmond 1954). These are more sandy and inherently less well supplied with bases than the Baschurch series brown earths which occur around Boreatton and the Baschurch Pools. Betula spp in Shropshire will tolerate base poor conditions (Sinker et al 1985), whereas Fraxinus in Shropshire is an important colonising species on base-rich soils (Sinker et al 1985). In comparison to New Pool, Fraxinus frequencies are higher in B6 at Boreatton Moss and the Baschurch Pools, it is possible that birch rather than ash tended to colonise the less fertile soils on the slopes around New Pool although both the Baschurch and Newport Series brown earths undergo base depletion when cleared and farmed (Crompton and Osmond 1954).

Taxus pollen occurs more frequently at Fenemere, Berth Pool and Birchgrove Pool in B6, in comparison to Marton, Boreatton and New Pool. It is possible that yew was a natural component of fen woodlands around the Baschurch Pools (cf Godwin 1975). Whilst the indications in B2 at Berth Pool (II) are that yew had encroached into areas where oak and possibly lime had been cleared, it could still initially have been present in fen or fen marginal woods. Yew does not appear to have been present in the pollen source area of Boreatton Moss until mid B5 and Taxus frequencies increase only slightly in B6 at the centre of Boreatton. Although Taxus frequencies are low at the four Baschurch Pools, there is evidence for a Taxus decline in B6 at Fenemere, Berth Pool and Marton Pool, but not at Birchgrove Pool where Taxus increases in B6. At Fenemere, the end of the B6 Taxus curve is associated with a reduction in Pinus a slight lowering of Quercus values and an increase in Fraxinus, Gramineae also increases slightly, and Plantago lanceolata occurs at 1-2% in the final two samples of the Taxus curve. At Marton Pool, Taxus temporarily ceases to be recorded in consecutive samples at 384cm. At this point, Pinus values are slightly reduced, in comparison to 396cm to 400cm. A reduction in Quercus occurs at 384cm and whilst Fraxinus is unaffected, a clear reduction in Corylus/Myrica occurs at 380cm. Gramineae does not increase although cereal pollen occurs at 388cm and Plantago lanceolata values are slightly higher in comparison to Fenemere. At Berth Pool, the Taxus reduction is associated with reductions in Quercus and Corylus/Myrica but with a rise in Alnus, increases in Alnus are also seen at Fenemere and Marton where Taxus is reduced. Some clearance of oak appears to be in evidence, but large clearings are not indicated. Yew appears to be a part of the woodland which is subject to clearance.

The rises in Fraxinus at Fenemere suggest that openings were created in the high forest canopy, Fagus appears in B6 at Fenemere and in consecutive samples in late B6 at the centre of Boreatton Moss. To a limited extent, clearance activity in B6 could have been advantageous to beech, although in the absence of planting, beech would probably not have become abundant in Shropshire (Sinker et al 1985). Although Taxus does not decline at Birchgrove Pool, Quercus does exhibit a distinct decline, Corylus/Myrica increases initially but then also declines and a slight rise in Betula occurs late in the phase. The indications are that some oak is being felled and possibly hazel removed from the understorey. The improved light conditions could have favoured birch, and Fraxinus frequencies remain higher in B6 in comparison to B5. Both Quercus and Alnus increase at the margin of Boreatton Moss in B6, relatively high Alnus frequencies occur in early B6 at the centre of the moss and a slight reduction in Quercus is evident at the centre in mid B6; progressive reductions in Quercus are also evident above 65cm at New Pool.

The most marked reductions in Quercus thus occur at Berth Pool and

Birchgrove Pool but, in comparison to Boreatton Moss, frequencies of Ulmus and Tilia remain relatively constant at Berth and Birchgrove in B6, Tilia continues to occur at c.1-2% and Ulmus at c.1-3%, Tilia occurs only once, at less than 1%, in B6 at the centre of Boreatton and Ulmus is present at 1% in only one sample from the centre in B6. Tilia is not present in mid B6 at the margin and Ulmus only occurs at less than 1%. Elm and lime appear, in relative terms, to be more abundant in the woodlands closer to New Pool and the Baschurch Pools and considerably less abundant around Boreatton Moss.

At all six sites, increases in Corylus/Myrica can be discerned in B6, at least in the earlier part of the phase, reductions in Corylus/Myrica are particularly evident in late B6 at Marton, Berth, and Birchgrove. Although Coryloid pollen has not been separated into Corylus and Myrica (cf. Edwards 1981), it is possible that the Coryloid increases reflect a certain degree of recolonisation by hazel in woodland tracts which had been subject to more intensive clearance in B5, at Berth, Birchgrove and the centre of Boreatton, Corylus/Myrica exhibited a clear decline during B5. Some shrub recolonisation could also be in evidence in the increases in Salix representation at the B5/B6 transition at Boreatton Moss and in B6 at Berth Pool. This is not certain, however, and could simply point to the enhanced flowering of willow, combined with improved pollen dispersal conditions in the understorey as oak, in particular, was cleared. Salix occurs intermittently in B6 at Fenemere and Marton and ceases to be continuously recorded above 60cm at New Pool, where Tilia recovers. The status of Salix in the vegetation is uncertain and reconstruction complicated by the fact that Salix is likely to be under-represented in pollen spectra (Vuorela 1973); Salix fragilis is frequent, as a tree, in the woodland belt close to Berth Pool today (Plates 1 & 2) and yet Salix pollen occurs at less than 1% in a sample from the mud-water interface (Chapter 7).

Hedera occurs in B6 at all six sites, thinning of the woodland would improve light conditions for ivy and also improve pollen dispersal conditions for taxa growing below the canopy. From B6 onwards Ilex appears in the pollen record at the edge and centre of Boreatton Moss. Ilex also appears in B6 at Berth Pool and Fenemere. Ilex aquifolium, holly, is responsive to woodland clearance, when it tends to increase in abundance (Godwin 1975). Ilex pollen is entomophilous and not well produced or dispersed. In Shropshire today, holly is abundant, and often a useful indicator of woodland antiquity (Sinker et al 1985), it is probable that holly abundance is substantially under-estimated in the pollen diagrams from the Baschurch area. Crataegus type, e.g. hawthorn, and Sambucus, probably elder, both appear at Boreatton Moss in B6, these types are not recorded at Fenemere, but at that site Frangula, alder buckthorn, and Lonicera, honeysuckle, do occur; Frangula also appears at Marton, as does Crataegus, the latter type also appears at Birchgrove. Both Frangula and Crataegus appear at Berth Pool and Sambucus, Rhamnus, buckthorn, and Crataegus appear at New Pool. A moderately diverse shrub flora is indicated. No individual taxon appears to be abundant apart from hazel but Crataegus monogyna, hawthorn can be a vigorous coloniser of abandoned clearings (Sinker et al 1985) and Frangula alnus, alder buckthorn, is today locally frequent in Shropshire on damp soils and also on peaty soils and the edge of mosses (Sinker et al 1985). Buckthorn, Rhamnus catharticus is occasional in Shropshire, usually on more fertile, calcareous soils; elder, Sambucus nigra is frequent throughout Shropshire, and can be indicative of high levels of phosphate and nitrate in soils directly affected by human habitation (Sinker et al 1985, Godwin 1975).

Ericaceae pollen is rare in B6 at all six sites, the lowlands appear to be predominantly wooded at this time and therefore the scope for heath colonisation will be very limited, although the wind dispersal of Ericaceae pollen is potentially restricted (Peck 1973). Ericaceae pollen at New Pool and Boreatton Moss could be derived from heath taxa growing on the peat surfaces. Ericaceae declines sharply in mid B5 at the centre of Boreatton, where a change in peat humification occurs, increases in Hydrocotyle pollen in both cores in mid B5 could point to the increased flooding of the surface of Boreatton (Chapter 3). Hydrocotyle continues to occur at the moss centre in B6 and it is conceivable that wetter conditions on Boreatton were deleterious to Calluna (cf. Godwin 1975) although Oxycoccus is also present on Boreatton today and is tolerant of wet conditions on peat surfaces (Godwin 1975). Scheuchzeria palustris is often a common taxon in the peat from flooding horizons on mosses (Godwin 1975, Tallis and Birks 1965) and continues to be recorded, in the pollen spectra, at c.1-2% in B6 at the centre of Boreatton; lower frequencies occur at the margin.

The highest Gramineae frequencies of B6 occur at the centre of Boreatton, where values of c.10-12% occur, graminaceous taxa could be present on the moss, although Plantago lanceolata occurs at up to c.5% and cereal, Tubuliflorae, Liguliflorae, Chenopodiaceae and Rumex acet all occur at the centre of Boreatton in B6. Cereal, Tubiliflorae, Plantago lanceolata and Rumex acet also occur at the margin of Boreatton in B6, clearance activity could still be causing increases in runoff to the moss (cf Lockwood 1983), leading to increases in the abundance of marsh pennywort, Hydrocotyle vulgaris, and Sphagnum. In late B6, reduced Hydrocotyle values are associated with moderately high Sphagnum frequencies; higher Sphagnum values are also associated with reduced Hydrocotyle values in later B5 and the latter part of B8-B10 at the centre of Boreatton, increases in Cyperaceae are also associated with the Hydrocotyle reductions and it is possible that pools on the moss, created by increased runoff, were first colonised by marsh pennywort and then invaded by Sphagnum and sedges. Open habitat indicator diversity is relatively low at Fenemere and Marton in B6, Plantago lanceolata values are slightly higher in B6 at Marton, where cereal pollen is recorded at 1%. Amongst the other herb pollen types occurring at the larger two meres, Rosaceae, Ranunculaceae and Cyperaceae could be derived from mire herbs whilst Rubiaceae, Urtica, Umbelliferae, Mercurialis and Hypericum perforatum type could indicate the presence of a limited herb flora within clearings. Gramineae frequencies in B6 at Berth Pool are comparable to those seen at Marton and Fenemere. Plantago lanceolata and Rumex acet also occur at very low frequencies and Umbelliferae and Urtica occur.

In contrast to the three other meres, Gramineae declines to less than 1% at the B5/B6 transition at Birchgrove although it increases to c.6% in mid B6, where Chenopodiaceae occurs and Plantago lanceolata increases. Clearance activity does not appear to be markedly more intense in the dominant pollen source area of any one of the pools. Clearance intensity in the localities of Berth and Birchgrove is not dissimilar to that indicated over possibly several square kilometres by the spectra from the larger two pools. Some cereal growing can be postulated in the pollen source areas of Fenemere, Marton and Boreatton Moss although the importance of arable farming to the communities active in the region around the sites is difficult to assess, cereal pollen is poorly dispersed by the wind (Vuorela 1973) and it appears probable that dense belts of woodland on damper soils were left unceared around the pools in B6. No significant *Alnus* reductions occur at the mere or moss sites in B6 and *Alnus* exhibits a marked increase in B6 at Berth Pool. Uncleared woodland on damper soils would act to filter, or simply block the transfer of some non-arboreal pollen from any small arable enclaves on the crests of the low sand and gravel ridges of the area. Although no cereal pollen is recorded at New Pool, Gramineae, *Plantago lanceolata* and other open habitat indicators are recorded throughout B5 to B6, *Urtica* also continues to occur, most pollen records of *Urtica* are probably referable to *Urtica dioica*, the common nettle. This taxon can occur naturally in fen woods (Godwin 1975) but is also indicative of nutrient-enriched soils and only occurs regularly at New Pool above horizons where Gramineae, Liguliflorae, *Plantago lanceolata* and *Rumex acet* appear regularly. Human impact thus appears to be spatially variable throughout the Baschurch/New Pool area at the end of the earlier Bronze Age, clearance activity is limited in scope and the indications are that land closer to Boreatton Moss was preferentially cleared.

Pteridium frequencies can be a useful index of the degree of openness of the woodlands of an area (Oldfield 1963, Beales 1980), *Pteridium* occurs at less than 1% in B6 at Berth Pool, Birchgrove Pool, and Marton Pool and at 1-2% in only one sample from B6 at Fenemere, a slight increase in *Pteridium* occurs at the top of the diagram from New Pool but this could, in reality, post-date B6. At Boreatton Moss, however, *Pteridium* occurs at 1-2% in several samples from B6 at the centre and reaches 4% in B6 at the margin. Bracken is present on the surface of Boreatton today, particularly towards the south of the moss, although this could be linked to the effects of drainage in drying the peat surface (*cf*. Oldfield 1963). *Pteridium* increased in frequency during the clearance phases B3 and B5 and also increases in frequency during the clearance expansion of B8-B10 (Chapter 5). In B6 at Boreatton *Pteridium* frequencies are taken, in association with Gramineae and open habitat indicator representation, as evidence that human impact on the woodland was greatest closer to Boreatton Moss. Around the other five sites clearance activity was less intense.

The fact that clearance intensity appears to be similar at both the smaller and larger pools suggests that its intensity over possibly several square kilometres was not dissimilar (cf Turner 1979). Throughout B3 to B6, that is, during the earlier Bronze Age, c.2000bc to 1300bc, clearances in the Baschurch/New Pool area are never extensive (cf Turner 1965) but a progressive alteration in woodland composition occurs. Clearance activity, although low in intensity, appears to have affected the whole of the Baschurch/New Pool area in B6, some more permanent, if small, cleared enclaves might have been created, but beyond these clearings the woodlands would have been exploited for materials such as leaf fodder, bast fibre (lime) as well as timber. Turner (1964a) identified three broad categories of anthropogenic impact on the vegetation, firstly, man could use the produce of the forests and thus affect the pollen production of one or more species; secondly, man could control the natural vegetation, but not change the species composition, thirdly, existing vegetation could be destroyed. In B6, the first and second of these categories appear to be operative, reductions in Quercus and Corylus/Myrica are in evidence but marked herb pollen increases are not in evidence (cf Turner, 1964a, 89).

Given their relatively small sizes, Berth Pool and Birchgrove Pool should, despite their relative proximity, be representative of pollen source areas which are at least partially independant. Marton and Fenemere, however, should be representative of pollen source areas which are mainly overlapping (cf Bennett 1986, 618). Inter-site comparisons of the frequencies of selected pollen types from B6 at Marton and Fenemere point to the similarities in the pollen spectra from the two sites at this time, mean frequencies are calculated using the main sum (total determinable land pollen excluding Cyperaceae and Coryloid):

	$\bar{x}$ Fenemere [1]	$\bar{x}$ Marton Pool [2]
Betula	5.25 (4.53 - 5.97)	5.58 (3.75 - 7.41)
Pinus	4.47 (2.8 - 6.14)	5.02 (2.82 - 7.22)
Ulmus	2.25 (1.76 - 2.74)	1.68 (1.14 - 2.22)
Quercus	38.9 (36.14 - 41.66)	36.32 (34.1 - 38.44)
Tilia	3.24 (2.31 - 4.17)	2.64 (2.26 - 3.02)
Corylus/Myrica	29.54 (26.49 - 32.59)	31.77 (26.23 - 37.31)
Gramineae	2.77 (1.77 - 3.77)	2.74 (2.03 - 3.45)

1. B6, Fenemere, 328cm to 352cm
2. B6, Marton Pool, 376cm to 400cm

Figures in brackets denote the range at one standard deviation from the mean, Corylus/Myrica is calculated as a percentage of total determinate land pollen.

In the cases of Betula, Pinus, Corylus/Myrica and Gramineae, the mean frequency at one site falls within one standard deviation of the mean at the other site. In the cases of Ulmus, Quercus and Tilia there is a tendency for higher values to occur at Fenemere:

Marton:	$\bar{x}$, plus 1σ	Fenemere: $\bar{x}$
Ulmus	2.22	2.25
Quercus	38.44	38.90
Tilia	3.02	3.24

The mean frequencies of Alnus can be compared for the four Baschurch Pools. Berth and Birchgrove should theoretically be more representative of their local environments (Jacobson and Bradshaw 1981, Prentice 1985):

$\bar{x}$ Alnus:		
	Berth (II)[1]	47.2 (42.61 - 50.79)
	Birchgrove[2]	41.1 (36.75 - 45.45)
	Marton	37.84 (35.41 - 40.27)
	Fenemere	34.54 (32.03 - 37.05)

1. B6, Berth (II), 208cm to 216cm
2. B6, Birchgrove, 316cm to 324cm

In the case of Alnus, higher mean frequencies appear at Berth and Birchgrove, where a higher proportion of local pollen would be expected, at Marton, however, the Alnus frequencies tend to exceed those at Fenemere. Differences between Marton and Fenemere are relatively slight, but there are indications that dry-land tree pollen is present at slightly higher relative frequencies at Fenemere. Human impact on the pollen productions from dry-land trees could have been slightly more intense closer to Marton Pool. Alternatively, Marton Pool could be exhibiting a tendency to be more representative of more localised environmental conditions, in comparison to Fenemere; alder could be equally abundant around both sites, but as a local tree it gives rise to higher pollen frequencies at Marton.

Examination of Figure 1 in Jacobson and Bradshaw (1981, 82) suggests that the balance of local extralocal and regional pollen inputs at the four Baschurch Pools should be as follows:

	Diameter (m)	Area (ha)	Pollen sources (%)		
			L.	E.L.	R.
Fenemere	300-400m	9.4	<10	15	75
Marton	250-300m	6.8	10	30	60
Berth	150-200m	2.9	20	60	20
Birchgrove	100-150m	1.7	25	60	15

In this instance, it should be stressed that extralocal pollen is assumed to be derived from within several hundred metres of the basin edge (Jacobson and Bradshaw 1981). Potentially, Marton Pool could be more representative of more localised pollen sources than Fenemere. Indications of this are limited in B6, but more apparent in early B10 (Chapter 5). The pollen evidence from all six sites points to a relatively low level of human activity in the woodlands of the area in the latter stages of the early Bronze Age. At Fenemere and Berth Pool, samples were selected from B6 for mineral magnetic analysis (1.2.3.2), the intention being to compare the iron mineralogy of the pool sediments during a phase of low-intensity human activity, as deduced from the pollen spectra, to the mineralogy during successive, more intense phases of clearance activity, B7 to B10.

4.1.2 Magnetic measurements

4.1.2.1 Berth Pool II (Figures 21, 23, 24 and 25)

Compared to successive phases, magnetic susceptibility values are highest in B6, and reach a peak at 208-210cm, peak ARM and SIRM values also occur at 208-210cm, where Quercus declines to less than 30% and Taxus to less than 1%. Mass specific χfd is high and SIRM/χ relatively high, SIRM/ARM values are higher in comparison to B7 and B8, but below the peak values of B10. ARM/χ values are similar in B6 and B7 and peak in B10, following a reduction in B8-B9. The coercivity curve for the sample from 212-214cm shows a relatively rapid loss of the applied forward magnetic field at low backfield strengths. Reverse field ratios are low, indicative of a softer magnetic mineralogy (Oldfield et al 1985a). A study of several soil profiles (Thompson and Oldfield 1986, 78-79) showed that, in brown earths, χ and SIRM peaks occurred in the top, 'A' horizon of the soils. In a brown earth soil under deciduous forest reductions, with depth, in ARM, SIRM and SIRM/χ were interpreted as indicating a down-profile reduction in the relative importance of stable single-domain magnetite; stable single domain minerals are often formed in topsoils by magnetic enhancement (Mullins 1977). Mineral magnetic analyses from a soil pit in the catchment of Newton Mere, Shropshire (Smith 1985, unpub) showed that in the upper, magnetically enhanced layers of the soil profile, high SIRM/χ values were associated with high χ and strongly negative IRM - 1000mT/SIRM, this combination of parameters pointed to a relatively high proportion of stable single domain magnetic grains, associated with secondary ferrimagnetic oxides, such as magnetite (Thompson and Oldfield 1986, 77). Frequency dependant susceptibility, χfd, represents a measure of the relative importance of fine, viscous magnetic grains, which are common in soils and soil derived sediments (Mullins 1977, Oldfield et al 1983, 42). In B6 at Berth Pool, the combination of high χ, χfd, SIRM, ARM, SIRM/χ and "soft" reverse field ratios points to the presence, in the sediments, of iron minerals derived from the topsoils in the catchment of Berth Pool (cf. Oldfield et al 1979).

The possiblity of in situ authigenic magnetic mineral formation in the sediments cannot be ruled out (Oldfield et al 1983, Hirons and Thompson 1986) although the parent material and tills of Shropshire are rich in primary magnetic minerals, for example, haematite (Smith 1985). Topsoils in the catchment of Bar Mere, Cheshire, which have developed on drift deposits rich in locally derived Triassic material include brown earths and brown sands which are similar to those found in the Baschurch area; fine particulate fractions of these topsoils include both primary and secondary magnetic minerals (Smith 1985, 144), in the subsoils, a significant haematite component was indicated (Smith 1985, 150). Changes in sediment quality at Bar Mere were thought to reflect the erosion of material from the catchment, sediment towards the top of a long core from Bare Mere was dominated by topsoil, the peak in topsoil-derived material corresponds to historical evidence for an expansion in arable farming in the catchment (Smith 1985, 162).

When attempting to clarify sediment-source linkages, however, particle-size specific magnetic measurements are indispensible (Smith 1985) and these have not been carried out for the Baschurch Pools. At Newton Mere, Shropshire, four phases of landscape dynamics could be identified in a long core; firstly, an initial period with an unstable landscape with detrital minerogenic infilling in the mere; secondly, a phase with little detrital input, possibly where a closed woodland around the mere allowed only fine grained magnetic minerals to enter the mere; thirdly, a period where mixed primary and secondary minerals entered the mere, possibly pointing to human disturbance of the land surface, and finally a later period where soft magnetic minerals predominate, pointing to the mobilisation of more secondary magnetic minerals from enhanced topsoil horizons (Smith 1985, 182). Mineral magnetic and pollen analytical studies from Peckforton Mere, Cheshire (Twigger 1983, unpub., Oldfield et al 1985a)showed that where pollen evidence pointed to intensive clearance activity, the magnetic characteristics of the sediment indicated topsoil erosion (Oldfield et al 1985a,39), inferences regarding sediment-source linkages were based on the data of Smith (1985).

It has thus proved possible to relate magnetic mineral assemblages within lake sediments from the Shropshire-Cheshire Plain to changing land use regimes, although evidence was found at Bar Mere which suggested that some chemical reduction of haematite was occurring in the lake sediments,probably at the mud water interface (Smith 1985, 157) and the authigenic alteration, or precipitation of magnetic minerals is a potential complicating factor in the search for sediment-source linkages (Smith 1985, Oldfield et al 1983, Hirons and Thompson 1986). Samples from B6 at Berth Pool plot to the top right of a graph of χ versus SIRM (Figure 23) and also to the top right of a plot of SIRM/χ against 'S' (IRM-100mT/SIRM), the plotting position of samples on these graphs is dependent upon sample mineralogy (Hirons and Thompson 1986), samples with high concentrations of ferrimagnetic minerals, e.g. magnetite will plot to the right of these graphs.

At two small lakes in County Tyrone, Killymaddy Lough and Weir's Lough (Hirons and Thompson 1986) sediment samples tended to have higher ferrimagnetic mineral concentrations, e.g. magnetite, during pre-historic and early historic clearance phases, but significantly higher anti-ferromagnetic concentrations, e.g. haematite, during more recent, more intensive farming phases. Softer, ferrimagnetic minerals appear to predominate in the sediments of Berth Pool in B6, authigenic precipitation is a possibility (Hirons and Thompson 1986), but limited erosion of topsoils could also be in evidence, the pollen data suggest that some anthropogenic activity was occurring in the proximity of Berth Pool and the other Baschurch Pools in B6.

4.1.2.2 Fenemere (Figures 22, 23, 24 and 26)

Three samples were taken from B6 at Fenemere, 332-334cm, 338-340cm and 344-346cm. χ , ARM and SIRM are relatively high, peak values occur at 332-334cm. In comparison to Berth Pool, magnetic mineral concentrations appear to be lower at Fenemere, χ reaches a peak value of 3.27 at Fenemere in B6 but 6.95 at Berth Pool. The sediment accumulation rate has been estimated at 22 C14 yrs/cm at Berth Pool but only 8.6 C14 yrs/cm at Fenemere. Fenemere had no natural inflow streams at this time, is surrounded by shallow relief and is not thought to have a large terrestrial catchment, the relatively high accumulation rate is thought to be indicative of high autochthonous primary productivity, a feature typical of most of the Shropshire-Cheshire meres today (Reynolds 1979). Autochthonous organic sedimentation is high and erosional loss limited, sediments can have low magnetic mineral concentrations even where the lithology of the area is characterised by high concentrations of primary magnetic minerals, as it is in Shropshire (Smith 1985). The χ peak in B6 at Fenemere is associated with a marked increase in χfd, pointing to the inwash of fine magnetic grains form topsoils (Oldfield et al 1983) values of ARM/χ , SIRM/χ and SIRM/ARM are comparable to Berth Pool in B6, and point to the presence of fine grained ferrimagnetic minerals in the sediments (cf. Thompson and Oldfield 1986). A "soft" magnetic response is indicated by the high reverse field ratios but a slight hardening occurs in the low reverse fields at 338-340cm.

At Peckforton Mere, Cheshire (Oldfield et al 1985a,39) high IRM values in association with soft high reverse, but harder low reverse fields were taken to indicate the inwashing of stable single-domain magnetic minerals from enhanced topsoil horizons (cf Smith 1985, Mullins 1977), during a period of clearance activity. A coercivity profile for the sample from 338-340cm (Figure 26) shows that a relatively rapid loss of the applied forward field occurs at lower field strengths, pointing to the presence of ferrimagnetic minerals, e.g. magnetite (Thompson and Oldfield 1986, Oldfield et al 1985a). Samples from B6 at Fenemere plot to the top right of scattergrams of χ versus SIRM and SIRM/ χ versus 'S', as at Berth Pool, ferrimagnetic minerals appear to predominate in the sediments (cf Hirons and Thompson 1986). Authigenic precipitation of ferrimagnetic minerals could be occuring (cf Oldfield et al 1983, Hirons and Thompson 1986, Thompson and Oldfield 1986), although at 340cm at Fenemere Plantago lanceolata and Pteridium increase in frequency, Urtica and Umbelliferae occur, Quercus declines and at 336cm an increase in Fraxinus occurs. It is at 338-340cm that a hardening in the reverse field ratios IRM - 20mT and IRM - 40mT occurs, pointing to an increase in the deposition of topsoil derived magnetic minerals (cf Oldfield et al 1986, 39). A small clearing could have been created in the catchment area of Fenemere, causing some topsoils to be disturbed and washed into the mere.

4.1.3 Sediment loss on ignition

4.1.3.1 Berth Pool (Figure 13)

At the boundary between B5 and B6, at 220-222cm loss on ignition declines slightly to 48.5%, but increases to 56.9% at 206-208cm in late B6, possibly, organic material from the catchment could be being washed into the pool; peat deposits surround the site and the magnetic data suggest that topsoil-derived minerals occur in the sediments. Marked increases in N.A.P. do not occur in B6, but Quercus is clearly reduced and Alnus begins to decline above 208cm. A limited degree of anthropogenic interference could be in evidence here, but it is possible that, with a high proportion of organic soils occurring close to the pool, L.O.I is not necessarily a good indicator of increasing human impact since, with relatively moderate levels of activity, organic material will tend to be washed into the pool and thus pollen evidence for clearance will not be accompanied by an apparent increase in allocthonous minerogenic inwashing.

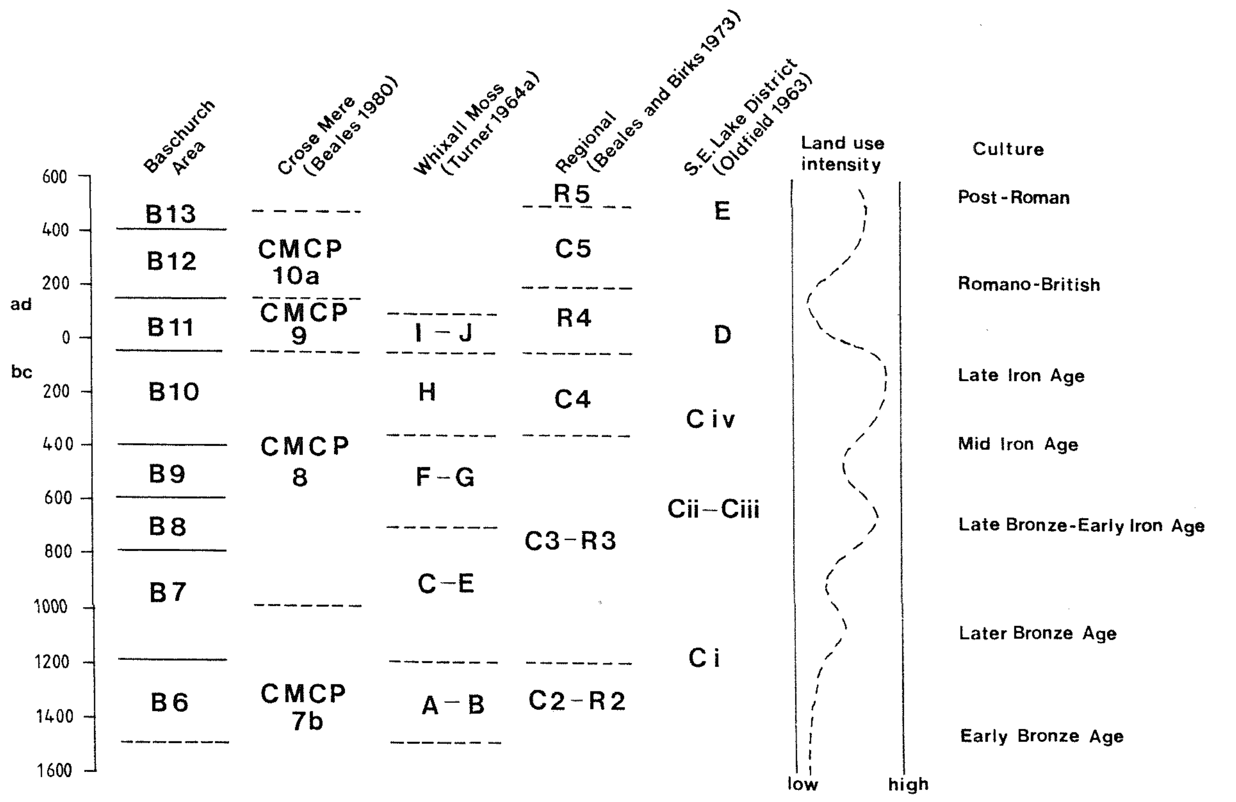
4.1.3.2 Fenemere (Figure 13)

Sediment loss on ignition is 57.7% at 334-335cm, slightly higher in comparison to Berth Pool but no measurements were made below this horizon at Fenemere. Between B6 and B11/B12 at Fenemere, the sediments remain predominantly organic, even during the maximum clearance expansion of B10 (Chapter 5). Autocthonous primary productivity is probably relatively high (cf Reynolds 1979), although with no inflows and relatively shallow relief in its restricted terrestrial catchment Fenemere would not be expected to experience a high degree of minerogenic inwashing at this time.

4.1.4 Archaeological evidence

The time period of B6 is estimated, by extrapolation of radiocarbon dates at Fenemere, and of correlated dates at Berth Pool and by its stratigraphic position closely above radiocarbon dated horizons at New Pool and Boreatton Moss to be c.1500 - 1240bc. In conventional archaeological terms, B6 dates to the final stages of the earlier Bronze Age (Megaw and Simpson 1979, Bradley 1984). The clearance activity of B6 appears to pre-date the major re-organisation of farming practices in Britain inferred in the years following 1300bc (Bradley 1984, 95). Human groups were evidently active in expanding cleared areas for pastoral land use c.1500bc (Hicks 1971, Tallis & Maguire 1972, Simmons and Tooley 1981). The Shropshire lowlands do not appear to have been widely cleared at this time, although the cemetery at Bromfield was occupied in the earlier Bronze Age (Stanford 1982). B6 correlates relatively well, in chronological terms, to the Bedd Branwen Period of the earlier Bronze Age, which spanned the years c.1450-1250bc (Burgess 1980, 257), new metalworking traditions spread through the marches at this time (Burgess 1980, 259). Cremation burials represented the dominant funerary tradition during this period, however, at the end of the Bedd Branwen period major social upheavals are indicated in the archaeological record; considerable adjustments in land use, settlement and social systems could well have occurred (Burgess 1980, Bradley 1978, 1984). A radiocarbon date from a rectangular floor area at The Breiddin Hill of 1550±100bc (Musson 1976) points to occupation of that site in the early Bronze Age, possibly during the time period of B6. The date of c.1250bc does appear to be significant in archaeological terms (Burgess 1980, Bradley 1984, Megaw and Simpson 1979), marking, as it does, a time of considerable social re-organisation in Britain and is conventially taken to mark the division between the earlier and later Bronze Age. C.1250bc is significant in palaeoecological terms in the Baschurch area since it marks a change from a limited

Fig 19 Regional Phase Correlation



level of anthropogenic activity, perhaps locally moderately intensive, to a level of activity which involves larger clearances being created over a wide area, with a greater degree of land use organisation.

4.1.5 Summary: Phase B6 (cf Figure 19)

The pollen diagrams from the Baschurch/New Pool area in B6 suggest that both in close proximity to the sites, and over a wider area, the intensity of clearance activity was very low, although the impact of man on the woodlands appears to have been greater closer to Boreatton Moss. The pollen evidence from Crose Mere (Beales 1980) in the earlier Bronze Age is indicative of a very low level of anthropogenic activity. Arboreal pollen frequencies remain high, Gramineae frequencies are minimal and herb pollen diversity is low. It is assumed here that the radiocarbon date of 3714bp for the onset of CMCP8 at Crose Mere is, as Beales (1980) suggests, too old, and that the date of the CMCP7b/CMCP8 transition is c.3000bp (4.2.1). B6 thus correlates to the later stages of CMCP7b. The pollen spectra from Crose Mere are, like those from Marton and Fenemere, mainly regional in character and suggest that across wide areas of the Shropshire lowlands, woodlands persisted as the dominant vegetation type throughout the earlier Bronze Age, although woodland structure and species composition was progressively altered. Parallels are thought to exist between B6 in the Baschurch Area and sections A and B in the pollen spectra from Whixall Moss (Turner 1964a); A and B at Whixall occur immediately below a horizon radiocarbon dated to 1288bc (Q - 467). Human impact on the vegetation appears to have been very restricted at this time in the area around Whixall Moss. If clearance activity was limited during the time period of B6, it appears to intensify at the B6/B7 boundary. The pollen evidence points to the creation of larger clearings in the lowlands, with the clearances being occupied by man for c.100 years, and it is possible that for half a millennium the whole of the Baschurch area was contained within a defined territory, where a stable system of land use rotation was practised.

4.2 Phase B7. Later Bronze Age small temporary clearances: 1240bc to 800bc

Introduction

Two distinct cycles of woodland clearance and regeneration can be discerned after 1240bc at the Baschurch Pools. There are indications of a similar pattern of clearance activity at Boreatton Moss in horizons above those assigned to B6. Inter-site comparisons are first made at the Baschurch Pools, where the pollen spectra are very similar and site to site correlation of the clearance and regeneration cycles is more certain, Boreatton Moss is then considered in detail and compared to the Baschurch Pools. The pollen spectra were not examined above B5-B6 at New Pool since evidence for disturbance of the top 50cm of peat was observed after the initial coring had taken place; it is possible that the Gramineae rise at 52cm at New Pool represents the B6-B7 transition, but this is uncertain and the site is not considered in this section. Calibration of the radiocarbon dates for Fenemere, using the curves in Pearson et al (1986) suggests a calendar age of c.1440 to 1520BC for 1240bc and c.120 AD for the radiocarbon date of 60 ad, both from Fenemere; extrapolation of these 'true' dates suggests that at Fenemere, B7 ends at c.1000 BC. Its duration is thus some 500 calendar years, suggesting that clearances were occupied for just over 100 calendar years and then abandoned and allowed to regenerate a woodland cover for approximately the same time (cf Figure 10).

4.2.1 The first later Bronze Age clearance and regeneration cycle at the Baschurch Pools

It is believed, on this basis of the excellent biostratigraphic correlation between the four Baschurch Pools and the proximity of the sites to one another, that the *Tilia* pollen frequency at all four sites declines to less than 1% simultaneously at c.1240bc. At all four meres, *Ulmus* and *Quercus* are reduced in association with the *Tilia* decline, *Corylus/Myrica* also declines and distinctive peaks in Gramineae occur. The diagrams from Berth Pool indicate some intra-site variability in the frequency of this first Gramineae peak; c.10% (II) to c.15% (III), although its appearance in both cores confirms that it is not simply a random fluctuation confined to one core. Gramineae, in isolation, is not an infallible indicator of clearance activity (Godwin 1975) since the many species which compose the family have a wide variety of ecological tolerances. Increases in the frequencies of other open habitat indicators are associated, at all four pools with this first Gramineae peak. Declines in arboreal pollen frequencies accompany the open habitat indicator increases at each site. At Birchgrove Pool, lower Betula, Ulmus, Tilia, Alnus and Fraxinus values are associated with the first Gramineae peak, c.310cm. At Berth, core III was counted from the start of B7; clear comparisons with B6 are not possible in this core, the Tilia reduction in III at 240-244cm is, however, believed, on the basis of biostratigraphic correlation to correlate to the Tilia decline at 202-204cm in II, lower Ulmus frequencies are evident in II although in both cores increases in Taxus occur immediately above the Tilia decline. At Fenemere and Marton decreases in Ulmus, Quercus and Tilia are apparent at the B6/B7 transition, reductions in Pinus also occur in early B7. The implication in the Pinus reduction is that in certain areas, pine formed part of the woodland which was cleared although the minimal Pinus frequencies at Berth and Birchgrove suggest that pine was not abundant close to at least these two sites (cf. Bennett 1984). The pollen evidence points to the removal from the woodlands of lime in particular although the clearance of elm and oak is also indicated. Locally, yew could have taken advantage of improved light conditions closer to Berth and Birchgrove and possibly closer to Fenemere, in comparison to Marton Pool. An enhanced degree of human impact, in comparison to B6, is in evidence. The clearance activity appears to be of a similar intensity throughout the Baschurch area. The B7 Tilia decline is marked as an important pollen zone boundary by ZONATION procedures, numerical zone splits also mark the alternating clearance and regeneration episodes of B7. At Fenemere, the 4th zone split occurs in both statistics between 324 and 328cm, where Tilia declines to less than 1%, zone splits also mark the boundaries between the clearance and regeneration episodes. At Marton, the 3rd split in SPLITINF occurs at the Tilia decline horizon between 372cm and 376cm, the pattern of zone splits is slightly different, in comparison to Fenemere, where no zone splits were made below the Tilia decline. As at Fenemere, however, zone splits mark the divisions between clearance and regeneration in B7 at

Marton. The B7 Tilia decline occurs between 308cm and 312cm at Birchgrove Pool, although important pollen frequency changes occur below this level, the 3rd zone split in SPLITINF occurs between 312cm and 316cm, where reductions in Alnus, Fraxinus and Corylus/Myrica occur and Gramineae begins to increase, zone splits occur between 298cm and 302cm and 302cm to 304cm, where lower Gramineae values are associated with a Fraxinus increase.

In Berth Pool II, the Tilia decline occurs between 202cm and 204cm. A single, minor zone split occurs at this horizon and pollen frequency variations in B6 are, by comparison, more significant. In common with Birchgrove Pool, zone splits occur at the horizon of the mid B7 Gramineae minimum, the pollen frequency fluctuations in early and mid B7 are thus of relatively minor importance, although, in comparison to the three other pools, a longer time period is represented in Berth II. In Berth III zonation splits occur in both statistics at the Tilia decline horizon at 240cm to 244cm, zone splits also mark the alternation between clearance and regeneration in B7. Fluctuations between clearance and regeneration, as inferred from the pollen spectra, are thus identified as moderately significant by ZONATION procedures, although in all five cores from the pools it is the B7/B8 boundary which is the most significant in terms of numerical zonation (Chapter 5).

Main characteristics: The first Gramineae peak

Fenemere: 328cm to 312cm

Cereal pollen (undiff) and Secale occur. Artemisia, Chenopodiaceae, Rumex acet and Plantago media/major are present; Plantago lanceolata frequencies increase from less than 1% to c.1-2%. Rosaceae, Urtica, Ranunculaceae and Filipendula occur, although the latter type is the only one to make its first appearance here, perhaps indicating the presence of Filipendula on wetter soils. Total tree pollen declines from c.65% to c.55%. Pteridium and Filicales spore frequencies increase.

Marton Pool: 372cm to 360cm

Cereal pollen (undiff) and Secale occur. Tubuliflorae, Liguliflorae, *Artemisia*, Chenopodiaceae Cruciferae and *Plantago media/major* are present at less than 1%. *Plantago lanceolata* and *Rumex acet* increase to slightly higher levels in comparison to Fenemere. Ranunculaceae, *Umbelliferae*, *Urtica* and *Filipendula* occur and, as at Fenemere, *Filipendula* makes its first appearance at this level. Total tree pollen declines from c.65% to c.55%. *Pteridium* and Filicales spore frequencies increase.

Birchgrove Pool. 312cm to 308cm

Cereal pollen (undiff) occurs. Tubuliflorae, Liguliflorae, *Artemisia*, Chenopodiaceae and *Rumex acet* occur, at less than 1%, and *Plantago lanceolata* frequencies increase. Caryophyllaceae, Rubiaceae, *Urtica* and *Hypericum perforatum* type could indicate herb expansions on drier soils, whilst Rosaceae, Ranunculaceae and *Succisa* could indicate herbs present on wetter areas; *Filipendula* again makes its first appearance at this first Gramineae peak. Total tree pollen declines slightly. *Pteridium* and Filicales spore frequencies increase.

Berth Pool (II) 204cm to 202cm
(III) 240cm to 236cm

Cereal pollen (undiff) occurs. Liguliflorae, Tubuliflorae and *Artemisia* occur in core III in association with the Gramineae peak but not in core II. *Plantago lanceolata* and *Rumex acet* frequencies increase in both cores as Gramineae increases. Amongst the other herb taxa, Ranunculaceae and Rosaceae types could represent herbs occupying damper habitats.

Total tree pollen declines from c.63% to 53% in core III, a decrease which is less clearly seen in core II.

The magnitude of the Gramineae increases is similar at all four sites; on the basis of the estimated sampling intervals (Section 4.2) the duration of this first Gramineae peak appears to be c.100 radiocarbon years. The fact that this postulated clearance phase is represented in a very similar form at all four sites suggests that the clearance activity itself was of a similar intensity throughout the area. Woodland clearance appears to have led to a diversification in the herb flora on both drier and wetter soils, woodland thinning is also indicated by the association, variable between the sites, of the shrub pollen types Sambucus, Frangula, Lonicera and Crateagus with the Gramineae peaks.

Amongst the aquatic pollen types, it is interesting to note that with some variability between the sites in frequency and occurrence, Sparganium/Typha, Menyanthes, Nuphar, Nymphaea and Potamogeton become more regularly represented at the first Gramineae peak. The representation of Sparganium/Typha increases at all four sites at the first Gramineae peak, Menyanthes is recorded for the first time in the diagram from Birchgrove Pool, Nuphar and Nymphaea are recorded together in two successive levels at Berth Pool (II) and Nymphaea increases to c.1-2% at Marton Pool and Fenemere. Potamogeton is recorded more frequently at the first Gramineae peak in Berth (II) as it was at the primary Tilia decline at 224cm in the same core. It therefore appears that, at the same time as woodland clearance was occurring, the emergent reed Typha angustifolia, or the fen species Sparganium, and the floating-leaved macrophytes Nuphar, Nymphaea and Potamogeton became more abundant in the meres themselves. It is possible that, as a result of clearance near to the pools, inwashing of sediment occurred and caused a shallowing of water at the margin, allowing emergents and floating-leaved macrophytes to become established. Alternatively, woodland clearance could have led to increases in surface water runoff into the pools, temporarily raising water levels and leading to some flooding of the fen peats around the sites. These newly created tracts of shallow water around the pools would provide suitable environments for colonisation by reeds and water lilies; clearance of alder could have improved light conditions in fen areas.

Biostratigraphic correlations can be discerned between the Baschurch Pools, Crose Mere (Beales 1980) and Whixall Moss (Turner 1964a) at the Tilia decline horizon. At Crose Mere, Tilia and Ulmus decline to less than 1% at c.280-290cm. Gramineae increases slightly at the Tilia decline, and declines itself as an increase in Fraxinus occurs. This Fraxinus increase is only seen in one sample; above which Fraxinus declines and a more substantial increase in Gramineae occurs. Rumex acetosa, Rumex acetosella, Plantago lanceolata and Chenopodiaceae occur in association with the initial Gramineae increase at c.290cm at Crose Mere. Pteridium and Polypodiaceae increase.

At Whixall Moss, increases in Gramineae and Pteridium occur just before the Tilia decline; following this, a short-lived reduction in Gramineae occurs as Fraxinus frequencies increase. The date for this sequence of pollen frequency changes at Whixall Moss is 3238± 115bp, c.1288bc.

This compares to the dates of 3190±60bp at Fenemere and 3714±129bp at Crose Mere. The radiocarbon sample at Crose Mere was taken at a lithological boundary; Crose Mere is larger and deeper than Fenemere with more accentuated relief at its margins, as such, it could be more susceptible to soil inwashing and the focussing of old carbon in the central deposits, even if clearance activity in the vicinity was of a relatively low intensity.

Turner's (1964) date refers to ombrotrophic peat and can therefore be considered to be more reliable than the Crose Mere date in respect of its potential for reversal. At one standard deviation, the Fenemere and Whixall Moss Tilia decline dates are inseparable:-

Fenemere	3130-3250 bp
Whixall Moss	3123-3353 bp

It is believed, as suggested by Beales (1980) that the date from Crose Mere is too old; the Fenemere and Whixall Moss dates together confirm that clearance activity affecting all the major woodland trees occurred in the north Shropshire Lowlands in the 13th Century bc. This clearance activity does not appear, initially, to have been of great intensity. The occurrence of cerealia (undiff) at the first Gramineae peaks at all four of the Baschurch Pools, and Secale at Marton Pool, Fenemere and Berth Pool suggests that some cereal growing was taking place in the pollen source areas of the sites. The fact that the smaller two sites, Berth Pool and Birchgrove Pool, both have cereal pollen grains, combined with the evidence from Fenemere and Marton Pool that a high proportion of woodland still existed in a wider pollen source area around the sites, tends to suggest that cereal growing was local to the sites. Cereal pollen generated in the ground flora is poorly dispersed (Vuorela 1973),particularly so when woodland tracts surround cultivated areas. Compared to Marton Pool and Fenemere, which are theoretically large enough for their cereal pollen to have a non-local source, Berth Pool and

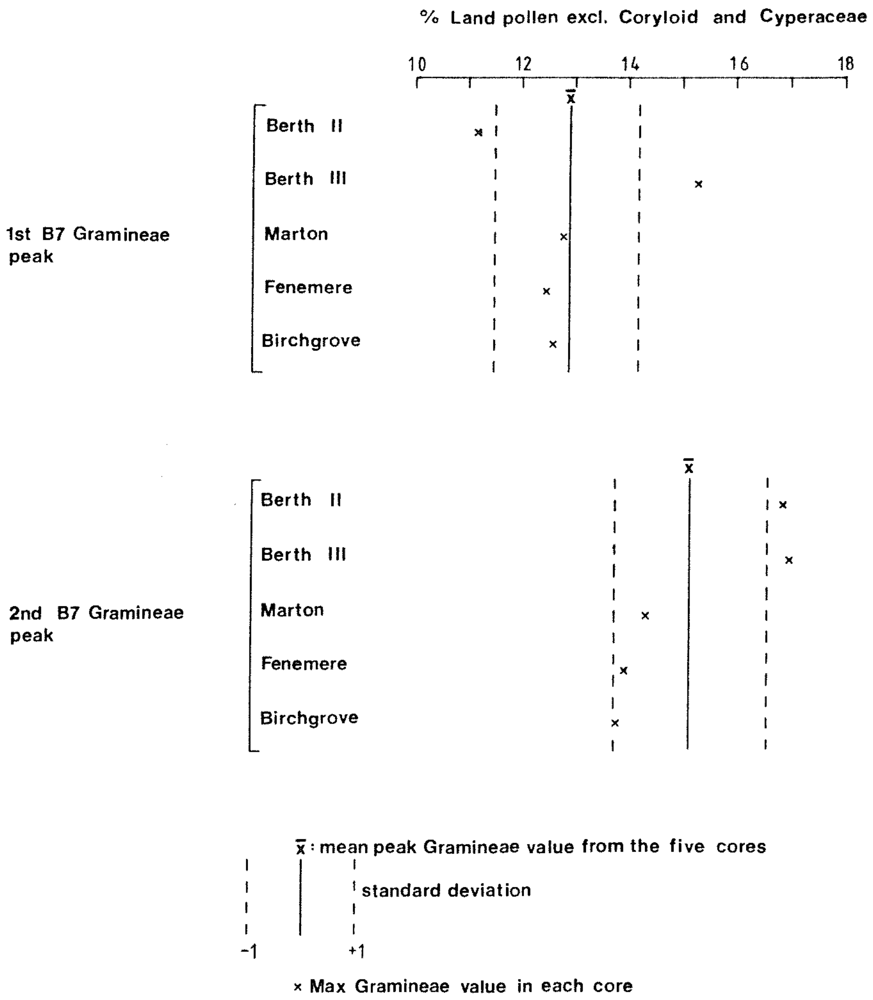
Birchgrove Pool are much more likely to represent the local area, particularly in respect of the occurrence there of cereal pollen associated with evidence for the continued present of tracts of uncleared woodland around the sites. The relative abundance of Plantago lanceolata, compared to other open habitat indicators, could be taken to indicate a predominance of pasture in the cleared areas; there are, however, doubts about the infallibility of Plantago lanceolata as a pastoral indicator (Edwards 1979, Behre 1981). Plantago lanceolata pollen could be generated from field edge weeds around cultivated plots (Edwards 1979) or from arable tracts turned over temporarily to fallow as part of a land-use rotation (Behre 1981).

Commenting upon the extent of woodland clearance, and the distance of that clearance from a given site, can be problematic (Oldfield 1970, Edwards 1982). At the Baschurch Pools it is interesting to note that, despite probable differences in site size c.1300bc, the magnitude of the Gramineae peak is similar in all five cores:-

	Max. Gramineae value	
Berth II	11.2%	
Berth III	15.3%	
Fenemere	12.5%	
Marton	12.8%	
Birchgrove	12.6%	
	$\bar{x}$ = 12.88	= 1.33

If two sites theoretically dominated by locally produced pollen, derived mostly from within several hundred metres, and two sites theoretically dominated by pollen derived from a kilometre or more away register a phase of clearance activity in a very similar way, it could be argued that that clearance is of a similar intensity over an area of at least several square kilometres around the sites. Across the five cores, the mean frequency of this Gramineae peak is 13.83% (Figure 20). The individual values from Marton Pool, Fenemere and Birchgrove Pool are all within one standard deviation of the mean (Figure 20). The values from Berth Pool are within two standard deviations from the mean, but not within one. This indicates that, as far as the first Gramineae peak is concerned, the variability in the Gramineae frequency at Berth Pool is greater than the variability

Fig 20 B7: Grass and Cereal Pollen at the Baschurch Pools



	1st Peak: Cereal	1st Peak: Secale	2nd Peak: Cereal	2nd Peak: Secale
Berth II	+		+	
Berth III			+	
Marton	+	+	+	
Fenemere	+	+	+	
Birchgrove	+		+	
Boreatton centre			+	
Boreatton margin			+	+

between the other three sites. Although the Gramineae peak in core II occurs at the junction of two core sections (2.2.1), an overlapping core section was taken to check the stratigraphy changes at this level, and no sediment appears to have been missed (2.2.1).

The duration of this first Gramineae peak, and the associated arboreal pollen reductions and weed pollen increases has already been estimated at c.100 radiocarbon years. At all four sites, this first Gramineae peak is succeeded by an increase in Fraxinus and , more obviously at Marton Pool, Fenemere and Birchgrove Pool, Quercus. At Marton Pool, Fenemere, and Berth Pool, increases in Corylus/Myrica are apparent, possibly reflecting regeneration within the shrub flora. Reductions in weed pollen frequencies accompany this first Fraxinus peak.

Main characteristics: The first Fraxinus peak

Fenemere. 304cm to 298cm

A slight rise in Betula occurs before Fraxinus increases. Ulmus regains some of its former representation, Quercus and Corylus/Myrica frequencies increase but Salix frequencies decline. Open habitat indicators are still present but Rumex acet is recorded less frequently and Plantago lanceolata declines to less than 1% at 302cm. Cyperaceae frequencies increase, perhaps indicating sedge colonisation of damper cleared soils. Total tree pollen increases sharply to c.75%, higher than pre-Tilia decline levels. Pteridium and Filicales frequencies decline to less than 1%.

Marton Pool. 348cm to 344cm

Ulmus regains some of its former representation, Quercus and Corylus/Myrica frequencies increase. Salix representation declines, compared to its frequencies during the preceding Gramineae peak. Plantago lanceolata declines and other open habitat indicators are recorded less frequently; only Plantago lanceolata itself is recorded at 384cm. Cyperaceae frequencies increase. Total tree pollen increases from c.50% to c.60%. Pteridium and Filicales frequencies decline to less than 1%.

Birchgrove Pool. 302cm to 298cm

Betula, Ulmus, Quercus, Alnus and Taxus frequencies increase as Fraxinus increases. Corylus/Myrica increases only slightly at 304cm but Salix representation increases.

Open habitat indicators are recorded less frequently, only Plantago lancolatà, reduced in frequency, and Rumex acet, at less than 1%, are recorded at 302cm. Total tree pollen increases. Pteridium and Filicales decline to less than 1%.

Berth Pool II 198cm to 196cm
III 232cm to 228cm

The Fraxinus peak is not clearly defined at core III. A clearer Betula increase is seen in core III, and an Ulmus increase in core II. A slight Corylus/Myrica increase occurs, more obviously in core II. Plantago lanceolata and Rumex acet frequencies are reduced. Total tree pollen increases in both cores. Pteridium frequencies decline.

Amongst the aquatic pollen types, Sparganium/Typha representation is reduced following the Gramineae peaks at Berth Pool, Marton Pool and Birchgrove Pool. At Marton Pool, Nymphaea and Potamogeton frequencies are reduced after the first Gramineae peak; at Fenemere, no aquatic pollen was recorded at the Fraxinus peak at 302cm. At Berth Pool there are reductions in the diversity of aquatic pollen following the first Gramineae peak and at Birchgrove Pool no aquatics are recorded at 298cm. The possibility was raised, during discussion of the first Gramineae peak, that clearance activity led to increased water runoff into the mere basins. With no natural outflow from these basins (Figure 3) increased waterlogging or flooding of the marginal fen peats could occur, providing shallow water environments for aquatic plants. The reduction in the frequency and diversity of aquatic pollen types, during the first Fraxinus regeneration, could therefore be due to a lessening in the degree of flooding of the pool margins as a regeneration of the full woodland canopy and the abondonment of farmed land reduced the amount and rate of direct overland water flow; tree regrowth could have increased shading in fen areas.

The age/depth profile from Fenemere (Figure 9) suggests that woodland regeneration lasted for approximately the same time as the first Gramineae peak. Cleared land in the pollen source areas of the sites was obviously abandoned and left to regenerate a tree and shrub cover. Although the apparent increase in the abundance of ash trees has been used to characterise this regeneration episode, since *Fraxinus* was the one tree pollen type which clearly increased in frequency at all four sites, it is evident that other trees regained some of their former abundance. There does not appear to have been any significant re-expansion of lime; a certain amount of soil fertility loss could have occurred. Given the relatively short duration of the regeneration episode, soil conditions might not have improved enough to allow lime to become re-established.

This first *Fraxinus* regeneration is succeeded at all four sites by a further reduction in arboreal pollen frequencies and an increase in Gramineae and other herb pollen.

4.2.2 The second clearance and regeneration cycle at the Baschurch Pools

Main characteristics: The second Gramineae peak

Fenemere. 296cm to 288cm

Betula and *Pinus* increase, *Quercus*, *Alnus*, *Fraxinus* and *Corylus/Myrica* decline, Cereal pollen occurs and Tubuliflorae, Liguliflorae, *Artemisia* and Chenopodiaceae occur at less than 1%. *Plantago lancolata* and *Rumex acet* frequencies increase. *Filipendula* is recorded again and *Hypericum perforatum* type appears for the first time on the diagram. Total tree pollen declines. *Pteridium* frequencies increase again.

Marton Pool. 342cm to 332cm

Betula and *Pinus* frequencies increase. *Quercus*, *Alnus*, *Fraxinus* and *Corylus/Myrica* decline. *Crataegus* and *Sambucus*, absent during the first regeneration, appear. Cereal pollen occurs. Tubuliflorae, Liguliflorae, *Artemisia* and Chenopodiaceae occur at 344cm immediately before Gramineae increases. *Plantago lanceolata* and *Rumex acet* frequencies increase. *Solanum dulcamara*, Ranunculaceae and *Filipendula* occur, probably indicating better light conditions in fen and damp-soil habitats. Pteridium and Filicales frequencies increase. Total Tree pollen declines slightly.

Birchgrove Pool. 302cm to 292cm

Betula increases. Quercus, Alnus, Taxus and Fraxinus frequencies decrease. Sambucus occurs, as it did at the first Gramineae peak. Cereal pollen occurs. Tubuliflorae, Liguliflorae, Artemisia Chenopodiaceae and Cruciferae occur at less than 1%; Plantago lanceolata does not increase but Rumex acet increases slightly. Other herb types diversify, for example, Polygonum bistorta appears and Umbelliferae and Hypericum perforatum type begin to appear more regularly. Total tree pollen declines from c.62% to c.52%. Pteridium and Filicales increase.

Berth Pool II 192cm
III 224cm

Alnus and Corylus/Myrica frequencies continue to decline. Taxus declines earlier in core III. Fraxinus declines more clearly at the Gramineae peak in core II, but declines after the Gramineae peak in core III. Cereal pollen occurs in both cores. Tubuliflorae occurs in both cores, at the Gramineae peak in core II, but just below it in core III. Liguliflorae occurs in core II but not in core III, the reverse of its pattern of occurrence in the first Gramineae peak. Artemisia occurs in both cores. Plantago lanceolata increases very slightly in core III, but more clearly in core II. Rumex acet is present in both cores. Hypericum perforatum type makes its first appearance in both cores at the second Graminea peak. Total tree pollen declines slightly. Pteridium frequencies increase in both cores.

In some cores, there are some detectable increases in the frequency and diversity of aquatic pollen types, compared to their representation during the first Fraxinus regeneration. At Birchgrove Pool, Nymphaea, Potamogeton and Sparganium/Typha, absent at 298cm, appear again at 296cm. After an absence at 302cm at Fenemere, aquatic pollen types become more diverse about 298cm. At Berth Pool, aquatics reappear in core III at 224cm after an absence at 228cm. In common with the first Gramineae peak, therefore, there are some indications that the diversity of aquatic pollen increases during the clearance episodes, possibly due to flooding on the peats at the margins of the meres (4.2.2).

The second Gramineae peak at all four sites thus has many vegetational similarities with the first and appears to be of approximately similar duration. Although _Quercus_, _Fraxinus_ and to a certain extent _Ulmus_ frequencies decline, _Betula_ and _Pinus_ increase at the same time at Fenemere and Marton Pool. _Betula_ frequencies increase at Birchgrove Pool. The opportunist colonisation by birch and pine, of areas cleared by elm, oak and ash, appears to be occurring. If the _Pinus_ pollen was being derived mainly from a distant source, such as a peat bog, its representation might be expected to be relatively constant, perhaps increasing slightly if the pollen productivity of the local aggregated pollen source area were reduced by clearance activity, allowing regional pollen a higher relative representation (Jacobson & Bradshaw 1981). At Marton Pool, however, _Pinus_ is absent at 348cm, at the first _Fraxinus_ maximum, increases to more than 6% at the second Gramineae peak and declines to less than 1% at the second _Fraxinus_ regeneration. This pattern is not so clearly seen at Fenemere, although _Pinus_ frequencies do increase at the second Gramineae peak. _Pinus_ only occurs at less than 1% at the Gramineae peaks at Birchgrove Pool and Berth Pool. The problems of interpreting _Pinus_ frequencies have already been discussed and, as with pre-_Tilia_ decline levels, the possiblility exists that the larger Fenemere and Marton Pool are recording higher inputs of _Pinus_ because distant sources are more important at these two sites. The magnitude of the Gramineae peaks themselves is similar at all four sites, although values are slightly higher at Berth Pool:

	Max. Gramineae %
Berth II	16.9
III	17.0
Marton	14.4
Fenemere	14.0
Birchgrove	13.8
	$\bar{x}$ = 15.22
	σ = 1.42

Range at 1σ = 13.8 - 16.64
Range at 2σ = 12.38 - 18.06

In this case, the Gramineae peak values from Berth Pool are almost identical in both cores. The Gramineae values at Berth Pool diverge from the other three sites by more than one standard deviation from the mean; this could suggest that open land was more extensive closer to Berth Pool, particularly when the Gramineae value at Birchgrove Pool, similar in size to Berth Pool, is much lower; both sites might be expected to accurately represent vegetation changes in their immediate locality.

The similarity in the Gramineae values from Berth Pool, compared to differences at the first Gramineae peak (4.2.2) again raise the possibility that a higher Gramineae value was not recorded in core II at the first peak because two core sections met at this depth. The first Gramineae peak in core II occurred in a layer of dark brown detritus mud interspersed with lighter mud deposits between 200cm and 215cm. An overlapping core section at the same core site also showed this layer. The stratigraphy change from dark brown detritus mud to dark brown detritus mud with interspersed lighter mud occurred at the junction of two core sections (2.2.1). Although the overlapping section clearly showed the well defined boundaries between these layers, it is possible that a restricted amount of sediment was not sampled by core II. Alternatively, a higher value of Gramineae pollen could exist within the unsampled 4cm of sediment between 198cm and 202cm. The duration of these Gramineae peaks has been estimated at c.100 years, given an estimated accumulation rate of c.22 C14 yrs per cm at Berth Pool, it is quite possible that a clearance indicator peak in one of these Gramineae phases could be missed when a 4cm sampling interval, c.50-80 C14 yrs, is used. In core III, no stratigraphy changes were noted in the field between 220cm and 250cm, where the Gramineae peaks occur. It is therefore considered probable that more variation in sedimentation occurred at the site of core II. When intra-site comparisons are made, it is clear that intra-site variations in sedimentation in combination with a sampling interval which is relatively wide, in respect of the actual duration of certain clearance or regeneration phases, at least have the potential to give rise to apparent intra-site variation in pollen frequencies. Despite these possibilities, however, the intra-site variation in the value of the first Gramineae peak could be genuine, in the sense that the relative proportion of grass pollen deposited in the pool did vary across the mud-water interface at this time.

The presence of two very similar short-lived clearance phases at each of the four sites can provide important confirmation about the behaviour of individual taxa during clearance and regeneration episodes in the Baschurch area.

One criticism of the designation of clearance or regeneration episodes on the basis of one core from one site given by Edwards (1979) is, if close-counted profiles cannot be replicated, little confidence can be attached to the designation of such episodes.

Apart from increases in Gramineae pollen, the four sites confirm that Plantago lanceolata is the most abundant open habitat indicator during the clearance phases. The tendency amongst the other open habitat indicators to experience a reduction in diversity during regeneration is also confirmed. The presence of cereal pollen is confirmed by all five cores. Given the probable dominant pollen source areas of at least Berth Pool and Birchgrove Pool, and the fact that cereal pollen is not well dispersed, particularly in an area where a high proportion of woodland cover is indicated (Vuorela 1973) it would appear that some cereal growing was occurring as part of this clearance activity in the Baschurch area. Pteridium and, in most cases Filicales frequencies increase in association with the Gramineae peaks at all four sites. Where regeneration of the woodland is indicated, Pteridium and Filicales frequences decline. In this case, these pteridophyte spores appear to be acting as good indicators of the presence of thinned or cleared woodland. Under improved light conditions on the woodland floor the species themselves would become more abundant and the dispersal conditions for the spores would improve; wind velocities within the woodland would be expected to increase as thinning and clearance occurred. Beales (1980) detected increases in the frequency of Pteridium and other woodland Pteridophyte spores at Crose Mere during later Bronze Age clearances phases.

Detailed pollen analyses from Ballynagilly, Co. Tyrone (Pilcher and Smith 1979) indicate that Pteridium frequencies increased in association with increases in Plantago lanceolata during later Bronze Age clearances.

Evidence from the English Lake District (Oldfield 1963) also points to bracken colonisation in association with cultural activity from the elm decline onward.

In general terms, the scope and intensity of the clearance activity characterised by the Gramineae peaks appears to be restricted. Total tree, shrub and herb+heath frequencies at the Gramineae maxima can be compared:-

	1st Gramineae peak			2nd Gramineae peak		
	Trees	Shrubs	Herbs and Heaths	Trees	Shrubs	Herbs and Heaths
BerthPool II	57.5	25.0	17.4	56.2	25.2	18.5
III	57.1	26.7	16.1	57.4	20.7	21.7
Birchgrove	52.1	30.5	24.7	58.5	28.5	12.8
Marton Pool	60.0	23.8	16.1	57.2	23.3	19.4
Fenemere	60.0	25.0	14.9	54.0	30.2	15.7

% Total determinable pollen, excluding aquatics.

These relative proportions suggest that in both the immediate locality of the sites, and within at least several square kilometres, the land is still predominantly wooded. If two sites dominated by locally produced pollen and two dominated by pollen from a wider source area, all situated less than 2km apart, show similar increases in herb pollen and decreases in tree pollen, a relatively even distribution of clearance activity can be envisaged.

In common with the first Gramineae peak, this second peak is succeeded, after c.100 radiocarbon years, by woodland regeneration, again characterised by increases in Fraxinus and some other tree and shrub pollen types.

Main characteristics: The second Fraxinus peak

Fenemere. 288cm to 280cm

Betula increases slightly and then declines as Fraxinus frequencies remain high. Pinus values are reduced and Ulmus increases slightly. Quercus, Alnus and Corylus/Myrica frequencies increase and Salix declines. Plantago lanceolata declines slightly, and only Rumex acet and Plantago lanceolata are recorded amongst the open habitat indicators at 284cm. Other herb taxa are reduced in diversity, only Rosaceae, Urtica and Cyperaceae occur, all at less than 1%, at 288cm. Total tree pollen increases from c.55% to c.75%. Pteridium declines to less than 1%.

Marton Pool. 332cm to 320cm

Betula increases initially at 332cm, but then declines, Pinus also declines. Ulmus, Quercus, Alnus and Fraxinus increase. Corylus/Myrica increases at the end of the regeneration phase. Gramineae and open habitat indicator frequencies decline; only Plantago lanceolata and Rumex acet occur, both at less than 1%, at 320cm. Other herb taxa are reduced in diversity; apart from Cyperaceae, only Rosaceae, Ranunculaceae and Umbelliferae occur, all at less than 1%, at 320cm. Total tree pollen from c.57% to c.70% Pteridium frequencies decrease.

Birchgrove Pool c.292cm

Betula, Quercus, Alnus and Fraxinus frequencies increase. Gramineae representation declines slightly at 292cm, but cerealia is also recorded. A reduction in the frequency and diversity of open habitat indicators occurs; Rumex acet declines to less than 1%, Plantago lanceolata values are low, compared to the first Gramineae peak although Liguliflorae and Artemisia are still present. The diversity of other herb types declines. Total tree pollen increases from c.52% to c.63%. Pteridium and Filicales frequencies decline.

Berth Pool II c.188cm
III c.220cm

Quercus and Fraxinus increase in core II, increases in Betula and

Ulmus are clearer in core III where Fraxinus frequencies remain relatively high but do not exhibit a clear peak. Taxus frequencies are higher in core II, but Salix frequencies are marginally higher in core III where Gramineae declines at 220cm. Tree and shrub increases are therefore indicated but, given the relatively short duration of the regeneration, set against the 4cm sampling interval, it is unlikely that an exact chronological correlation will be achieved between sampled levels in both the cores. If a regeneration phase is spanned by only 2 sampled levels in two separate cores, four temporally separate stages of the regeneration could be shown, giving at least the impression of intra-site pollen frequency variations when core to core correlation is attempted. Generally, however, pollen frequencies are similar at the Gramineae minima in both cores:-

	%'s	
	Berth II (188cm)	Berth III (220cm)
Betula	7.4	4.9
Ulmus	1.2	2.3
Quercus	30.9	27.4
Alnus	25.8	33.7
Fraxinus	7.0	7.6
Corylus/Myrica	16.7	16.3

There are no clear open habitat reductions, apart from the decline in Rumex acet in core III. Again, the sampling interval is possibly not fine enough to more clearly show up frequency changes associated with the postulated woodland regeneration. Apart from Cyperaceae only Rosaceae, Urtica and Filipendula occur at 220cm in core III, and only Urtica at 188cm in core II. Total tree pollen increases in both cores. Pteridium frequencies decline.

In common with the previous Fraxinus regeneration, there is evidence for a reduction in the diversity of aquatic pollen. No aquatic pollen is recorded at 188cm at Berth Pool, core II. Aquatic pollen diversity is reduced at 292cm at Birchgrove Pool, at 316-320cm at Marton Pool and 280cm at Fenemere.

These aquatic pollen reductions involve Nymphaea, Nuphar Potamogeton and Sparganium/Typha in varying degrees from site to site. The pollen totals involved are small, but nevertheless there is some indication that a reduction in open shallow water is associated with woodland regeneration. It is possible that in the absence of clearance activity in the catchment of the meres, that there is a reduced tendency for the margins of the meres to flood, where such flooding was a consequence of increases in overland water flow from areas denuded of intercepting tree and shrub cover.

The evidence for woodland regeneration, confirmed in all five cores, points to a decrease in the abundance of grass, clearance weeds and other herbs in association with an expansion first of birch and then ash with oak tending to succeed these primary deciduous woodland colonisers. This pattern is almost identical to the first Fraxinus regeneration, particularly at Fenemere where a clear succession from birch to ash to oak is indicated during the first regeneration. The increases in Ulmus frequencies, particularly at Marton Pool and Berth Pool, core III, during the second regeneration, suggest that the clearance activity has not led to long-term soil fertility losses. Elm has a preference for more fertile soils (Godwin 1975), and a decline in elm at Pawlaw Mire in the Pennines is attributed by Sturludottir and Turner (1985) to soil fertility loss during mesolithic clearance activity.

The duration of both clearance and regeneration phases is so regular as to suggest a considerable degree of land-use organisation with areas successivly cleared and then abandoned and re-cleared on a regular time scale.

At this point it is necessary to compare the pollen frequency changes c.1200-1300bc at the Baschurch Pools with those at Boreatton Moss.

4.2.3 Boreatton Moss

4.2.3.1 The centre of the Moss

Biostratigraphic correlation between Boreatton Moss and the four Baschurch Pools suggests that at the centre of the moss the pollen spectra between 158cm and 140cm correspond to phase B7 at the Pools.

The first clearance and regeneration cycle c.158cm to c.150cm

At 156-158cm Quercus, Fraxinus and Betula frequencies decline. A short lived increase in Pinus occurs and Corylus/Myrica frequencies are temporarily reduced. Although Tilia is recorded only intermittently after 173cm, it is possibly significant that Tilia is not recorded at all between 159cm and 146cm. This temporary cessation of Tilia representation at 159cm obviously has chronological parallels with the 1240bc Tilia decline at the Baschurch Pools. Some woodland removal appears to be in evidence, although the peak value of Gramineae occurs where Quercus frequencies have begun to increase again. Cereal pollen, Tubuliflorae, Liguliflorae and Artemisia are present where Quercus declines but Plantago lanceolata shows no clear increase in frequency. A clear increase in Pteridium occurs in association with the Gramineae increase at 152-156cm. Between 150cm and 154cm Quercus and Alnus frequencies increase and Gramineae declines. Corylus/Myrica increases in frequency and Pteridium declines. The sequence of clearance-regeneration is not as clear as it is at Baschurch, but nevertheless there are indictions of a short lived opening-up of the woodland, with grass and bracken becoming more abundant, followed by a closing of the woodland canopy and regrowth of oak and, to a certain extent, ash and yew.

The second clearance and regeneration cycle c.150cm to c.140cm

Alnus and Taxus decline, and Quercus frequencies are reduced again above 150cm, a slight reduction in Fraxinus occurs at 144-146cm. Corylus/Myrica frequencies decline and Gramineae increases. Cereal pollen occurs and Plantago lanceolata increases at 148cm. Apart from Plantago lanceolata only Rumex acet occurs amongst the open habitat indicators. A short-lived increase in Urtica occurs and a reduction in Ericaceae is seen. Pteridium does not increase. There is therefore some evidence for the expansion of cleared land although, unlike the Baschurch Pools, this does not include evidence for a diversified herb flora and bracken colonisation. At 140-142cm, Betula, Ulmus, Alnus, Quercus and Fraxinus increase in frequency. A slight increase in Corylus/Myrica and an increase in Salix occurs. Ericaceae frequencies increase agin, Gramineae declines and Plantago lanceolata frequencies are reduced. Only Plantago lanceolata occurs amongst the open habitat indicators at 142cm. Unlike previous clearance phases (Chapter 3) no increase in Hydrocotyle occurs in association with evidence for vegetation clearance although a small rise in Sphagnum occurs at the second Gramineae peak at 144cm.

None of the pollen frequency fluctuations between 140cm and 160cm are marked as important pollen zone boundaries by ZONATION statistics; this is in contrast to the Baschurch Pools where zone splits are placed in between the Gramineae and Fraxinus peaks. One possible explanation of this, particularly in the light of the limited open habitat indicator increases at Boreatton Moss, is that the clearance activity itself did not occur in quite the same proximity to Boreatton in comparison with the Baschurch Pools. Pollen from cleared areas close to the Baschurch Pools would form a more significant part of the total pollen input in comparison to Boreatton Moss, if clearance activity were more distant from Boreatton Moss.

Despite the absence of ZONATION boundaries there are obviously many biostratigraphic similarities between Boreatton Moss and the Baschurch Pools after c.1200-1300bc.

The successive Quercus reductions at 146cm and 156cm at the centre of Boreatton Moss are similar to those seen at the Baschurch Pools. The Gramineae peaks are obviously similar in magnitude and apparent duration, and the decline in the representation of Taxus at 148cm at the centre of Boreatton Moss is very reminiscent of the decreases in Taxus representation at the second Gramineae peaks at Berth Pool, Birchgrove Pool and Fenemere. The evidence from Boreatton Moss, particularly from the second clearance-regeneration episode, confirms the importance of ash as a colonising species during the succession back to oak woodland (Godwin 1975). The apparent removal of yew from most of the woodland is evident during this phase, it could be that the wood of the yew was particularly attractive to the pre-historic settlers in the area and it was therefore selectively felled. Godwin (1975) notes the variety of uses of yew throughout the pre-historic period. If the central core from Boreatton Moss can be seen as representing the regional pollen source area of the site a more localised picture should emerge at the margin. A comparison of the edge and centre of the moss at this point essentially confirms the presence of renewed clearance activity in the area c.1200bc. There is evidence for successive clearance and regeneration although the sequence itself is shown less clearly at the site margin.

4.2.3.2 Boreatton Moss: edge and centre in phase B7

A biostratigraphic correlation between the edge and centre of Boreatton Moss can be made at the following levels:

	1st Gramineae peak	2nd Gramineae peak
Centre	154cm	144cm
Edge	172cm	166cm

In both cores, Ulmus frequencies are higher at the second Gramineae peak, Quercus frequencies decline at the second Gramineae peak at the edge, but the two distinctive Quercus reductions seen at 146cm and 156cm at the centre are not seen at the edge. Fraxinus frequencies in both cores tend to be higher at and immediately after the second Gramineae peak:

Edge: Fraxinus peaks at the Gramineae peak, 168cm
Centre: Fraxinus peaks following the Gramineae peak, 142cm

In both cores, Taxus is not represented after the second Gramineae peak. Alnus frequencies decline in association with the Gramineae peaks at the edge, a slight increase in Alnus occurred in between the Gramineae peaks at the centre, this effect is just discernable in between the Gramineae peaks at the edge, at 170cm. A reduction in Corylus/Myrica is more apparent at the second Gramineae peak at both the edge and centre. In common with the central core, Plantago lanceolata frequencies only show a clear increase at the second Gramineae peak at the margin, otherwise, other open habitat indicators are less frequent and diverse in comparison to the previous clearance phase in the earlier Bronze Age (Chapter 3).

There appears to be a contrast, between the edge and the centre, in the representation of Pteridium. Whereas at the centre of the moss Pteridium is only present at less than 1% at the second Gramineae peak, it is continually represented at more than 5% at equivalent levels at the margin.

The most likely explanation for this variation is the presence of a discrete, local source of Pteridium near the marginal core site, a source which is not productive enough to give high Pteridium frequencies at the centre. During the earlier Bronze Age clearance phase, B5 (Chapter 3) Gramineae frequencies were higher at the margin of the moss than at the centre, this does not appear to be the case in this phase. Despite a degree of comparability between Boreatton Moss and the Baschurch Pools, after c.1200bc, the clearly ordered sequence of clearance and regeneration, following two distinct cycles, is not exactly replicated at Boreatton Moss.

This could be because the clearance activity itself is relatively distant from the moss, in comparison to the Baschurch Pools. The declining Quercus frequencies above 172cm at the margin certainly indicate oak woodland reduction but the two characteristic short lived decreases seen at the centre do not appear at the margin. One possible explanation for this is that the central core is recording clearance and regeneration phases up to a kilometre or more away from the site whilst the marginal core represents a more specific indication of the type of woodland clearance occurring around the western edge of the Moss. The magnitude of the Gramineae peaks can be compared to those at Berth Pool, the nearest of the Baschurch Pools:

	1st Gramineae peak	2nd Gramineae peak
Boreatton centre	14.2	18.4
Boreatton margin	16.2	20.2
Berth II	11.2	16.9
Berth III	15.3	17.0
	$\bar{x}$ = 14.22	$\bar{x}$ = 18.12
	σ = 1.88	σ = 1.33
Range at 1σ :	12.34 - 16.1	16.89 - 19.45

At one standard deviation from the mean the frequency of the second Gramineae peak is higher than the first. At the four Baschurch Pools the mean frequency of the second Gramineae peak was also higher than the first although there was a partial overlap in the range at one standard deviation. All five sites in the Baschurch area are therefore in reasonable agreement as to the registration of these later Bronze Age phases of clearance and regeneration. Clearance activity does not appear to have been concentrated in a single locality within the Baschurch area. Despite the probability that the five sites concerned are dominated by varying proportions of more localised and more distant pollen source areas, the pollen diagrams derived from them are similar.

It could be argued that Berth Pool and Birchgrove Pool are also receiving mainly regional pollen although subsequent evidence (Chapter 6) suggests that their pollen source areas are very restricted and that they are dominated by pollen derived from within 100m to 200m of their margins.

The similarity in the character, magnitude and duration of the two clearance and regeneration cycles suggests that the same type of economic activity, and indeed the same prehistoric culture were responsible for the entire sequence. The regularity of the clearance-regeneration cycle is such that a quite extensive system of land use planning could be in evidence, with tracts of woodland cleared, occupied, temporarily abandoned and then re-occupied as part of an organised pattern of land use in the area (cf Bowen 1978; Bradley 1978, 1984; Fowler 1983).

4.2.4 Magnetic measurements

4.2.4.1 Berth Pool II (Figures 21, 23, 24 and 25)

Two samples were taken from B7, 192cm to 194c, and 196cm to 198cm. Compared to B6, χ, ARM and SIRM are reduced, but remain relatively high, there is, however, a marked reduction in χ fd. ARM/χ values are comparable to B6 but SIRM/χ and SIRM/ARM are reduced, changes in magnetic grain size and domain type are indicated (Oldfield et al 1985a), the concentration of viscous magnetic grains appears to decline (Oldfield et al 1983). A 'soft' response is evident at the high reverse fields of -200mT and -100mT, magnetite appears to be the dominant magnetic mineral (Oldfield et al 1985a), a slightly harder response is evident at the lower reverse field, -40mT, at Peckforton Mere, Cheshire (Oldfield et al 1985a) a combination of soft high reverse and harder low reverse fields was taken to point to topsoil magnetic

Fig21 Berth Pool II. Magnetic Measurements

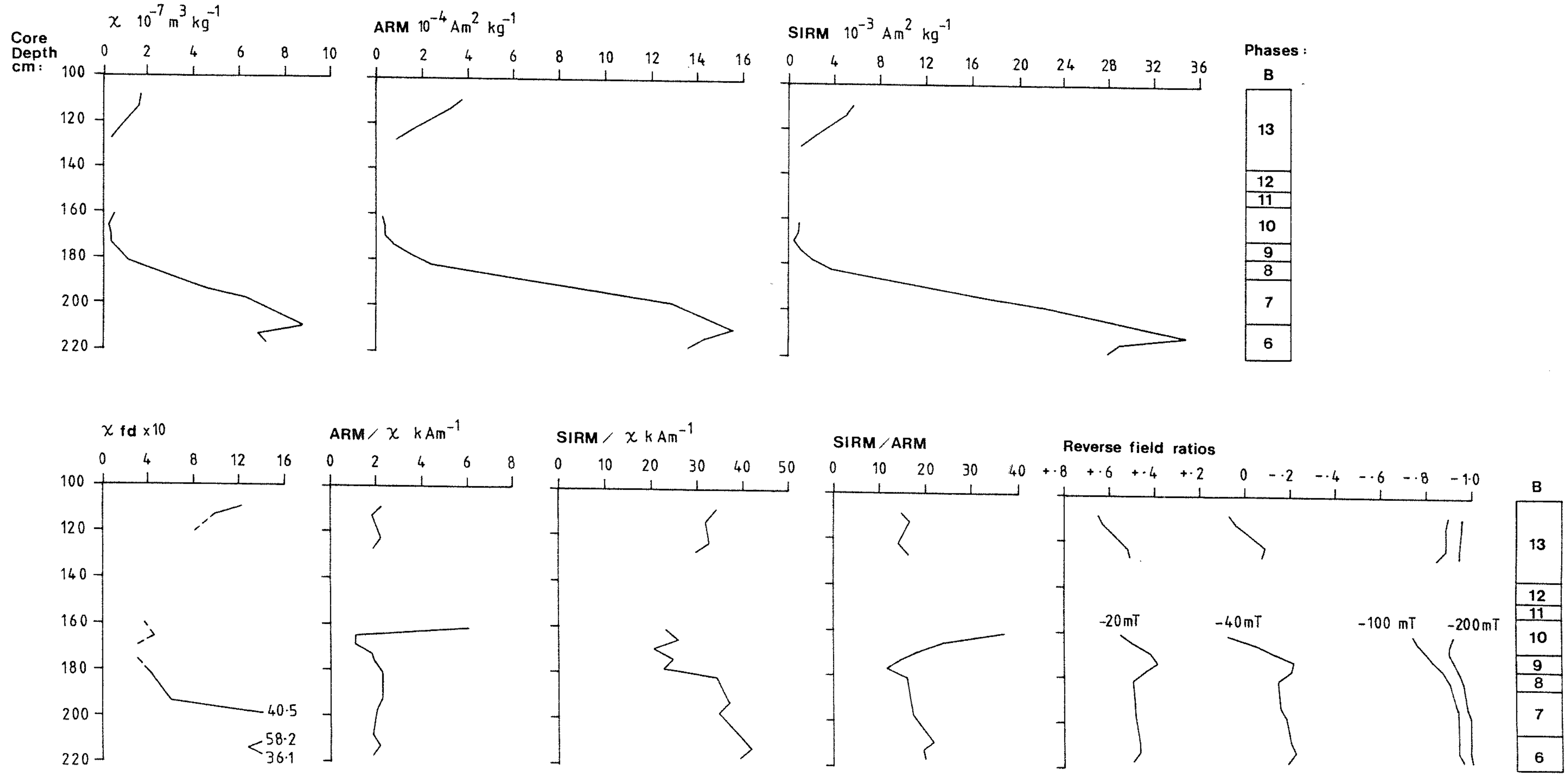


Fig 22 Fenemere. Magnetic Measurements

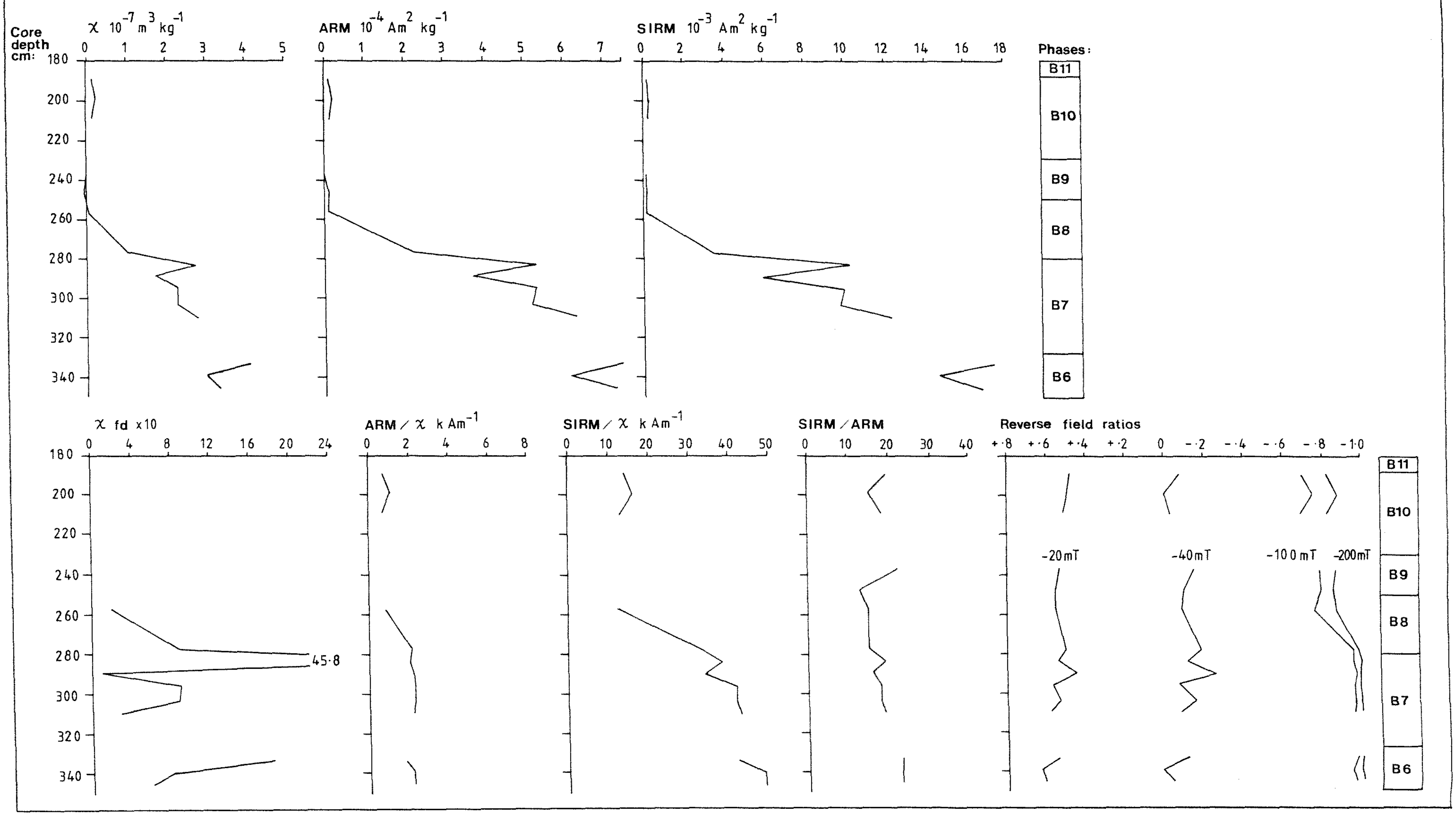


Fig 23 χ versus SIRM

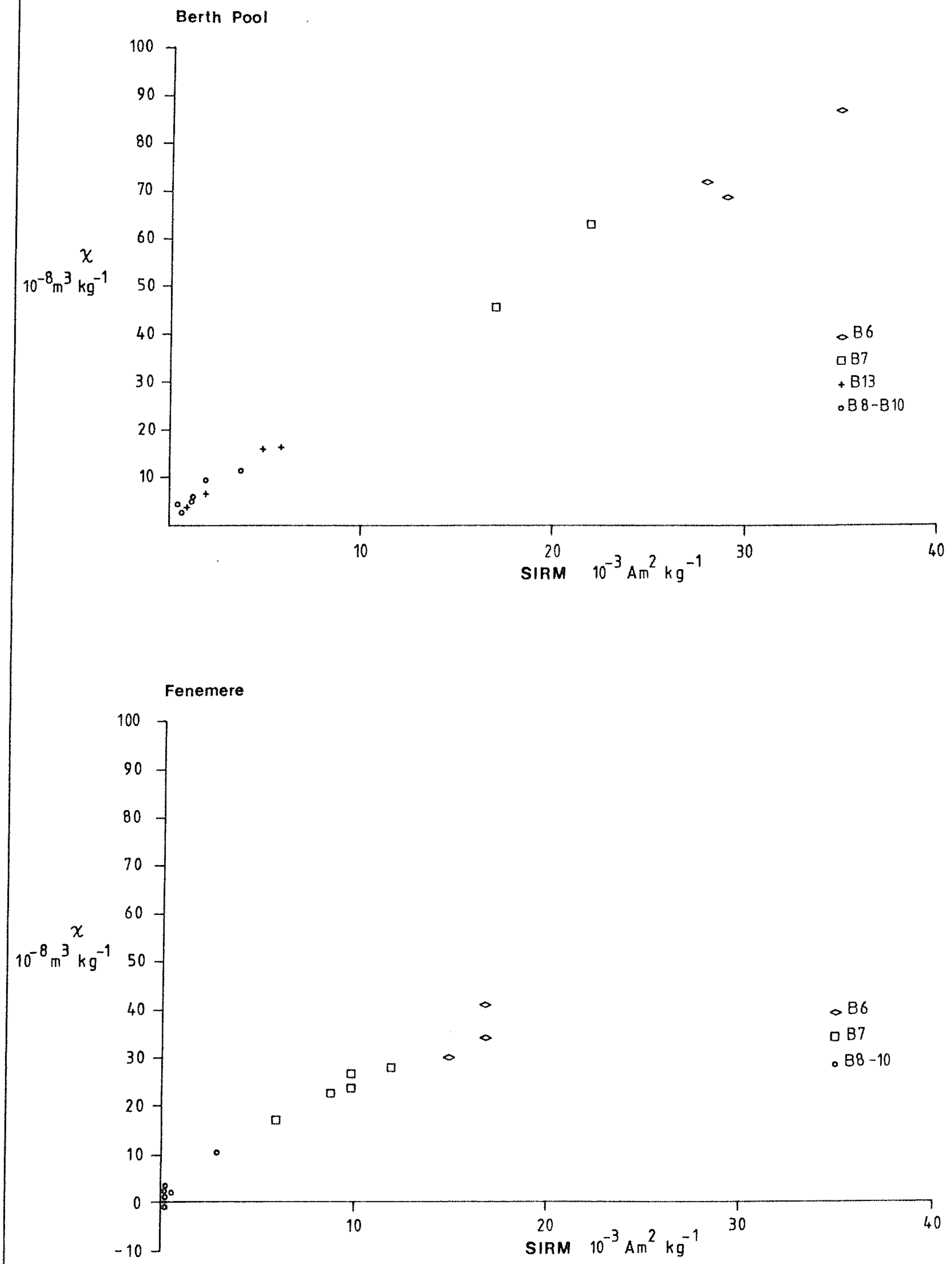
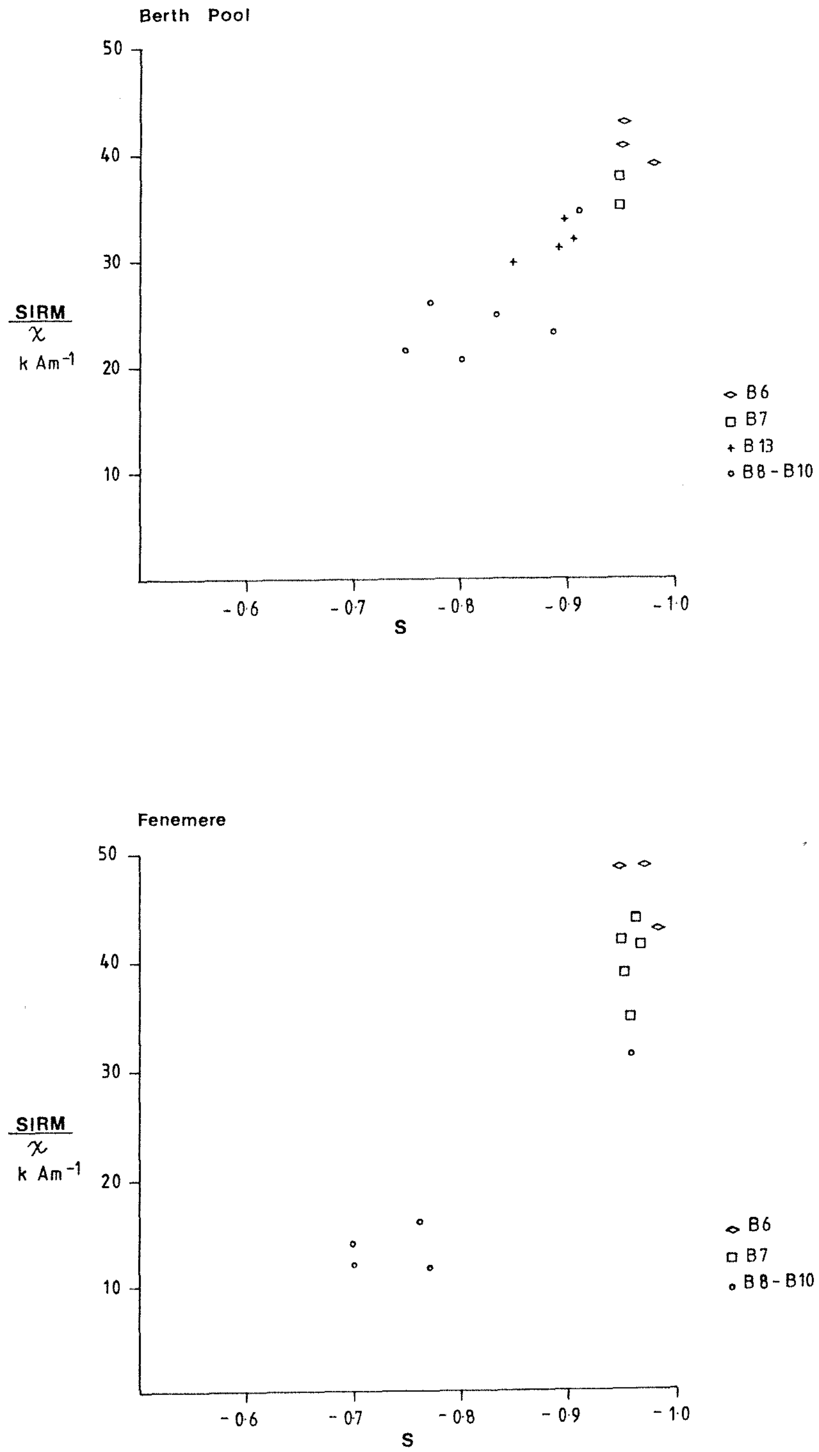


Fig 24 SIRM / χ versus 'S' Ratio



S: $\frac{IRM_{-100\,mT}}{SIRM}$

Fig 25 Berth Pool II. Coercivity Profiles

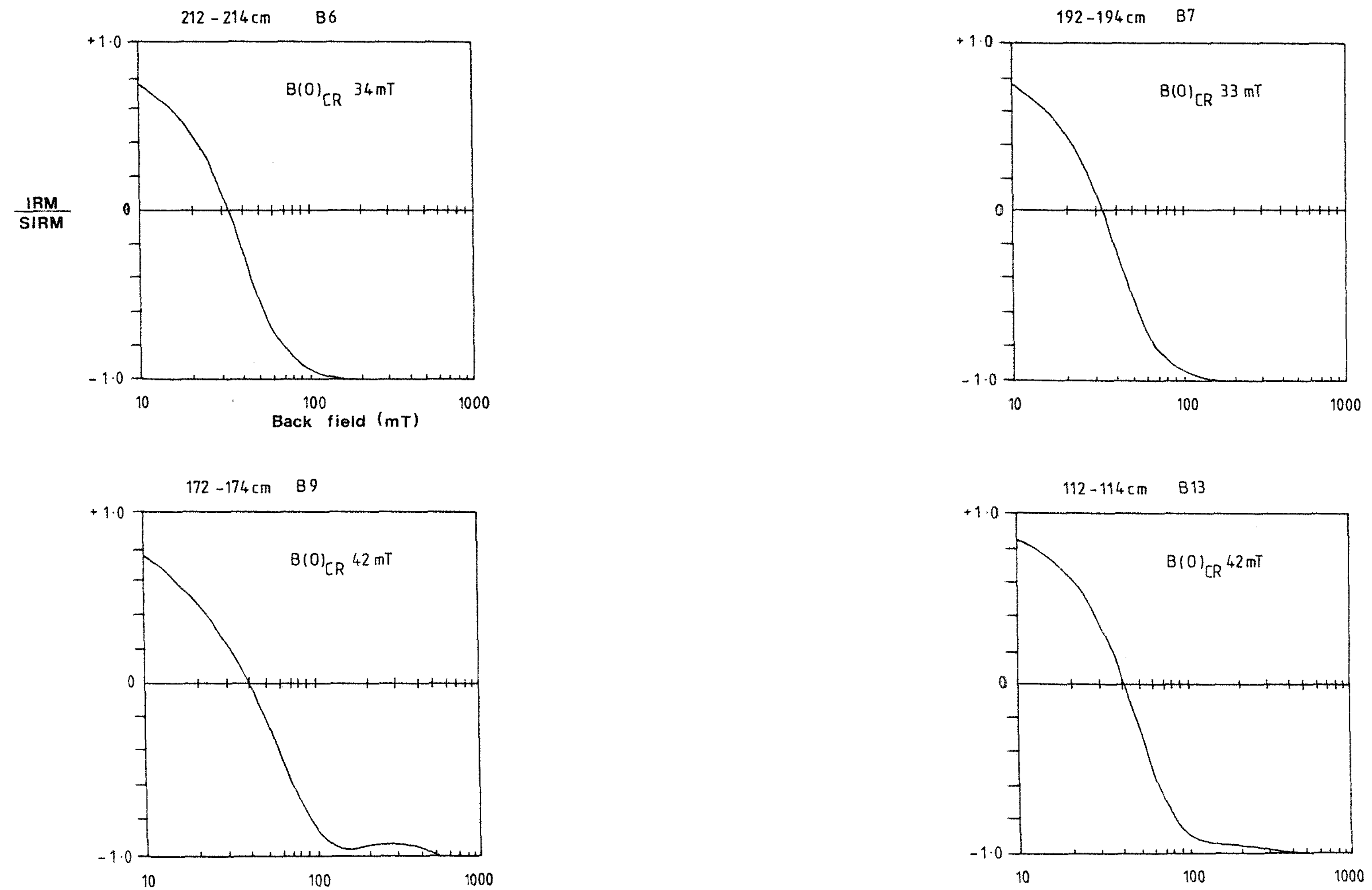
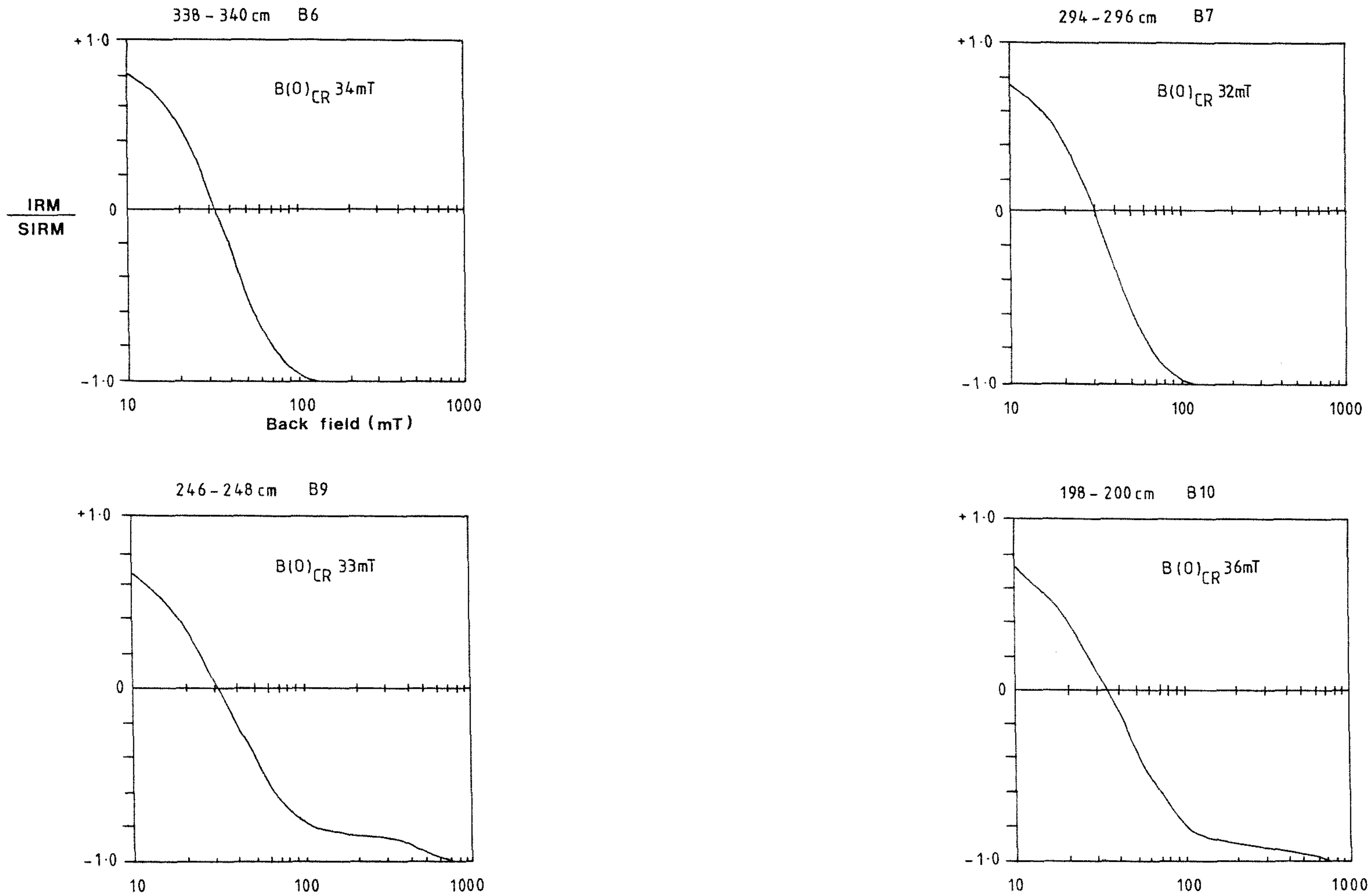


Fig 26 Fenemere: Coercivity Profiles



mineral assemblages (cf. Smith 1985). A coercivity profile for 192cm to 194cm (Figure 25) is closely similar to the profile for 212cm to 214cm, for both profiles, the coercivity of remanence of the samples, $(B_o)_{cr}$, is similar, this is a measure of the hardness of the magnetic minerals and there does not appear to have been an appreciable change from B6 to B7. Using Figure 11 in Bradshaw and Thompson (1985, 212) the combination of $(B_o)_{cr}$ and SIRM/χ values for B6 and B7 point to the presence of single domain magnetite in the Berth Pool sediments, a magnetic mineral from typical of topsoils (Oldfield et al 1985a). Samples from B7 plot towards the right of scattergrams for χ versus SIRM and SIRM/χ versus 'S' (IRM-100mT) (cf Hirons and Thompson 1986), this plotting position suggests that ferrimagnetic (eg single domain magnetite) rather than antiferromagnetic (eg haematite) minerals are important. The reduced values of χfd, SIRM/ARM and SIRM/χ in B7 point to changes in the magnetic grain size and domain state, in comparison to B6 (cf Thompson and Oldfield 1986, Oldfield et al 1985a),conceivably, magnetic minerals from different levels in the soil profile are being mobilised as a result of the intensification in clearance activity indicated in B7 although there are no indications of the inwashing of haematite, a primary magnetic mineral abundant in the sub soils of the area (Smith 1985). Changes in the erosional regime could be in evidence here, although changes in magnetic grain size do not necessarily relate to changes in the particle size of inwashed non-magnetic material (Bradshaw and Thompson 1985, 211).

4.2.4.2 Fenemere (Figures 22, 23, 24 and 26)

In common with Berth Pool, χ , ARM and SIRM are reduced in B7, in comparison to B6, initially, χ fd is reduced although an increase occurs at 302cm to 304cm and 294-296cm; the second Gramineae peak of B7 begins at 296cm, χ fd declines at 288-290cm, where evidence for woodland regeneration appears. The sharp rise in χfd at 282cm to 284cm could, in reality be linked to clearance activity in the earliest stages of B8. Values of ARM/χ in B7 are mainly unchanged from B6 but SIRM/χ and SIRM/ARM are reduced, the same changes in these ratios are seen in Berth II. The coercivity profile for 294 to 196cm is closely similar to that for 338cm to 340cm in phase B6 (Figure 26) a slightly softer magnetic mineral strength is indicated by the reduction in $(B_o)_{cr}$ from 34 (B6) to 32 (B7), the combination of $(B_o)_{cr}$

and SIRM/χ for B6 and B7 at Fenemere points to the presence of single domain magnetite in the sediments (Bradshaw and Thompson 1985, 212). The 'S' parameter (-100mT/SIRM) does not indicate any haematite admixture (cf. Hirons and Thompson 1986, Bradshaw and Thompson 1985). B7 is characterised by 'soft' high reverse fields, -200mT and -100mT, but fluctuating low reverse fields. As in B6, the reverse field -40mT/SIRM shows a temporary hardening; this hardening in the low reverse fields, also indicated at -20mT/SIRM occurs where the pollen evidence is indicative of clearance activity:

Sample depth	Vegetation	-40mT/SIRM	-200mT/SIRM
288 - 290cm	Regeneration	-0.26	-0.99
294 - 296cm	Clear	-0.09	-0.99
302 - 304cm	Regeneration	-0.17	-1.00
308 - 310cm	Clear	-0.09	-1.00

Harder low reverse fields and soft high reserve fields, in association with high χ occurred during certain phases of clearance at Peckforton Mere, Cheshire, and were taken to be indicative of the inwashing of single domain magnetic assamblages from topsoils (Oldfield et al 1985a, Smith 1985), fluctuations in χ fd point to fluctuations in the inwashing of viscous magnetic grains from topsoils (cf. Oldfield et al 1983). In combination, the magnetic parameters point to the predominance of ferrimagnetic minerals in the sediments, although changes in grain size and type are indicated in B7, compared to B6. SIRM/ARM is particularly sensitive to grain size changes (Thompson and Oldfield 1986). Samples from B7 plot below those from B6 on a scattergram of χ against SIRM, on account of their lower χ and SIRM; on the plot of SIRM/χ against 'S' (-100mT/SIRM) the B7 samples plot well to the top right of the diagram, due to their low 'S' ratio, pointing to relatively high ferrimagnetic mineral concentrations, eg. magnetite (cf. Hirons and Thompson 1986). Changes in magnetic mineral source could be in evidence in B7 at both Berth and Fenemere although despite the similarities between the results from these sites and certain clearance phases at Peckforton Mere (Oldfield et al 1985a), precise linkages between sediment magnetic assemblages and catchment sources are problematic, since particle size-specific magnetic measurements have not been made in this study (cf Smith 1985) and there uncertainties about the extent to which the clearance activity noted in the pollen spectra is actually affecting the sediments. The terrestrial catchments of the pools are difficult to define (cf Sinker 1962) and these catchments could be very limited. Furthermore the belts of peat which separate the pools from the cultivatable soils could act to peturb the flux of sediment from cleared soils to the pools (cf. Oldfield et al 1985b); it is not clear to what extent the clearance activity seen in the pollen spectra is occurring on soils which could be washed into the pools. Possible sediment-source linkages have been proposed for Bar Mere, Cheshire (Smith 1985) and, on the basis of data given in Smith (1985), for Peckforton Mere, Cheshire (Oldfield et al 1985a),but both of these lakes had inflow streams which provided a potential link from farmed soils to lake sediments. The small catchment sizes and, apparently, high autocthonous organic productivity at Berth and Fenemere could lead to relatively low magnetic concentrations in the sediments, despite the indications of clearance activity in the pollen spectra. There were indications, however, at Newton Mere, Shropshire, that changing anthropogenic impact over time had affected the mineral magnetic assemblages in the sediments (Smith 1985). The sediments at Newton Mere are mainly highly organic, and the site has no natural inflows (Smith 1985), although brown earth soils are not separated from the margins of Newton Mere by extensive peat deposits, and clearance activity could potentially, have occurred in very close proximity to the pool.

4.2.5 Sediment loss on ignition and erosion indication

4.2.5.1 Berth Pool II (Figure 13)

Sediment loss on ignition at 188-190cm, at the end of B7, is 59.3%, compared to 56.9% in B6. The sediments are thus mainly organic, probably as a result of high organic primary productivity in the lake although clearance activity could have resulted in some inwashing of the peat adjacent to the pool. Clearer evidence for the in-washing of deposits from the catchment is seen in the increase in the percentage of Indeterminate/Unidentified pollen during B7. This composite curve occasionally includes pollen types which were structurally sound but could not be identified using pollen identification keys, such types, however, were rarely encountered and only amounted to 1-2 grains on occasional slides, The curve for Indet/Unident thus represents almost exclusively the proportion of pollen which was too degraded to be positively identified. At Crose Mere, increases in the proportion of indeterminable (mainly degraded) pollen coincided with herb pollen maxima and were taken to be indicative of soil inwashing; pollen left undisturbed under oxidising conditions within the soil will tend to deteriorate (Havinga 1984) and could be washed in to lakes under conditions of exhanced erosion of surface soils (Oldfield et al 1985b). The increase in Indet/Unidentified pollen in B7 at Berth Pool persists into B8-B10, where pollen evidence for intensive clearance becomes more marked, and when mineral magnetic measurements point to sub-soil erosion (Chapter 5). Apart from the magnetics, there is thus other, independant evidence for soil erosion in the catchment of Berth Pool, in B7 and in subsequent phases where clearance activity is indicated.

4.2.5.2 Fenemere (Figure 13)

In B6, sediment loss on ignition was measured at 57.76%; in B7 it increases to 62.0% at 319-320cm and 63.9% at 314-315cm (Depths correlated from C14 core to main core); further increases in L.O.I occur in B8, where intensified clearance is indicated. Increases in the frequency of Indeterminate/Unidentified pollen occur in B7 at Fenemere, in fact, a short curve spans the first Gramineae peak, declining to less than 1% where woodland regeneration is indicated and increasing again where the second Gramineae peak occurs.

The percentage of Indet/Unident pollen increases in B8, where clearance intensification is indicated, declines slightly in B9, a phase of reduced clearance activity, and increases again in B10 where clearance intensifies. In B7, therefore, there is evidence for surface soil inwashing in the form of increases in degraded pollen, it is possible that rises in L.O.I indicate the inwashing of some peat eroded from around the mere. The radiocarbon date for the *Tilia* decline was taken from horizons equivalent to 320cm to 330cm on the main diagram where the proportion of degraded pollen is very low; there are good biostratigraphic grounds for accepting this date (1240bc) as valid. A date from the start of B8, however, is thought to have been reversed by old carbon inwashing (*cf* Pennington et al 1976) and degraded pollen frequencies are in fact increasing at this time. The L.O.I results are thus only interpreted in a speculative way as far as soil inwashing is concerned but, in combination, the evidence of degraded pollen increases and mineral magnetic measurements does suggest that soil was eroded into the pools in B7.

4.2.5.3 Indeterminate/Unidentified pollen as an erosion indicator

At Marton Pool and Birchgrove Pool Indet/Unident pollen also increases in frequency in B7 and again in B8, at Marton Pool, relatively high frequencies persist throughout B9 and B10 but decline in B11 where woodland regeneration is indicated. The picture is slightly different at Birchgrove Pool where degraded pollen inwashing declines in B9 to B10 although it increases again in B11 to B12, where there is pollen evidence for cereal growing close to the pool (Chapter 6, Chapter 7).

At Boreatton Moss, limited increases in Indet/Unident occur where clearance activity is indicated in B3 and late B5 (Chapter 3) and in B8-B10 (Chapter 5), although the pattern is less clear at the margin of the moss in comparison to the centre. Some eroded soil pollen could be mobilised at the edge of the moss, and washed across the surface; this could complicate interpretation of palynological contrasts between the edge and the centre of the moss. Such contrasts might not be due solely to variations in aerial pollen input across the peat surface (Chapter 5). At New Pool, frequencies of Indet/Unident increase in B3 where there is evidence for woodland clearance and this could be due to soil erosion. The indications are, particularly at the pools, that the proportion of badly degraded pollen in the sediments increases as pollen evidence for woodland clearance becomes more marked, suggesting that at least some of the clearance and farming activity is occurring within the terrestrial catchments of the pools (cf Oldfield et al 1985b).

4.2.6 Archaeological evidence

There is firm evidence for the presence of human groups in the Welsh Marches between c.1200bc and c.880bc. A Bronze Age cemetery at Bromfield (Figure 1) has radiocarbon dates from its earlier and later phases of, respectively, 1556±178bc (BIRM 64) and 762±75bc (BIRM 62) (Stanford 1982). Stanford (1982, 318) suggests, on the basis of all the evidence from the entire period covered by the Bromfield cemetery, including Neolithic and Beaker artefacts, that the society responsible for the C1 cemetery at Bromfield had developed from Neólithic beginnings and eventually formed possibly the only element in the Iron Age hillfort communities of the Marches. If archaeological evidence indicates continuity of this order, then perhaps it should be stressed that demarcated phases of vegetational change should not be taken to be indicative of a fixed series of human activity phases involving separate cultural groups.

Nearer to the Baschurch area, Bronze Age cremations from Sharpstones Hill, Shrewsbury, have yielded radiocarbon dates of 1255±130bc and 1020±188bc (Coles and Harding 1979). These dates are coincident with the radiocarbon date for the second <u>Tilia</u> decline in the Baschurch area; 3190±60bp (SRR-2923). Even if a degree of cultural continuity existed in the Bronze Age societies, economic changes certainly seem to have occurred (Bradley 1978, 1984; Burgess 1980).

The date for the second <u>Tilia</u> decline in the Baschurch area, c.1240bc, placed this feature, and the associated evidence for clearance activity, in the early part of the later Bronze Age (Megaw & Simpson 1979). This is thought to have been a period of considerable economic transformation, in which re-organisation of farmland occurred together with a planned advance into new agricultural areas (Bradley 1978). At this time, a marked hiatus in material, economic and religious traditions is indicated in the archaeological record (Burgess 1974). An agricultural crisis may have developed during the 13th century bc, and certainly social changes are in evidence (Burgess 1980). It is therefore possible that the clearance and regeneration cycles commencing c.1240 bc in the Baschurch area were a function of a new system of agricultural organisation which developed at the onset of the later Bronze Age (<u>cf</u> Bradley 1984).

<u>4.2.7 Summary: phase B7 (cf Figure 19)</u>

The inter- and intra-site pollen profile replicability observed in the Baschurch area in B7 is such that no localised spatial variation in the intensity of clearance activity can be inferred with confidence. Turner (1979, 285-286) states that:

> "If the evidence from several pollen catchments indicates a consistent pattern of vegetation or vegetational change during a particular period, one can begin to think, albeit with caution, of that vegetation or vegetational change as being typical of the region as a whole, especially when the pollen catchments differ from one another in their topography and proximity to known archaeological sites".

The intensity of the clearance activity seen at Crose Mere, Whixall Moss and the Baschurch Pools, c.1200bc appears to be similar, although the double cycle of clearance and regeneration seen at Baschurch is not in evidence at Crose Mere and Whixall Moss. Compared to the Baschurch pools, a wider sampling interval has been used at Crose Mere (Beales 1980), and this could be a reason why a double-cycle of clearance and regeneration is not recorded. At Whixall Moss, however Turner (1964a) estimated that at the Tilia decline at 1288bc the peat had accumulated at c.20-30 years per cm. Consecutive 1cm samples were taken for pollen analysis at Whixall Moss; given the above estimate of the peat accumulation rate, this sampling interval would be expected to show up clearance and regeneration cycles alternating at c.100 year intervals. If the pollen profiles from the Baschurch area are compared to the regional vegetational history outlines by Beales and Birks (1973), the clearance-regeneration cycles in phase B7 appear to correlate to the middle Bronze Age clearance and regeneration phases C2 and R2. The clearance and regeneration cycles in the Baschurch area are similar, in terms of their date, duration and vegetational characteristics to the small temporary clearances identified by Turner (1965) at Tregaron Moss in Wales and Bloak Moss in Scotland. At Tregaron, a later Bronze Age clearance with clearance/occupation and regeneration phases of approximately equal duration, as at Baschurch, was estimated to have lasted some 50 years (Turner 1965, 344). At Bloak Moss, three successive clearances were identified. These were of the same duration as the Tregaron clearance and occurred between 1400 and 1000bc. Turner (1964a) states that in terms of their vegetational character, these temporary clearances accord with Iversen's (1949) description of a "Landnam", with the following successive stages:

1. Rise in herbaceous pollen
2. Maximum of culture pollen
3. Return to high forest. Iversen (1949, 16).

This type of sequence is in evidence at the Baschurch Pools, and is particularly clearly seen between 380cm and 360cm at Marton Pool:

1. 372-380cm. Decline in Quercus and Tilia, increase in Gramineae and Pteridium.

2. 364-372cm. Tubuliflorae, Chenopodiaceae and Rumex acet appear at 372cm, Plantago lanceolata frequencies are high.

3. 360-364cm. Betula is reduced, Quercus recovers and open habitat indicators are recorded less frequently, Gramineae and Pteridium decline.

The pollen profiles from the Baschurch area at least confirm the presence of two typical later Bronze Age temporary clearances in that locality although it would appear that, in areas still under forest at the start of the later Bronze Age, there was some variability in the number of small temporary clearances which occurred prior to more widespread and intensive deforestation. The occurrence of cereal pollen, particularly during the second Gramineae peak, when Gramineae values are generally higher compared to the first peak (Figure 20) suggests that arable agriculture formed at least a part of the economic basis of the human activity. Turner (1965) noted that pollen sites bordering the highland areas of Britain, including Whixall Moss, produced evidence for the presence of pastoral farming throughout the last three millennia. During phase B7 in the Baschurch area the relatively high frequencies of Plantago lanceolata suggest that the land use was predominantly pastoral (Turner 1964a),although uncertainties do surround the value of Plantago lanceolata as an indicator of specific types of land use (Behre 1981, Edwards 1979). The regularity of the clearance and regeneration cycles in phase B7 suggests that the land was being cleared and then abandoned as part of a planned system of land use rotation; land allotments, or agricultural territories were demarcated across wide areas of Britain during the later prehistoric period (Fowler 1983). In the case of the three small temporary clearances identified by Turner (1965) at Bloak Moss, which were made between c.1400-1000bc, Tinsley and Grigson (1981, 236) take the view that the clearances were made by "successive groups . . . migrating into and out of the Bloak Moss region", the clearance activity appears to have been "typical of the region as a whole" (Tinsley and Grigson 1981, 236), but the implication in the first statement is that there was a degree of randomness in the creation and abandonment of the clearances. Tree and non-tree pollen frequencies are closely comparable when the four Baschurch Pools are compared in B7, given that the site differ in size, it is reasonable to suggest that the level of clearance activity was the same over many square kilometres (cf. Turner 1979). However, the chronological regularity of the cycles of clearance and regeneration does not immediately suggest random in- and out-migration. Conceivably, the "abandoned" land remained part of an agricultural territory (cf Fowler 1983, 218). Turner (1975) estimated the size of the cleared areas, during the phase of small temporary clearances at Bloak Moss, as being no more than a few hundred metres in diameter; at Bloak Moss (Turner 1965) the Gramineae, Plantago and Pteridium frequencies are similar to those seen at the Baschurch Pools in B7, and it could be that the cleared enclaves in the Baschurch area were similar in size to those postulated at Bloak Moss. Limbrey (1987) suggests that during the prehistoric period in the Severn Lowlands, marked soil fertility losses would not tend to occur over short periods. Certainly, under intensive arable farming today the Baschurch Series brown earths show little sign of leaching and plant nutrient loss to lower soil horizons (Crompton and Osmond 1954); clearances would thus tend to be semi-permanent rather than temporary. As long as uncertainty surrounds the precise economic basis of the human activity, no firm conclusions can be drawn about the reasons for the, apparently, regular clearance occupation and abandonment in B7. B7 is succeeded, c.800bc by a more marked expansion of woodland clearance in the area, during the time period of this phase, B8, fortified hilltop settlements were established in Wales and the Marches.

CHAPTER 5

LATER BRONZE AGE AND IRON AGE VEGETATION CLEARANCES

5.1 Introduction

Three phases of vegetational change are defined between c.800bc and c.50bc:

Phase B8 c.800bc to c.600bc
Phase B9 c.600bc to c.400bc
Phase B10 c.400bc to c.50bc

During these three phases, extensive woodland clearance is indicated although there are clear inter-site contrasts concerning the Baschurch Pools and Boreatton Moss. The order and position of numerical zone splits attest to the palynological significance of the phase boundaries. Loss on ignition measurements indicate slight increases in inorganic deposition in the meres during these phases and mineral magnetic evidence for sub-soil erosion is seen. Increases in floodplain alluviation occur in the lower Severn basin c.2600bp (Shotton 1978; Brown 1982, 1983a, 1983b; Brown and Barber 1985); the deposition of a buff-red silty clay is believed to be associated with the clearance of woodland from the river terraces (Brown and Barber 1985) and the exposure of sub-soils to erosion (Shotton 1978).

During the time period of phase B8, defences were constructed at The Breiddin hillfort, 24km to the west of Baschurch (Figure 1; Musson 1976). Stanford (1972b) dates the main period of hillfort occupation in the Welsh Marches to the centuries following c.450BC, the palynological evidence suggests that clearance activity became more extensive at this time. The pollen profiles from the Baschurch area point to a spatial variation in the nature and intensity of the clearance activity during these three phases.

5.2 Phase B8: Clearance expansion c.800bc to c.600bc at the Baschurch Pools

Inter-site correlations are clearer between the Baschurch Pools during phases B8 to B10, and for this reason the Pools are first compared to one another, and then to Boreatton Moss, where intra-site pollen profile variability occurs (Section 5.5). At the Baschurch Pools, the main characteristics of the pollen frequency changes occurring during phase B8 are as follows:

Fenemere 280cm to 250cm

Betula, Quercus, Ulmus, Fraxinus and Corylus/Myrica decrease in frequency but Pinus increases; the occurrence of Taxus becomes more infrequent. Shrub pollen representation diversifies above 270cm, where Ericaceae is recorded more frequently. Gramineae frequencies increase and cereal pollen occurs, also, the representation of open habitat indicators increases; Rumex acet in particular becomes more abundant. Total tree pollen is reduced, and increases in Pteridium and Filicales spores occur. The first zone splits in ZONATION are placed between 280cm and 270cm, indicating the significance of the pollen frequency changes at the onset of B8.

Marton Pool c.320cm to c.300cm

Depths are given on the basis of biostratigraphic correlation to Fenemere, a suggested age/depth profile for Marton Pool (Figure 11) indicates dates of 750bc for 320cm and c.600bc for 300cm.

Betula, Quercus, Ulmus, Fraxinus and Corylus/Myrica decrease in frequency but, in common with Fenemere, Pinus increases. Salix increases and Frangula and Sambucus occur. Gramineae increases and Ericaceae occurs more frequently, cereal pollen is recorded in association with increases in the frequency and diversity of open habitat indicators. Total tree pollen is reduced and Pteridium frequencies increase. In common with Fenemere, the first zone splits in ZONATION are made at the onset of B8.

Birchgrove Pool c.288cm to c.270cm

Depths are based on biostratigraphic correlation to Fenemere. The age/depth profile suggested in Figure 12 gives ages of 800bc for 284cm and 520bc for 268cm.

Betula, Quercus, Ulmus, Fraxinus and Alnus decrease, Taxus occurs less frequently and Corylus/Myrica declines but Fagus is recorded more often. A short-lived increase in Salix occurs but shrub pollen diversity is low; Gramineae increases and cereal pollen occurs. Open habitat indicators increase in frequency; representation is generally higher than at the larger two pools, particularly for Rumex acet, Liguliflorae and Chenopodiaceae. Other herb pollen types occur more often, for example, Urtica. Compared to Marton and Fenemere, a more marked decline in total tree pollen occurs, Pteridium also attains higher frequencies, compared to the latter two sites. ZONATION splits confirm the significance of the pollen frequency changes.

Berth Pool II c.184cm to 176cm

184cm is assumed, by biostratigraphic correlation to Fenemere, to equal 800bc. The age/depth profile for Berth II, suggested in Figure 8 gives a date of 600bc for 176cm.

Betula, Quercus, Ulmus, Fraxinus, Alnus and Taxus decline. Corylus/Myrica declines but Sambucus increases. Ericaceae increases and Gramineae frequencies rise; the relative expansion of Gramineae frequencies is similar to that seen at Birchgrove Pool. Cereal pollen occurs and Tubuliflorae, Liguliflorae, Cruciferae, Plantago lanceolata and Rumex acet all increase at the onset of this phase. Amongst the other herbs, increases in Hypericum perforatum type, Rosaceae, Ranunculaceae and Urtica are particularly clear. Total tree pollen declines dramatically. Pteridophyte spores increase in frequency but Pteridium values are lower than at the other three sites. In common with the other sites, ZONATION statistics confirm the significance of the pollen frequency changes at the onset of this phase.

Berth Pool III c.210cm to c.200cm

Betula, Ulmus, Quercus, Alnus, Fraxinus and Taxus decline. Compared to Berth II, Alnus frequencies are slightly higher. Betula and Fraxinus decrease to less than 1% earlier in core II than they do in Core III; Taxus frequencies are lower in core III. The reduction in Corylus/Myrica is similar in both cores, also, Sambucus is recorded more often in both cores at the onset of B8. Ericaceae frequencies are lower in core III but Gramineae and open habitat indicator increases are similar in both cores. Reductions in total tree pollen are comparable to core II. In all five cores from the Baschurch Pools the B7/B8 boundary is identified, by numerical zonation of the pollen spectra, as the point at which the most significant changes in pollen frequency occur.

It is evident at Berth Pool, Birchgrove Pool and to a more limited extent at Marton and Fenemere that Sparganium/Typha frequencies increase at the onset of B8. Nuphar is recorded for the first time at Marton Pool where Nymphaea and Potamogeton also occur more often. Menyanthes appears for the first time in the Berth Pool cores, and Potamogeton becomes more frequent in Berth II. As in phase B7, there is therefore some evidence for an increased abundance of emergent aquatics and floating leaf macrophytes, in association with evidence for vegetation clearance. The partial clearance of carr woodland is one potential cause for an increase in the abundance of aquatic taxa. Alternatively, increased surface water runoff and higher soil moisture levels, as a direct consequence of increased clearance activity (Lockwood 1983, also, Chapters 3 and 4 above) could be causing enhanced waterlogging and flooding at the margins of the pools (cf. Plate 12).

5.2.1 Inter- and intra-site variations: the Baschurch Pools in phase B8

During phases B6 and B7, the higher Pinus frequencies at Fenemere and Marton Pool were thought to indicate the presence of a higher proportion of regional, far travelled pollen in the sediments of the latter two sites. Bennett (1984) only inferred the presence of pine in the immediate vicinity of a given site where Pinus pollen frequencies exceeded 20% T.P. Pinus only occurs at c.5-10% of the main sum, excluding Coryloid, at Fenemere and Marton and, on Bennett's criterion, a local presence of pine should not be suggested. The clear contrast in Pinus frequencies between Marton/Fenemere and Berth/Birchgrove in B8 is therefore taken as further confirmation of the assertion that the larger two sites are receiving a higher proportion of far-travelled or regional pollen; this pollen is tending to overshoot the smaller two sites (Tauber 1965). Given the proximity of the Baschurch Pools to one another this consistent pattern of differential Pinus representation appears to confirm the predictions of theoretical models of pollen source area versus basin size (Tauber 1965, Jacobson and Bradshaw 1981, Prentice 1985).

Betula declines to less than 1% first at Berth II, and then in Berth III but is continuously represented at c.5% in B8 at Birchgrove Pool and Marton Pool and c.8% at Fenemere. The contrast between Berth Pool and Birchgrove Pool, which are believed to be more representative of their local environment than Marton or Fenemere suggests that the abundance of birch has been reduced to a greater extent in the vicinity of Berth Pool, compared to areas around Birchgrove Pool, and a wider area around Marton Pool and Fenemere. Reductions in total tree pollen are greater at Berth and Birchgrove Pool, in comparision to Marton and Fenemere. Therefore clearance activity appears, in relative terms, to have been more intensive closer to the former two sites than it was in average terms over the dominant pollen source areas of the latter two sites although it is possible than some enclaves within the aggregated pollen source areas of Marton and Fenemere were cleared as intensively as the areas close to Berth and Birchgrove evidently were. Figure 33 shows the ratio of total dry land tree pollen (excluding Pinus) to total open habitat indicator pollen; open habitat indicator pollen has a higher representation at Berth Pool. The reduction in Alnus at Berth and Birchgrove is more marked in comparison to Marton and Fenemere in B8 and it is possible that some alder was removed from wetter peaty soils near the margins of Berth and Birchgrove. These peats form narrower belts around Berth and Birchgrove and so any localised removal of alder would show up as a sharp decline on the pollen diagrams. Wider expanses of peat exist around Marton and Fenemere (Figure 5), if these supported alder and were not subject to clearance this could account for the continuously high representation of Alnus at the latter two sites. Additional evidence for intensive clearance close to Berth Pool and Birchgrove Pool is seen in the behaviour of the Quercus pollen curves. If the intensity of woodland clearance was similar throughout the region, then the diagrams from Marton and Fenemere would not be appreciably different to those from Berth and Birchgrove (cf Turner 1979); indeed, the diagrams from all four sites were similar during B7.

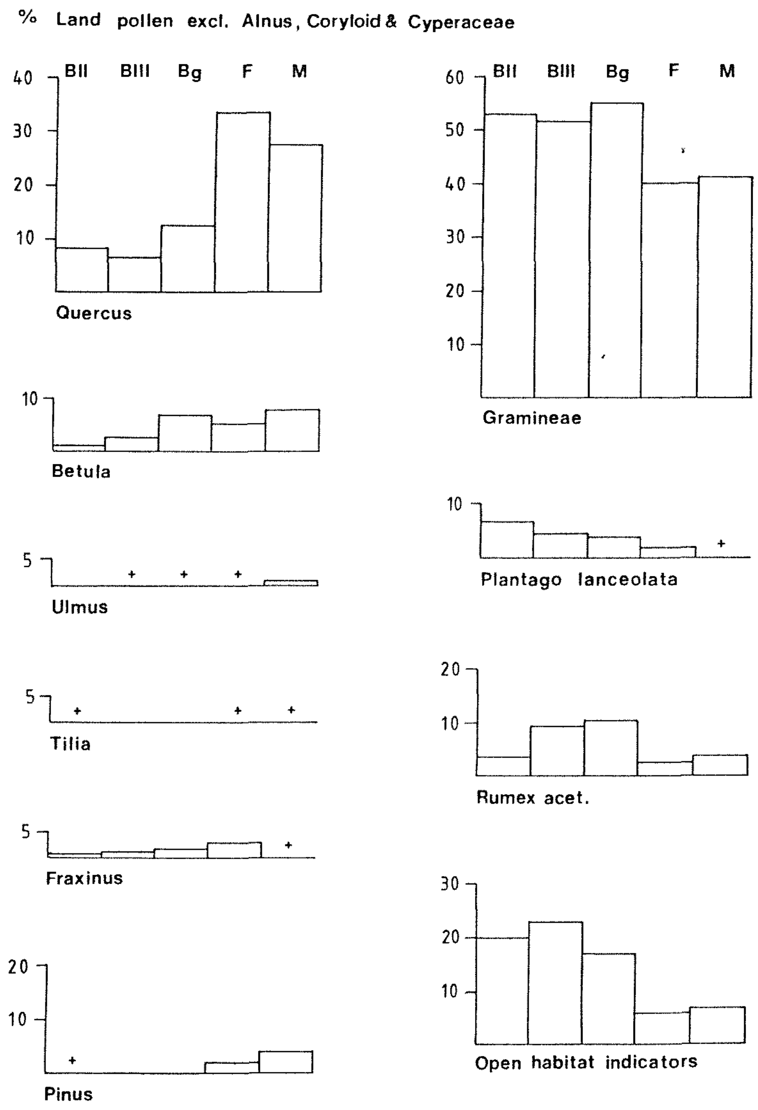
In general terms, woodland clearance appears to have encroached closer to the shores of the two smaller sites. Figure 33 suggests that, averaged over the whole of the pollen source areas of Marton and Fenemere, there is a much higher ratio of dry land tree to open habitat indicator pollen types, in comparison to Birchgrove Pool and particularly to Berth Pool, although potential does exist for such ratios to vary within a lake basin (Davis et al 1971). Clearance activity could be concentrated on the crests of the sand and gravel ridges which surround the pools; a higher proportion of the land within 500m of Berth Pool and Birchgrove Pool (Figure 5) supports well drained brown earth soils (2.1.5). In comparison, tracts of poorly drained peat around Marton and Fenemere could still be supporting uncleared carr woodland, which would stand between cleared land and the pool margins and could be responsible for filtering clearance indicator pollen out of below-canopy airstreams (Tauber 1965, 1967b).

Tracts of less well drained gley soils lie to the south and east of Marton and Fenemere and almost certainly fall within the pollen source areas of these two sites. Indeed, the Crewe series gleys to the east of Marton Pool have the poorest natural drainage for any gley type in the region (Crompton and Osmond 1954). If the frequencies of selected pollen types are compared from site to site with Alnus as well as Coryloid and Cyperaceae omitted from the pollen sum (Figure 27), open habitat indicator pollen still has a higher representation at the smaller two pools, although Gramineae frequencies are more comparable between the four sites.

Although the precise site to site correlation of an individual pollen spectrum is unlikely to be achieved, the biostratigraphic correlations between the Baschurch Pools are extensive and it is believed that the pollen frequencies on which Figure 27 is based are presentative of the maximum clearance intensity in B8 at all the sites.

When inter-site variations in Alnus frequencies are considered, it

Fig 27 **B8: Selected Pollen Types**



BII	Berth II	176cm
BIII	Berth III	204cm
Bg	Birchgrove	268cm
F	Fenemere	260cm
M	Marton	308cm

Depths of B8 Gramineae maximum, c 600bc

is evident that the most marked inter-site contrast occurs between Birchgrove Pool and Marton Pool. Some of the Alnus pollen at Birchgrove Pool could be derived from more extensive areas of alder carr around Marton (cf Oldfield 1970), but if it is assumed that some alder would remain uncleared, forming a partial fringing tree belt around Birchgrove Pool (cf Plate 1) and providing a local source of Alnus pollen, it could be argued that Alnus pollen from around Marton Pool is not reaching Birchgrove Pool in high proportions, again suggesting that the pollen source area of Birchgrove Pool is, in the main, highly localised. Alnus frequencies are higher at Berth Pool, compared to Birchgrove; conceivably, slightly larger areas of alder carr were left uncleared around Berth Pool. Alternatively, as it is slightly larger than Birchgrove Pool, it could be deriving more Alnus pollen from areas closer to Marton and Fenemere. Alnus frequencies are generally comparable between both cores from Berth Pool, if slightly higher in core III; core II is closer to the northern shore, and, possibly alder clearance was variable around the mere margins.

Ulmus, which regained some of its former representation after being reduced at the 1240bc Tilia decline horizon at the onset of B7 (Chapter 4), declines again at the onset of B8. Ulmus occasionally reaches 1-2% at Marton, Fenemere and Birchgrove in B8, but not at Berth Pool, where both cores confirm that its occurrence becomes intermittent, always at less than 1%. Tilia occurs occasionally, and at less than 1% in the earlier part of B8 in all five cores, but shows an increase in the final stages of B8 at Marton and Fenemere. During most of phase B8, however, the reduced representation of Ulmus and Tilia, together with reductions in Quercus, points to a far more comprehensive reduction in the extent of the broadleaved woodlands around the sites than that which occurred during clearance phases B1 to B7. To a certain extent, it could be argued that, locally, more elm and lime trees are removed from the pollen source areas of Berth Pool and Birchgrove Pool during B8 than are removed from the aggregated pollen source area of Marton and Fenemere, although this does not preclude the existence of enclaves within the pollen source areas of the latter two sites where the intensity of woodland clearance paralleled that which appears to have occurred closer to Berth Pool and Birchgrove Pool. Taxus representation is at the onset of B8 at Berth Pool, although the end of a continuous curve occurs earlier in core III. Taxus representation becomes more intermittent at Fenemere and Birchgrove Pool, but a similar pattern is not clearly discerned at Marton Pool. Yew is tolerant of a variety of substrates (Godwin 1975) and could be present on peaty soils around the pools. It appears to have been a component of the woodland which was cleared on previous occasions in the area. At Berth Pool, Taxus was reduced to less than 1% during clearance activity in B5 and at the B6-B7 boundary. The pollen frequencies prior to the B8 Taxus decline suggest that yew could have been locally frequent in the woodland around the meres; its frequencies tend to be higher at the smaller two sites.

The wide ranging nature of the woodland clearance is also indicated by the reductions in Fraxinus at the onset of B8. Ash appeared to become more abundant in the woodland during the clearance-regeneration cycles of B7. Fraxinus reductions at all four pools in B8 point to the clearance of ash from the woodland both locally and over a wider area. The continuous curve for Fraxinus appears to end earlier in core II from Berth Pool, compared to core III. This delayed end to the Fraxinus curve has parallels in the tendancy for Betula frequencies to remain slightly higher in core III in B8. Tree pollen totals are closely comparable in both cores, however, tree pollen as a percentage of total determinate land pollen falls to c.16% in core II and C.18% in core III. Given that the intensity of clearance could vary around the immediate margins of the pool, core II could be more open to the influence of pollen from land at the northern end of the pool whilst the frequencies in core III, with a more central location in the lake, represent an evened-out record from the whole of the lake's pollen source area.

Amongst the shrub pollen types recorded during B8, Corylus/Myrica representation is substantially reduced at both Berth Pool and Birchgrove Pool; reductions are most marked at the former site. At the larger two sites higher Corylus/Myrica frequencies parallel the occurrence of, generally, higher arboreal pollen frequencies. The separation of Corylus and Myrica pollen is not attempted here (cf Edwards 1981) although Beales (1980) assigned all Coryloid pollen at Crose Mere to Corylus avellana. Myrica gale is recorded today at mere and moss sites in Shropshire and Cheshire (Sinker 1962; Sinker et al 1985, Tallis 1973) and it is considered possible that at least some of the Coryloid pollen from the Baschurch area is attributable to Myrica. Generally, however, Coryloid frequencies are reduced, and during B7 increase, in parallel with arboreal pollen frequencies. This points to understorey hazel as an important contributor to the Coryloid curve.

In both cores from Berth Pool, Corylus/Myrica declines to c.3% during B8; this compares to frequencies of c.10-15% at Marton and Fenemere. Again, the palynological evidence suggests that clearance is more intensive close to Berth Pool and Birchgrove Pool compared to its intensity when averaged over the pollen source areas of Marton Pool and Fenemere. At Berth Pool Sambucus is recorded in successive samples throughout B8, in some instances at 1-2%. This is in contrast to Birchgrove Pool where it is not recorded in B8 although at Marton and Fenemere Sambucus does occur in B8. The pattern of occurrence of other shrub pollen types is variable between the sites. Hedera and Ilex occur more often at Fenemere and Frangula is recorded more often at Marton Pool. Elder has a strong association with soils found within human settlements (Godwin 1975, 336) and it is conceivable that in this case it could indicate a settlement site closer to Berth Pool than to the other meres, particularly given the fact that it is not recorded at Birchgrove Pool, which should be equally as representative of its local area as Berth Pool. In the absence of any known later Bronze Age settlement site from the Baschurch area, comments relating to Sambucus as a settlement indicator remain highly speculative. Alder buckthorn is a common species of moss edges and peaty soils in Shropshire (Sinker et al 1985) and in this instance a tendancy for Frangula pollen to occur more often at Marton Pool could point to the presence of wider areas of uncleared or partially cleared damper woodland around that site. There could be a tendancy for alder buckthorn to become more abundant where woodland was cleared from damper soils.

Salix representation is variable between the four pools, frequencies rise in the early stages of B8 at Marton Pool but are comparatively low at Fenemere. Salix is recorded intermittently at Birchgrove

Pool. Its values in early B8 at Berth Pool are lower in comparison to B7 at that site. Interpretation of the Salix frequencies is complicated by the fact that more than one species could be contributing to the pollen curve. Willow could be cleared from drier soils but could also be part of partially cleared carr communities where some opening of the woodland could aid its pollen dispersal. At all four sites Ericaceae pollen frequencies exceed 1% for the first time on the diagrams during B8. Frequencies are slightly higher in Berth II, compared to Berth III. Studies by Peck (1973) showed that streamborne transfer played an important part in the distribution of the large Ericaceae tetrads. With no inflowing streams during the prehistoric period the Baschurch pools might be expected to under-represent heather abundance, in terms of the pollen-vegetation relationship. Evans and Moore (1985), however, observed a good correspondence between Calluna pollen frequencies and its local abundance in moorland vegetation, suggesting that wind dispersal of its pollen could be an important dispersal mechanism for the species in some environments. A limited expansion in heath vegetation is therefore postulated in phase B8. Ericaceae was recorded, at low frequencies, during previous clearance episodes in the area and in the case of B8 its increased pollen frequencies could be due in part to improved dispersal conditions for its pollen, given the apparent opening out of the vegetation.

The marked increase in Gramineae frequencies is, in association with increases in other herb and spore frequencies, taken to be indicative of a considerable expansion in the area of open land in the Baschurch area. The highest Gramineae frequencies occur at Birchgrove Pool, and the lowest at Marton Pool, although, if Alnus is eliminated from the pollen sum, Gramineae frequencies are comparable between all four sites. Gramineae attains slightly higher values in Berth II, compared to Berth III. As with other pollen types, frequencies are closely comparable between the two cores but with some indications of a higher N.A.P. input and lower A.P. input in core II. Also at Birth Pool both cores confirm increases in the frequencies of open habitat indicators, for example, Tubuliflorae, Liguliflorae, Cruciferae, Plantago lanceolata and Rumex acet. The frequency of occurrence of these types increases at all four sites at the onset of B8 but their relative frequencies tend to be lower at the larger two meres. In part, this could be because their relative frequencies are, to a certain extent, supressed by the high Alnus representation, although Figure 33 shows a higher ratio of dry land trees to open habitat indicators at the larger two meres. Variation occurs between the sites in respect of the representation of individual open habitat indicators. Rumex acet frequencies are higher at the smaller two sites, and highest of all at Birchgrove Pool. Liguliflorae and Cruciferae frequencies are higher at Berth Pool and, generally, Plantago lanceolata frequencies are lower at Fenemere and Marton Pool. If an Arable:Pastoral index (Turner 1964a) is calculated at the level of peak Gramineae values in B8 in each core, there is a tendancy for lower indexes to be recorded at Berth Pool. The total number of pollen grains included in the calculation is shown in brackets.

		Index
Berth II	176cm (62)	40.3%
Berth III	204cm (38)	31.5%
Marton	308cm (7)	28.5%
Fenemere	260cm (9)	55.5%
Birchgrove	268cm (27)	66.6% (B8/B9 division)

The numbers of pollen grains involved are very low at Fenemere and Marton Pool, and an exact correlation between the Berth Pool cores has probably not been achieved. The abundant production and good dispersal of Plantago lanceolata could lead to the erroneous inference of pastoralism (Edwards 1979), perhaps more so at larger sites where long distance pollen transport is relatively important. Long distance transport of Plantago pollen should be less important at Berth Pool and Birchgrove Pool. Here, the contrast in the index could suggest that the land use is mainly pastoral nearer to Birchgrove Pool. A particular problem with using the Arable: Pastoral index at Fenemere and Marton Pool could be the filtration of herb pollen by uncleared carr, and any damper woodland on the margins of the brown earths. Clearance indicators with lower pollen productivity than Plantago would be less well represented at the larger two meres, even though arable enclaves could be located within the pollen source areas of these two sites. The low Alnus frequencies at Birchgrove Pool could point to the presence of only a narrow, possibly discontinuous alder fringe at this site and so there would be less filtering of herb pollen from cleared areas around the site. Theoretically, Berth Pool and Birchgrove Pool should be within the dominant pollen source areas of Marton Pool and Fenemere. The results above suggest that Arable:Pastoral indexes of c.30% to c.70% could be recorded within the pollen source area of a single site, whilst the site itself records an index of c.50%. It is therefore probable that at a large site an A:P index will not be adequately representative of the agricultural activity within the pollen catchment of that site. A:P indexes should be approached with even greater caution if it is thought that significant filtering of N.A.P. could be occurring in surrounding woodland (cf Caseldine 1981). Cereal pollen is recorded in B8 at the Baschurch Pools but it is possible that cereal growing itself was only practised on the best-drained soils on the crests of the sand and gravel ridges in the Baschurch area. Combined with the poor dispersal of cereal pollen (cf Vuorela 1973) this factor of crop location could lead to the occurrence of very low cereal pollen frequencies in the meres themselves (cf Edwards 1979, 256).

For other herb taxa, the onset of B8 is marked in all five cores by an overall increase in the diversity of the pollen types recorded. Increases in the pollen frequencies of Rosaceae, Ranunculaceae, Urtica and Hypericum perforatum type are particularly clear at Berth Pool, and are confirmed by both cores. Urtica frequencies clearly increase at Birchgrove Pool, Ranunculaceae, Umbelliferae and Urtica are recorded, albeit in single samples, at more than 1% at Marton Pool. Generally, the frequency of occurrence of herb pollen types is not as great at Fenemere and Marton Pool as it is at Berth and Birchgorve. This inter-site variation in the representation of herb taxa could be taken as an indication that a greater degree of openness in the vegetation is to be found closer to the shores of Berth Pool and Birchgrove Pool. Not only would a wider variety of open habitats be available for herb colonisation close to the smaller pools but, also, less fringing woodland would exist to filter N.A.P.

Clearly, the predominant soil conditions within 500m of each of the meres (Figure 5) are more suitable for farming around Berth Pool and Birchgrove Pool, although tracts of brown earth soils are present within 500m of the shores of Fenemere and Marton. A similar variety of herb pollen types occurs at all four sites, suggesting that a comparable variety of open habitats exist in the pollen source areas of all the sites. As far as pollen types and frequencies are concerned, the spectra from the two larger sites are obviously very similar, if anything, the frequencies of Alnus are slightly higher at Marton Pool. If it is assumed that, in relative terms, Fenemere has always had a larger surface area than Marton Pool, then the latter site could be open to more localised influences on the pollen spectra, particularly if it has always been c.7ha in extent. The question of the extent and nature, and indeed the existence of water surface coalescence between Marton and Fenemere cannot readily be answered with reference to the pollen spectra from these two sites, since the spectra are so similar. Although coalescence has been reported during historic times at Marton and Fenemere, the degree of similarity between the spectra cannot be attributed solely to the effect of inter-basin pollen exchange, since, theoretically, two sites of this size and in this proximity would be expected to produce near-identical pollen spectra in the absence of any inter-basin water movement. The increases in herb pollen representation point to a spatially variable increase in the extent of open land in the Baschurch area The full spectra from the smaller two sites suggest that this clearance activity was locally intensive; the spectra from the larger sites suggest that some woodland was left uncleared, although uncertainty surrounds the extent of the uncleared woodland. It could have existed either as thinned woodland throughout the pollen source area, or alternatively denser woodland on peats and damper brown earths around the mere basins. Some of the herb pollen types are derived from taxa which would have occurred naturally within the vegetation, even in the absence of anthropogenic interference or the temporary appearance of canopy breaks caused by falling trees. Naturally occurring taxa which can however benefit from anthropogenic interference are known as apophytes (Birks 1986b); the apophytes include Urtica dioica and Hypericum perforatum type (Groenmann-Van Waateringe 1978). In the Baschurch area, taxa included in the Rosaceae and Ranunculaceae familites, and also Filipendula could have occurred naturally in carr and fenn environments (Sinker et al 1985) from where they would increase their range if damper soils were cleared.

Continuous curves for Urtica, Hypericum perforatum type and Rosaceae span B8 in both cores from Berth Pool. Ranunculaceae occurs in several samples at more than 1% and Cruciferae (undiff), which could also include pollen from wetter areas, begins a continuous curve at the onset of B8. Frequencies of the above types tend to be lower at Birchgrove Pool; conceivably, slightly more extensive areas of damper grassland became established closer to Berth Pool. At all sites, Cyperaceae pollen increases in frequency at the onset of B8, most noticeably at Birchgrove Pool. An increase in the abundance of sedges can be postulated, again suggesting that a more open vegetation became established on some damper soils. Increases in the representation of aquatic and emergent taxa occur at the onset of B8. Increases in the frequency of Sparganium/Typha are most obvious, possibly reflecting the expansion of burr reed or reed mace on cleared carr soils. The more frequent appearance of Nymphaea and Potamogeton in the pollen diagrams might simply be due to the removal of some woodland shading in suitable habitats. Woodland clearance could, however, have caused increases in soil water throughflow and surface runoff into the mere basins (Lockwood 1983). The low lying soils bordering the meres do become flooded today following heavy rains (Plate 12), although the drainage ditches eventually conduct this water away. In the absence of natural outflow streams, clearance activity could lead to prolonged rises in water level at the margins of the pools, thus aiding the establishment of aquatic and emergent taxa.

The pollen evidence for woodland clearance at the onset of B8 is complemented by increases in the frequencies of fern spores. Pteridium and Filicales (undiff) also occurred more frequently during the clearance episodes of phase B7. The highest Pteridium frequencies occur at Birchgrove Pool. Locally, bracken colonisation appears to have been greater on cleared land around the latter site, in comparision to land around Berth Pool. Pteridium frequencies are higher at Fenemere than at Marton Pool. This is in keeping with the generally higher grass and herb pollen values at the former site and could suggest that clearance activity has, in places encroached nearer to the shores of Fenemere than to those of Marton. Sand and gravel ridges supporting Newport series brown earths (Figure 5) surround the southern and eastern shores of Fenemere whereas wider areas of peat and poorly drained gley soils surround Marton Pool. It is interesting to note that Pteridium frequencies are higher at Fenemere and Marton Pool than at Berth Pool. Apparently bracken colonistion of cleared land was locally restricted around this site. One possible explanation for this could be that less of the open land around Berth Pool was converted to rough pasture and hence liable to bracken colonisation. In relative terms more pasture land could have existed closer to Birchgrove Pool, alternatively, the pastureland around Birchgrove Pool could have been drier, supporting more bracken and also docks and sorrels, whereas at Berth Pool, herbs of damper ground such as the Rosaceae, Ranunculaceae and possibly Cruciferae were more abundant.

Bracken expansion is also indicated at this time at Crose Mere, where the assemblage zone CMCP8 is designated by Beales (1980) as the "Gramineae-Pteridium aquilinum LPAZ".

The maximum clearance expansion of phase B8 is dated, by extrapolation of the radiocarbon dates at Fenemere, to c.650bc or c.2600bp at 260cm (Figure 9). The age/depth profile at Berth Pool (Figure 8) based on correlated radiocarbon dates, indicates an age of c.600bc for the Gramineae peak at 176cm in core II. Also, the age/depth profile at Birchgrove Pool (Figure 12) indicates a date of c.650bc for the maximum Gramineae expansion at c.270-280cm. The clearance activity of phase B8 thus appears to commence in the Baschurch area c.800bc, peak in intensity c.650bc and decline in intensity after 600bc. An increasing amount of evidence suggests that c.2600bc was a crucial date in the environmental history of the Severn basin. The regional significance of phase B8 is emphasised in the next section.

5.2.2 The regional significance of phase B8

The Baschurch Pools lie on an interfluve between two rivers, the Perry and Roden. These rivers are tributaries of the Severn and join that river, respectively, west and east of Shrewsbury which is 10km to the south of Baschurch (Figure 1). The date of 2600bp, the time of maximum clearance expansion in B8, is highly significant in the environmental history of the Severn basin. c.2600bp has been fixed as the date of a major lithological change in the floodplain stratigraphy of the River Severn (Shotton 1978, Brown 1982, 1983a, 1983b, Brown and Barber 1985). At this time, the deposition of a new sedimentary unit commences. Deep deposits of a "buff-red silty clay" (Shotton 1978) begin to accumulate on the floodplain of the Severn. This floodplain deposit is thought to be derived from the sheetwashing and erosion of unweathered Triassic sandstone, this material having been exposed to erosion in ploughland subsoils (Shotton 1978, Brown 1982, 1983a). Radiocarbon dated pollen profiles from the Severn basin (Brown 1983a) show an increase in the intensity of woodland clearance at this time. Between 2800 and 2400bp suspended sediment output in the River Severn is estimated to have increased by c.500% (Brown and Barber 1985). The increase in floodplain sedimentation is attributed to an increase in the terrestrial erosion rate, an increase which occurred as a direct consequence of late Bronze Age and early Iron Age deforestation (Brown and Barber 1985).

At Berth Pool and Fenemere mineral magnetic analyses suggest that an increase in the amount of sub-soil being washed into the Baschurch Pools occurred during B8, this compares to the evidence from B6 and B7 (Chapter 4) where the inwashing of topsoil magnetic minerals appeared to predominate.

<u>5.2.3 Magnetic measurements</u>

<u>5.2.3.1 Fenemere</u>

During phase B8 at Fenemere (Figure 22) the values of χ, ARM and SIRM decline sharply, this points to a marked reduction in the proportion of fine grained secondary ferrimagnetic minerals being washed into the lake (<u>cf</u> phase B7, Chapter 4). Changes in the type and size of magnetic crystals are indicated by declines in the ratios of ARM/χ and SIRM/χ. A reduction in χfd points to a reduction in the proportion of inwashed viscous magnetic grains from topsoil horizons (<u>cf</u> Mullins, 1977, Oldfield et al 1983). The degree of hardness of the magnetic minerals increases in phase B8; the high reverse field ratios 'S' and -200mT become less strongly negative. At Peckforton Mere, Cheshire, it was hypothesised that a combination of low IRM values and "hard" responses in high and low reverse fields indicated substantial inwashing of haematite-rich sediment derived from the Triassic parent material (Oldfield et al 1985a, 38). The reasons for an increased inwashing of parent material at Peckforton Mere were thought to include accentuated channel scour, perhaps as a response to vegetation clearance. In addition, the construction of dwellings and the occurrence of deeper ploughing could expose the parent material (Oldfield et al 1985a). A sand and gravel ridge borders the eastern shore of Fenemere. If brown earth soils on this substrate were ploughed in B8, subsoil magnetic minerals could have been washed into the mere. Shotton (1978,31) suggested that the ploughing of soils during late autumn, when rainfall would be high, could lead to the enhanced erosion of unweathered Triassic-derived substrates (cf Fullen and Reed 1986).

In Figures 23 and 24 the samples from B8 plot out more towards the bottom left of the diagrams, compared to the plotting position of the samples from B7. The plotting position is dependant upon the mineralogy of the samples concerned. Mineral magnetic analyses of limnic sediments from sites in Co. Tyrone, Northern Ireland, showed that during periods of intensified farming sediment samples tended to plot towards the lower left hand of a graph of χ versus SIRM. This plotting pattern was attributed to the presence of haematite in the samples (Hirons and Thompson 1986). Similarly, in the Tyrone sites, samples from periods of intensified farming plotted to the lower left of a graph of SIRM/χ versus 'S'. A sample from 276-278cm at Fenemere plots to the lower left of the graph of versus SIRM, but more to the lower right of the graph of SIRM/χ versus 'S' showing that softer, ferrimagnetic oxides were still being deposited in the sediment at this time. At 256-258cm, however, the sample plots to the lower left hand of both diagrams, pointing to a high antiferromagnetic, eg, haematite, input into the sediment of Fenemere (cf Hirons and Thompson 1986).

At Fenemere, there is a significant inverse correlation, $r_s = -0.88$, between and pollen evidence for anthropogenic activity, a similar relationship was observed by Hirons and Thompson (1986). At Fenemere, this could point to a marked reduction in the inwashing of ferrimagnetic minerals, although there is evidence to suggest that magnetic susceptibility can be lost as sediments oxidise (Hilton and Lishman 1984). Mineral magnetic analysis of the Berth Pool and Fenemere sediments was carried out c.24 months after coring, and oxidation may therefore have affected the magnetic susceptibility of the sediment.

5.2.3.2 Berth Pool II

Magnetic measurements from B8 at Berth Pool (Figure 21) are very similar to those seen at Fenemere (above). χ , ARM and SIRM all decline sharply at c.180cm or c.2600bp. Mineralogy changes are indicated by decreases in χfd, an initial decline in ARM/χ , a decline in SIRM/χ and an increase in SIRM/ARM (Figure 21). Whereas an increase in ARM can be indicative of an increase in the deposition of finer grained magnetic minerals (Thompson and Oldfield 1986) a rise in SIRM/ARM points to an increase in the deposition of coarser-grained magnetic minerals (Thompson and Oldfield 1986). A "harder" response can also be seen in the high reverse field ratios; during B8, low reverse field ratios also increase (Figure 21). Figures 23 and 24 show that samples from B8 at Berth Pool plot towards the lower left of graphs of χ versus SIRM and SIRM/χ versus 'S'. In combination, the magnetic measurements point to a change in the iron mineralogy of the Berth Pool sediments in B8. Instead of the finer grained secondary ferrimagnetic minerals which appear to have predominated in the sediments in B7, in B8 a significant admixture of coarser grained antiferromagnetic minerals is indicated. As at Fenemere, there is an inverse relationship between χ and pollen evidence for anthropogenic activity: $r_s = -0.70$. In terms of the magnetic mineralogy of the sediments of these two pools, the B7/B8 boundary is obviously a significant one. Simplistic linkages between sediment mineralogy and changing catchment sources for eroded materials are not always possible; autochthonous iron precipitation can influence sediment mineralogy (Hirons and Thompson 1986, Oldfield et al 1983b). Furthermore, particle size specific magnetic measurements can be a very useful aid to interpretation (Smith 1985), such measurements have not been made here.

On the basis of the evidence presented here, however, it is suggested that, in contrast with phase B7, phase B8 is characterised by by relatively high haematite inputs into the Berth and Fenemere sediments, this is attributed to increased subsoil erosion.

5.2.4 Sediment loss on ignition (Figure 13)

During phase B8 at Fenemere and Berth Pool percentage loss on ignition appears to remain relatively constant. At Fenemere, L.O.I rises slightly from just under 70% to between 70% and 80%. A radiocarbon date from 260 to 270cm of 3160$\pm$50bp (SRR 2922) compares to a date from 320 to 330cm of 3190$\pm$60bp (SRR 2923). It is believed that SRR-2922 has undergone reversal, probably as a result of the inwashing of older carbon during the clearance activity of phase B8 (cf Pennington et al 1976). Extensive areas of peat surround Fenemere (Figure 5) and it is thought possible that during B8 some of this peat could have been eroded into the mere, peturbing the radiocarbon date SRR-2922. Conceivably, the slight rise in L.O.I at 260cm suggests that organic as well as inorganic material was washed into Fenemere during B8. L.O.I samples at 190cm and 160cm from Berth Pool II showed, respectively, ignition losses of c.60% and 50 to 60%. Evidently, the sediments of Berth Pool and Fenemere remained predominantly organic during the later Bronze Age and Iron Age.

5.3 Phase B9: Post-600bc reductions in clearance activity at the Baschurch Pools

The end of phase B8 is marked at Fenemere, Marton Pool, Birchgrove Pool and, to a much more limited extent, at Berth Pool by palynological evidence for a reduction in the intensity of anthropogenic vegetation clearance.

The phase of reduced clearance activity is more clearly identifiable at Marton Pool and Fenemere, where numerical zone splits confirm the significance of the palynological changes. The dating of phase B9 is based on the extrapolated age/depth profile at Fenemere and biostratigraphic correlation between the four sites, although, in general terms the suggested age/depth profiles for Marton Pool, Birchgrove Pool and Berth Pool II confirm a median date of c.500bc for phase B9. Biostratigraphic correlation between Berth Pool and the other three sites is difficult to discern but, generally, the palynological evidence at all four sites suggests that to a varying extent, the impact of man on the vegetation of the Baschurch area was reduced c.500bc.

Main characteristics:

Fenemere 250cm to 230cm

Betula and *Pinus* increase, *Quercus* increases slightly and *Tilia* and *Alnus* also increase in frequency. Gramineae frequencies are reduced and *Plantago lanceolata* declines to less than 1% at 248cm. Total tree pollen increases and total herb and heath pollen declines. *Pteridium* decreases but Filicales spores tend to increase in frequency.

Marton Pool c.300cm to c.280cm

Betula and *Pinus* increase and *Tilia* is recorded more frequently. *Alnus* increases and a slight rise in *Corylus/Myrica* occurs. Ericaceae frequencies are generally higher but open habitat indicator pollen is reduced in diversity. Only *Plantago lanceolata* and *Rumex acet* are recorded at 280cm. The diversity of other herb pollen types is also reduced; apart from Cyperaceae, only Rosaceae and Urtica both at less than 1% are recorded at 288cm. Tree pollen totals increase and herb and heath totals decline. Pteridium declines to less than 1%, but Filicales spores increase in frequency.

Birchgrove Pool c.268cm to c.260cm

Little variation is seen in arboreal pollen frequencies at these levels, Coryloid frequencies also remain low. Gramineae frequencies are reduced but still exceed 40%. Liguliflorae declines to less than 1% and Artemisia and Chenopodiaceae occur less frequently. Plantago lanceolata increases and Rumex acet remains relatively high. Changes in species abundance could be occurring within weed communities, but with no significant overall reduction in the area of open land. Little change occurs in total tree and total herb/ heath pollen but Pteridium and Filicales frequencies decline.

Berth Pool II c.176cm to c.168cm

Phase B9 at Berth Pool is defined primarily on the basis of chronological correlation to the other sites. Gramineae frequencies decline slightly but little variation occurs amongst the recorded herb pollen types.

Berth Pool III c.200cm to c.192cm

Biostratigraphic correlations with the above levels from Berth Pool II occur at these horizons. Gramineae is reduced slightly between 198cm and 202cm. Salix increases at 202cm and at 198cm a short lived increase in Coryloid pollen occurs. These changes have biostratigraphic parallels in core II where a short Salix curve begins at 172cm and a very slight rise in Coryloid pollen occurs at 168cm. In levels assigned to B9 in both cores slight reductions in Liguliflorae occur but Plantago lanceolata and Rumex acet frequencies increase.

5.3.1 Inter- and intra-site variations: The Baschurch Pools in phase B9

Fluctuations in aquatic pollen frequencies occur in all five cores in the levels discussed above. At Fenemere, Sparganium/Typha is absent between 228cm and 244cm, Nymphaea and Nuphar also occur less frequently in the latter stages of B9 and the earlier part of B10. At Marton Pool aquatic pollen diversity is reduced at 288cm. Only Potamogeton and Sparganium/Typha occur at 168cm in Berth II, and only the latter type occurs at 196cm in Berth III. Sparganium/Typha is also reduced at Birchgrove Pool in B9.

The pattern of aquatic pollen frequency fluctuations observed at all four sites tends to suggest that, as periods of lower land use intensity progress, reductions in the abundance of emergent and floating-leaf aquatic vegetation occur. A reduction in suitable environments is one possible cause, as any shallow water in fen or carr areas becomes subject to increased shading by re-expanding alder cover. Less intensive land use in the lake catchments, however, could also lead to comparative reductions in soil moisture levels and surface water runoff as woodland becomes re-established on drier soils (cf Lockwood 1983).

In the latter case the margins of the meres would become less liable to flooding (cf Plate 12). In this way, shallow water environments suitable for colonisation by aquatic vegetation could become more restricted.

The tendancy for Sparganium/Typha representation to be reduced during phases of reduced clearance activity could suggest that, in part, Phragmites is contributing to the Gramineae pollen curve. If reedmace or burr-reed increase in abundance during clearance phases, the common reed might also be expected to expand its range.

Fluctuations in arboreal pollen frequencies at Fenemere and Marton Pool suggest that some re-expansion of woodland is occurring in phase B9. Compared to phase B8, Betula frequencies are higher at both Marton Pool and Fenemere in B9, with the highest frequencies occurring at the latter site. Betula frequencies remain relatively low at Birchgrove Pool at this time. A very slight rise in Betula occurs at 196cm in Berth III and Betula is temporarily recorded at more than 1% at 172cm in Berth II. A limited re-expansion of birch could be in evidence here although the inter-site contrasts suggest that it was not particularly significant closer to Berth Pool and Birchgrove Pool.

Peaks in Pinus pollen frequencies occur during B9 at Fenemere and Marton Pool. Values are generally slightly higher at the former site. Pinus continues to occur intermittently at the smaller two meres and it is probable that most of the Pinus pollen at Fenemere and Marton Pool is being derived from more distant rather than more local pine woodland. If some land in the region was abandoned, or used less intensively during B9 it could have been subject to partial heathland colonisation. Pine could have been present as a heathland species, leading to an expansion in Pinus pollen frequencies at sites with more regional rather than more local pollen source areas. Many of the peat mosses in the region could have been subject to partial colonisation by pine, and this again would tend to lead to higher Pinus frequencies being recorded at sites with relatively wide pollen source areas.

Although Pinus only occurs intermittently during B8-B10 at Berth Pool and Birchgrove Pool, there are indications that the B9 Pinus increase seen at Fenemere and Marton is detectable at these two sites:

Birchgrove Pool

cm	Main pollen sum:	Pinus	Phase
256	492	-	B10
260	469	3	B9/B10
264	473	2	B9
268	433	-	B9
272	314	1	B8

The raw pollen count for Pinus is shown

Berth Pool II

cm	Main pollen sum:	Pinus	Phase
164	332	1	B10
168	339	1	B9/B10
172	349	1	B9
176	431	3	B8/B9
180	344	-	B8

Berth Pool III

cm	Main pollen sum:	Pinus	Phase
188	294	1	B10
192	299	3	B9/B10
196	355	-	B9
198	294	1	B9
202	333	-	B8

There is thus limited evidence that, at the approximate time of B9, slight increases in the deposition of Pinus pollen occur at the smaller two pools, although the pattern is imprecise. Extrapolation of the radiocarbon dates at Fenemere suggests that a regional Pinus pollen maximum occurred in Shropshire c.400bc. A pine stump from Hardy's (1939) pine stump layer at Whixall Moss has a date of 348bc (Godwin and Willis 1960, Turner 1964a). Peat from this layer has been dated to 2180±50bp 230bc (SRR 3074),(Haslam, in prep) and extrapolated dates at Fenemere point to a regional Pinus pollen decline c.1950bp/0bc.

At Marton Pool and Fenemere, Quercus frequencies continue to decline during B9. A trend towards lower Quercus values continues at Birchgrove Pool and at Berth Pool Quercus frequencies remain low. Removal of oak from the woodland of the area thus appears to continue during phase B9. Reductions in Quercus are more obvious at Fenemere than at Marton Pool but at both these sites the B8/B9 transition is marked by increases in Tilia representation. B9 is not therefore characterised by a simple pattern of continued woodland clearance, which affected all the forest taxa, but rather by changes in woodland compositon. Tilia is not recorded in B9 in Berth III and only occurs at less than 1% in B9 at Birchgrove Pool. Lime regrowth can thus be postulated in parts of the Baschurch area in B9. Conceivably, a reduction in the intensity of land use allowed lime to become re-established in some areas. Fagus is recorded more often at Fenemere during B9 but not at Marton Pool. It does occur at Birchgrove Pool in B9 but occurs only rarely throughout the whole profile from Berth Pool. Shropshire is not thought to be within the natural range of beech as a native tree in the British Isles (Sinker et al 1985). The pollen spectra from

The Baschurch area suggest that, in the absence of planting, beech did not become an effective competitor in the presence of other broadleaved trees. The readiness with which Tilia appears to have become re-established in phase B9 in the Baschurch area suggests that soil fertility was not dramatically reduced as a result of the clearance activity of phase B8. Lime generally has a preference for more fertile mor soils (Godwin 1975). A continuous curve for Fraxinus spans B9 at Fenemere although frequencies are only c.1-2%, elsewhere, its occurrence is more intermittent. Ash thus persists as a woodland component in the Baschurch area during phase B9, although it appears to have been less abundant closer to Berth Pool and Birchgrove Pool.

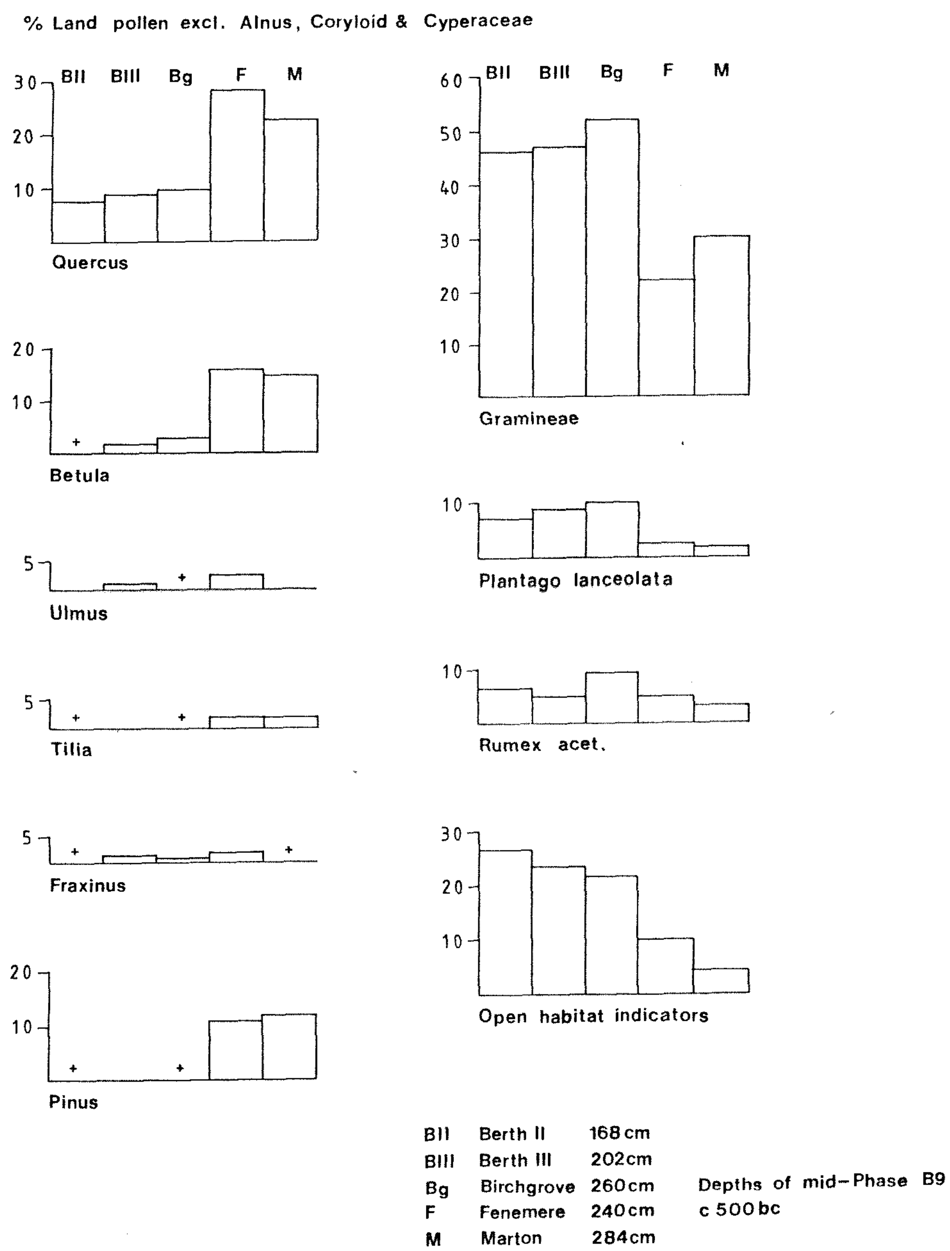
Alnus frequencies remain low at Berth Pool and Birchgrove Pool, but clear increases in Alnus are seen at Marton Pool and Fenemere; Alnus occurs at 35 to 40% at Fenemere but fluctuates between 40 and 50% at Marton Pool. Some alder regrowth on damper soils can be inferred at Marton and Fenemere, but not at Berth Pool or Birchgrove Pool although a very slight rise in Alnus does occur at 264cm at Birchgrove. The inter-site contrasts in Alnus frequency, particularly between Fenemere/Marton and Birchgrove Pool suggest that the pollen source area of Birchgrove Pool is very restricted. It is probable that at least a proportion of the Alnus pollen at Birchgrove Pool is derived from trees growing at the lakeside. The amount of alder pollen derived from beyond the immediate margin of Birchgrove Pool therefore appears to be minimal, despite the evidence from Marton and Fenemere for quite extensive belts of alder around those two sites.

Little change in Corylus/Myrica frequencies occurs at either Marton Pool or Fenemere during B9; frequencies remain low at both Berth Pool and Birchgrove Pool. Other herb pollen types continue to be recorded at Fenemere and Marton Pool; Salix, Hedera Frangula and Lonicera all occur. Salix, Sambucus and Crataegus occur at less than 1% at Birchgrove Pool but at Berth Pool Salix frequencies increase slightly during B9. It is not certain whether the slight Salix rise at Berth Pool represents willow growth within carr woodland or on damper soils which had previously been cleared. In contrast to its pattern of occurrence at the other three sites, Sambucus is recorded in consecutive samples from late B8 to early B12 (Chapter 7) at Berth Pool; in later phases Sambucus actually occurs at c.1-2% in consecutive samples. Elder is often associated with enriched soils within settlement areas (Godwin 1975) and it is interesting to note that another taxon which can have similar preferences, the common nettle could be the principal contributor to the high frequencies of Urtica pollen recorded at Berth Pool.

Generally arboreal and shrub pollen frequency contrasts between Marton/Fenemere and Berth/Birchgrove suggest that whilst some "regional" reduction in land use intensity occurred in B9, such a reduction is not easily traceable in the pollen spectra at the latter two sites; the possibility exists that, during B9, Berth and Birchgrove lay nearer to a focus of settlement.

Reductions in Gramineae frequencies occur at all four sites in this phase, although values still exceed 40% at Birchgrove Pool and at Marton Pool and Fenemere Gramineae values are equal to or in excess of those recorded during the clearances of B7 (Chapter 4). Figure 33 shows the inter-site contrasts in the ratio of "dry land trees" to "open habitat indicators". The pattern established in B8 persists into B9 with higher dry tree:open habitat pollen ratios at the larger two sites. These ratios are obviously more highly generalised at the larger sites, with their larger pollen soruce areas (Jacobson and Bradshaw 1981), furthermore, the pollen-filtration effect of fringing carr woodland could be greater at Marton and Fenemere. Arboreal pollen produced at canopy level might be expected to encounter better dispersal conditions than that produced nearer ground level. The lower Alnus values at Birchgrove Pool and Berth Pool point to more restricted, perhaps discontinuous alder belts and this would favour the lateral transport of herb pollen to the pools (cf Vuorela 1973, Caseldine 1981). If selected tree and herb percentages are calculated with Alnus removed from the main sum (Figure 28) the contrasts between the smaller and larger sites in respect of arboreal and non-arboreal representation are emphasised in most respects although the contrast in Gramineae frequencies between Marton Pool and Berth Pool becomes less marked. Again, higher Alnus values at Fenemere and Marton probably attest to the presence of fringing alder woodland which would limit the lateral

Fig 28 B9: Selected Pollen Types



transfer of pollen below the canopy but which would not affect the above canopy transfer of, for example, Pinus.

Reductions in the diversity and frequency of open habitat indicator pollen are more evident at Marton Pool, compared to Fenemere, particularly at c.280cm at Marton Pool where only Plantago lanceolata and Rumex acet occur in association with the highest Alnus values. Tubuliflorae, Liguliflorae, Artemisia, Chenopodiaceae, Cruciferae, Plantago lanceolata and Rumex acet all occur at 240cm at Fenemere. If land were still occupied to the east and south of Fenemere during B9, this could account for the relatively more diverse representation of open habitat indicators at this site. Drier, well drained brown earth soils border the eastern shores of Fenemere (Figure 5) and one consequence of this could be the presence of a much narrower alder fringe in this area, lateral transfer of herb pollen to Fenemere could thus be less restricted. Apart from the typical open habitat indicators, other herb pollen types continue to be recorded at Marton Pool and Fenemere during B9, although most of these types could be derived from damper soils, perhaps bordering fen or carr. Cyperaceae, Rosaceae, Ranunculaceae and Filipendula pollen could all be derived from plants occupying damper habitats (Sinker et al 1985). At Fenemere it is noticeable that Umbelliferae ceases to be recorded during B9, although it persists in the pollen record at Marton Pool, Urtica, however, persists in the pollen record at both sites. At Fenemere, Labiatae, Leguminosae and Rubiaceae tend to appear more often during more intensified phases of clearance activity, this also appears to be true for Campanulaceae, Labiatae, and Hypericum perforatum type at Marton Pool. The Labiatae family includes taxa with a variety of ecological requirements. Although many occupy wetter soils the more common members of the Rubiaceae, however, for example Galium spp often occupy scrub or grassland on damp to dry soils (Sinker et al 1985).

A diverse and abundant herb pollen flora characterises Berth Pool and Birchgrove Pool during phase B9 but some changes in species composition are indicated in the cleared areas. At Birchgrove Pool, Liguliforae declines to less than 1%, albeit temporarily at 268cm and Artemisia and Chenopodiaceae are recorded less often in comparison to their occurrence during phases of clearance expansion. Rumex acet frequencies remain relatively high but a clear increase in Plantago *lanceolata* occurs. As at Marton Pool and Fenemere, there are indications that Campanulaceae, Labiatae and Rubiaceae are more usually associated with phases of increasing clearance activity. *Urtica* declines to less than 1% at 264cm and, generally, the indications are that during B9 at Birchgrove Pool a temporary reduction in species diversity occurred within some of the dry land herb communities around the site. Ranunculaceae continues to be recorded, however, and a slight increase in Rosaceae occurs at 264cm.

At Berth Pool, Liguliflorae frequencies continue to be relatively high in B9, Cruciferae continues to occur at more than 1% but both cores suggest increases in the frequencies of *Plantago lanceolata* and *Rumex acet*; slightly higher *Rumex acet* values occur in Berth III but generally percentages are closely comparable between the two cores. Other herb taxa continue to be represented during B9 at Berth Pool. Campanulaceae occurs at more than 1% in both cores in levels assigned to B9, Rosaceae exhibits a continuous curve and Ranunculaceae is relatively well represented. Slight reductions in *Urtica* are evident in both cores in the upper levels of B9 and the continuous curve for *Hypericum perforatum* type persists in both cores. Also at Berth Pool, Leguminosae, Umbelliferae and Rubiaceae continue to occur during B9. The evidence from Berth Pool therefore suggests that the diverse herb flora which developed in B8 remains largely unchanged during B9.

Taking into account the evidence from both B8 and B9, Campanulaceae, Leguminosae, Cruciferae, Liguliflorae, Rosaceae, Ranunculaceae, *Urtica* and *Hypericum perforatum* type are more frequent in the pollen record at Berth Pool in comparison to Birchgrove Pool and certainly in comparison to Marton Pool and Fenemere. In the contemporary vegetation communities of Shropshire (Sinker et al 1985) *Hypericum perforatum* itself, Cruciferae types and *Taraxacum* (included in Liguliflorae) are all abundant on disturbed land. *Taraxacum* spp (eg, dandelions) are particularly common on grass verges subject to regular mowing and compaction. *Rumex acetosa* is common in grassland, although *Rumex acetosella* does not compete well with tall grasses (Sinker et al 1985). The *Urtica* pollen curve could include pollen from *Urtica urens* which is a species of arable fields and habitation areas, and Urtica dioica which has a wide habitat range but is particularly associated with nutrient rich soils. Taxa within the Campanulaceae, eg, Campanula spp have a wide ecological tolerance but some typify species rich herb communities (Sinker et al 1985). Herbs of the Rosaceae and Ranunculaceae families are often found on damper soils although the Ranunculaceae occupy a wide range of habitats. The precise interpretation of herb pollen spectra is problematic where pollen types are identified only to family level, however, the general indictions in the pollen record from B8 and B9 in the Baschurch area are that a relatively high degree of anthropogenic disturbance occurred on both wetter and drier soils in close proximity to Berth Pool. The higher frequencies of Plantago lanceolata and Rumex acet at Birchgrove Pool could suggest that, in comparison to areas around Berth Pool, wider tracts of drier grassland existed in close proximity to Borchgrove Pool; Plantain and sorrels tend to prefer damp to dry soils in Shropshire today (Sinker et al 1985). Both wetter and drier soils appear to have been cleared in the pollen source areas of Fenemere and Marton Pool, source areas which should theoretically include the land around both Berth Pool and Birchgrove Pool.

During the clearance episodes of phase B7 (Chapter 4) Pteridium spores increased in frequency, a pattern which was repeated during the postulated clearance expansion in phase B8. During phase B9, clear declines in Pteridium frequencies occur at Fenemere, Marton Pool, where it declines to less than 1%,and Birchgrove Pool. At Berth Pool, Pteridium values in B9 are generally comparable to those in the preceding phase. In contrast to the decreases in Pteridium at Fenemere, Marton Pool and Birchgrove Pool, frequencies of Filicales spores tend to increase during B9. It is possible that, given a limited re-expansion of broadleaved woodland, fern taxa with a greater degree of shade tolerance than Pteridium became more abundant, although the fact that pteridophyte spores are still generally well represented in B9 suggests that the woodland which did exist was relatively open (cf Beales 1980). The tendancy for higher Pteridium values to occur at Birchgrove pool, in comparison to Berth Pool, could suggest that cleared areas on drier soils occur in closer proximity to Birchgrove Pool, bracken being intolerant of waterlogging (Sinker et al 1985). Similarly, at Fenemere and Marton Pool, the tendancy for higher Pteridium frequencies to occur at Fenemere could point to the presence of some cleared land on better drained soils in closer proximity to that site than to Marton.

In vegetational terms therefore, phase B9 is characterised by a general regional re-expansion of deciduous woodland, where birch and lime in particular increased in abundance. Within this woodland however, cleared enclaves continued to exist. As far as the Baschurch area is concerned, evidence for clearance contraction and woodland regrowth is most readily discernable at Marton Pool and Fenemere, detectable to a limited degree at Birchgrove Pool but not easily identifiable at Berth Pool and it is possible that the latter site was nearer to a focus of human activity.

5.3.2 Magnetic measurements

5.3.2.1 Fenemere

Magnetics samples from 236-238cm and 246-248cm (Figure 22) have low values of χ, ARM and SIRM, χ values are in fact too low to allow χfd to be reliably measured (G. Yates, pers. comm), for this reason, the interparametric ratios ARM/χ and SIRM/χ are not shown. A rise in SIRM/ARM occurs at 236-238cm, slight decreases in the reverse field ratios -20mT and -40mT occur but a relatively "hard" magnetic response still occurs at the higher reverse field strengths of -100mT, or 'S' and -200mT/IRM_{850mT}. The combination of decreasing low reverse field ratios, increased high reverse field ratios and low IRM values at Peckforton Mere, Cheshire (Oldfield et al 1985a) was thought to indicte the predominance of substrate magnetic mineral sources including unweathered parent material, glacial erratics and drift (cf Smith 1985). This combination of parameters at Fenemere which has a similar catchment lithology to Peckforton Mere, suggests that the erosional input into the mere is dominated by magnetic minerals from the catchment substrate. Unlike Peckforton Mere, Fenemere is not thought to have had any inflow streams during the prehistoric period; streams would expose substrate materials in their banks and beds. The possibility exists therefore that subsoils and glacial drift were exposed somewhere within the terrestrial catchment of Fenemere during phase B9. Some human activity, albeit low in intensity could still have been occurring in the Fenemere catchment at this time. The rise in SIRM/ARM points to the presence of coarser magnetic grains (cf Thompson and Oldfield 1986), pointing to the presence of substrate magnetic minerals, as opposed to finer grained secondary ferrimagnetic minerals from topsoils (Oldfield et al 1985a, Oldfield et al 1983, Smith 1985, Thompson and Oldfield 1986). The coercivity curve for the sediment sample from 246 to 248cm (Figure 26) shows that the sample is continuing to retain a proportion of its induced forward magnetisation even at high reverse fields, this again points to haematite admixture in the sediments (Oldfield et al 1985a), although the coercivity of remanence, 33mT is similar to that for samples from B6 and B7. Due to the unreliability of the χ measurements in B9 these samples are not included on the scattergrams of χ vs SIRM and SIRM/χ vs 'S'.

5.3.2.2 Berth Pool II

Samples form 168-170cm and 172-174cm in Berth Pool II are assigned to phase B9. Figure 21 shows that in comparision to B8, χ, ARM and SIRM are reduced. χfd values for B9 were thought to be unreliable but χ was high enough to allow the calculation of interparametric ratios; ARM/χ declines, SIRM/χ remains relatively low but SIRM/ARM increases. Increases in both high and low reverse field ratios occur. The coercivity curve for 172-174cm shows that, in comparison to previous phases, the sediment from B9 is retaining more of its forward magnetisation at higher reverse fields. The results from Berth Pool II are therefore very similar to those from Fenemere, pointing to an admixture of "harder" magnetic minerals such as haematite. The higher values of χ at Berth Pool could point to a greater degree of erosion in the catchment of that site, compared to Fenemere (cf Oldfield et al 1983b). At Berth Pool, disturbance of the outwash sands and gravels which make up the hillock of The Berth (Figure 3, Plate 6) could have provided a source for substrate magnetic minerals adjacent to the pool itself. Figures 23 and 24 show that the samples from B9 in Berth II plot below and to the left of samples from B6 and B7 on the graphs of χ versus SIRM and SIRM/χ versus 'S', this plotting pattern points to a hardening in the iron mineralogy of the sediment during B9 (cf Hirons and

Thompson 1986). The coervicity of remanence for the sample from B9 (Figure 25), 42mT, is higher in comparison to that for B6 and B7, pointing to a hardening of the iron mineralogy (Oldfield et al 1985a).

5.3.3 Sediment loss on ignition

L.O.I measurements for samples assigned to B9 have not been made. The L.O.I surves shown in Figure 13 suggest that throughout phases B6 to B11, loss on ignition of the sediment of the pools varies between 60% and 80% at Fenemere and 50% and 60% at Berth Pool. Extrapolation of the actual data points suggests that during B9, the sediments of Berth Pool and Fenemere were predominantly organic.

5.3.4 Phase B9: Regional correlations between the Baschurch area, Crose Mere and Whixall Moss

Biostratigraphic correlations are possible between the Baschurch Pools and Crose Mere during phase B9 at the former sites and pollen assemblage zone CMCP8 at the latter site. CMCP8 is thought on the basis of the evidence from the Baschurch Pools to commence c.1200bc (Barber and Twigger 1987). This is a later date than that indicated by a radiocarbon date from Crose Mere (Beales 1980) but this date, 3714$\pm$129bp (Q-1234) was questioned by Beales (1980, 156). If it is assumed that CMCP8 does indeed commence c.1200bc, and there are excellent biostratigraphic correlations between the CMCP7b/CMCP8 boundary at Crose Mere, B7 at the Baschurch Pools and the 1288bc *Tilia* decline at Whixall Moss (Turner 1964a), then it is reasonable to expect biostratigraphic parallels between B9 and mid CMCP8. At c.230cm at Crose Mere, *Betula*, *Pinus* and *Tilia* frequencies increase and a reduction in Gramineae occurs, a slight reduction in *Pteridium* is also detectable. These pollen frequency changes are obviously very similar to those occurring in B9 and a date of c.500bc is therefore suggested for c.230cm at Crose Mere (*cf* Figure 19).

At Whixall Moss, high *Pinus* values occur at the F/G boundary (Turner 1964a, 1965). Increases in *Quercus* are detectable at this point, where Gramineae, *Plantago* and *Pteridium* are reduced and where the diversity of other herb pollen types is reduced. Turner (1965) suggests a date of 250bc for section H in the spectra at Whixall, obviously indicting an earlier date for section F, where the higher *Pinus* frequencies develop. Taking Turner's (1965) date of c.50bc for c.42cm at Whixall, and c.1280bc for c.87cm, a generalised accumulation rate of c.27 radiocarbon years/cm is indicated. Although peat accumulation rates can be expected to vary quite widely (Walker 1970) and the above rate may represent an over-simplification, it does point to a date of c.500bc for c.60cm where *Pinus* increases in the upper levels of section F. It is therefore suggested that B9 is approximately chronologically coincident with Section F (Figure 19).

It thus appears that c.500bc a certain amount of woodland expansion occurred in the Shropshire lowlands although the extent to which cleared areas contracted was variable throughout the region. After 400bc, the palynological record from the Baschurch Pools indicates a renewed impetus in clearance activity. As far as the Baschurch area is concerned these clearances appear to have been more extensive than those which occurred during B8.

5.4 Phase B10: Renewed clearance activity c.400bc to c.50bc at the Baschurch Pools

In the second half of the first millennium bc palynological evidence from the Baschurch area points towards a renewed impetus in anthropogenic activity. Compared to phase B9, wider areas of land appear to be cleared of woodland, the date of peak clearance intensity is estimated to be c.100bc.

Main characteristics

A relatively high degree of biostratigraphic correlation can be observed between the pollen spectra from Fenemere, Marton Pool and Birchgrove Pool during this phase, at Berth Pool however, biostratigraphic parallels with the other three sites are difficult to discern and therefore B10 is defined primarily with reference to the suggested age/depth profile for Berth II (Figure 8).

The main palynological features of phase B10 at the Baschurch Pools are as follows:

Fenemere 230cm to 188cm

Betula, *Pinus*, *Quercus*, *Alnus*, *Fraxinus*, and later in the phase, *Tilia* frequencies are reduced; *Taxus* occurs more intermittently. *Corylus/Myrica* frequencies continue to decline. *Hedera* and *Frangula* occur more often in the earlier stages of B10 and *Ilex* occurs more often in the latter stages. Ericaceae increases in frequency early in the phase but declines later. Gramineae increases and Cereal and *Secale* are recorded, *Cannabis* type occurs once in mid-B10. Open habitat indicator representation improves, Liguliflorae occurs more frequently in early B10 and *Rumex acet* peaks at the end of the phase. Other herb pollen types increase in frequency and diversity, herb and heath pollen reaches 50% of total determinable land pollen in late B10. *Pteridium* increases but Filicales frequencies are reduced. *Sphagnum* spores occur relatively frequently in B10, a trend which developed during B8.

Marton Pool c.280cm to 240cm

Betula increases slightly in mid-B10, but declines later in the phase, reductions in Pinus occur and Quercus is reduced in the second half of the phase. Alnus frequencies initially remain high but then decline. Tilia occurs marginally less often in the latter stages of the phase, where Taxus also occurs less frequently. Corylus/Myrica values are further reduced, but an increase in Salix occurs late in B10. Compared to Fenemere, Hedera, Ilex and Frangula occur in fewer samples and Ericaceae occurs at less than 1% more often at Marton Pool. Substantial increases in Gramineae occur only in the latter part of B10; increases in the frequency and diversity of open habitat indicators are mainly restricted to the later stages of the phase although the distinctive Rumex acet peak seen in late B10 at Fenemere has a parallel at 242cm at Marton. Generally, increases in the frequency and diversity of herb pollen types are more restricted at Marton, compared to Fenemere. Total herb and heath pollen remains at less than 50% total determinable land pollen. Pteridium increases but frequencies are lower than at Fenemere; Filicales values tend to be higher at Marton. As at Fenemere, Sphagnum is recorded more often in B8 to B10 cf B6/B7.

Birchgrove Pool c.260cm to 244cm

Betula and Alnus frequencies remain low and Quercus reaches a minimum, Fraxinus increases in the mid to late stages of the phase. Corylus/Myrica increases in the latter part of the phase; an increase in the diversity of shrub types is associated with the Coryloid increase. Ericaceae occurs at more than 1% in consecutive samples and cereal pollen occurs at more than 1% at the Gramineae maximum. Open habitat indicators are well represented, with Rumex acet the most common type. Compared to 260 to 264cm, a wider variety of herb pollen types are recorded. Total herb and heath pollen exceeds 75% of total determinable land pollen. Pteridium rises to more than 20% of total land pollen plus pteridophytes but Filicales representation is much lower in comparision to Marton and Fenemere.

Berth Pool II c.168cm to 152cm

Betula is absent at 160cm but increases in frequency slightly in the upper levels of the phase. In comparison to B8 and B9, Quercus frequencies are lower; Alnus rises during the latter stages of B10. Corylus/Myrica frequencies remain low but a continuous Salix curve spans the phase. A short-lived increase in Sambucus occurs in mid B10 and Ericaceae occurs at c.1% in consecutive samples. Gramineae frequencies are lower in comparison to B8 but cereal and Secale pollen are recorded. Chenopodiaceae appears for the first time since B7, Cruciferae increases but a slight reduction in Plantago lanceolata occurs. In comparison to B8 and B9, higher Rosaceae, Urtica and Hypericum perforatum type frequencies occur in B10. Total herb and heath pollen actually declines in relative terms in B10, this appears to be due to the combined effect of rises in Alnus, Salix and Sambucus. Compared to B8 and B9, higher Pteridium values occur in B10.

Berth Pool III c.192cm to 172cm

Betula occurs at less than 1% in two samples, Quercus frequencies are more variable, compared to core II, but Alnus values are similar in both cores, Alnus increases in the second half of B10. In both cores, Fraxinus occurs more irregularly from the B9/B10 transition, also, Taxus makes its last appearance in core III at the B9/B10 transition, and is not recorded in core II from this point until it reappears in B12. Corylus/Myrica frequencies remain low but a slight increase is indicted towards the end of the phase. In common with core II, a continuous Salix curve spans the phase, also Sambucus increases. The continuous Ericaceae curve in core II has no parallel in core III, but, in common with core II, Gramineae is reduced in core III. In common with core II, slightly higher Cruciferae frequencies occur and reductions in Plantago lanceolata and Rumex acet are evident in mid B10. Continuous curves for Rosaceae and Hypericum perforatum type span B10 and Urtica increases later in the phase. Total herb and heath pollen declines but frequencies remain comparable with core II. Pteridophyte representation is variable between the cores, higher Pteridium values occur earlier in III and the continuous Filicales curve of III is not seen in II.

Taking all five cores into consideration, it is evident that, in comparison to phase B9, increases in the frequency and diversity of aquatic pollen types occur during B10. At Fenemere, *Hydrocotyle* occurs for the first time in the core during B10, *Myriophyllum* type also occurs for the first time. Compared to the B9/B10 transition at Fenemere, the latter stages of phase B10 are characterised by the more frequent occurrence of *Nuphar*, *Nymphaea*, *Potamogeton* and *Sparganium/Typha*. *Alisma* occurs for the first time. At Marton Pool, a clear reduction in the diversity of aquatic pollen types occurs at the B9/B10 transition. Above this however, *Hydrocotyle* occurs for the first time, *Menyanthes* and *Nuphar* are recorded and *Nymphaea*, *Potamogeton* and *Sparanium/Typha* occur more frequently. A continuous curve for *Sparganium/Typha* spans B10 at Birchgrove Pool and *Alisma* occurs for the first time. *Hydrocotyle* also makes its first appearance in the Berth Pool pollen spectra in B10. In both cores, slight reductions in *Sparganium/Typha* at the B9/B10 transition are followed by the establishment of continuous curves for this type during B10.

It has been suggested above that the clearance of some carr woodland could have led to improved light conditions in some shallow water areas at the pool margins, thus leading to increased colonisation by emergent aquatics such as burr-reed, reedmace and common reed and also floating-leaf taxa such as water lilies. Also, clearance on drier land could have resulted in increased surface and sub-surface water flow to the pool margins (*cf* Lockwood 1983); an enhanced degree of flooding on marginal peats (*cf* Plate 12) could assist colonisation by aquatic vegetation. It has been suggested by Sinker et al (1985) that the shading effect of the surface algal blooms which regularly "break" in the meres (Reynolds 1979) could be responsible for the "surprisingly poor" macrophyte flora in these typically nutrient rich lakes. Reynolds (1979) suggests that the present eutrophic condition of the meres "may have evolved following forest clearance" (1979, 157). If this is so, then enhanced algal productivity could have been a characteristic of the meres during the Bronze Age and Iron Age and could have inhibited macrophyte colonisation of the main water bodies, cleared fen or carr areas at the mere edges could thus have been potentially important habitats for aquatic vegetation.

5.4.1 Inter- and intra-site variation at the Baschurch Pools in phase B10

In terms of its main vegetational characteristics, phase B10 is similar to B8, progressive reductions in the area covered by broad-leaved woodland lead to the more extensive colonisation of the area by more open vegetation communities. Over much of Shropshire, these open communities appear in particular to be characterised by a high production of Gramineae pollen and Pteridium aquilinum spores (cf Beales 1980, 141).

Birch appears to remain as a component of the woodlands of the area, although reductions in Betula frequencies at Fenemere in particular suggest that the abundance of birch is reduced during B10. In the later stages of B10, Betula frequencies are comparable between Fenemere, Marton Pool and Birchgrove Pool, constituting c.5% of the main land pollen sum. The representation of Betula at Berth Pool is markedly lower than at the three other sites, Betula declines to less than 1% in early B10 in core III and was not recorded at all in the count from 160cm in core II. If most of the Betula pollen in B10 at Birchgrove Pool was derived from long distance transport, then at least 5% Betula might be expected at Berth Pool, since this site is larger than Birchgrove. During phases B8 and B9 contrasts in the frequencies of Quercus, Alnus and particularly Pinus between Marton/Fenemere and Birchgrove suggested that the pollen source area of Birchgrove Pool was mainly localised. If the Betula pollen at Birchgrove is derived from more locally growing individuals of birch, then these birch trees do not appear to have had a significant effect upon the Berth Pool pollen spectra. Similarly, the birch pollen sources responsible for Betula frequencies of up to c.7% to 8% at Marton Pool and Fenemere in B10 do not appear to have been important at Berth Pool. The contrasts in Betula frequencies during B10 therefore at least suggest that the dominant pollen source area of Berth Pool has a radius of not more than c.300m and that within this area birch trees were rare or absent.

The clear contrast in Pinus frequencies between the smaller and larger sites persists during B10, continuous curves for Pinus are present at both Fenemere and Marton Pool whilst Pinus is recorded only intermittently at Berth Pool and occurs only at the upper and lower boundaries of B10 at Birchgrove Pool. This inter-site contrast can be interpreted in terms of the variable representation of more distant pollen sources, with the pollen spectra at the larger two sites having a more regional character (Tauber 1965, Jacobson and Bradshaw 1981, Prentice 1985). Some of the Pinus pollen could be derived from more local sources, but Bennett (1984) was only prepared to infer a significant local presence of pine when Pinus pollen exceeded c.20% of total pollen. Pinus pollen is generally held to be abundantly produced and well dispersed (Godwin 1975), although there are some dissenting views (Williams 1985). The Pinus frequencies from B8-B10 at Marton and Fenemere are, however, very similar to those from CMCP8 at Crose Mere, another lake large enough to have a regional character in the pollen spectra (Beales 1980). The contrast in Pinus frequencies between Fenemere/Marton and Birchgrove Pool can also be interpreted as evidence for the independance of the water surface of Birchgrove Pool. Water surface coalescence between Marton Pool and Fenemere has occurred during historical times (local reports) and it is conceivable that, if this had occurred during the prehistoric period Birchgrove Pool might also have been affected by coalescence with the two larger pools. After very heavy rainfall, the ditch linking Birchgrove Pool to Fenemere (Figure 3) has been observed flowing back in the direction of Birchgrove (local report). Pinus pollen is buoyant in water (David and Brubaker 1973) and thus higher Pinus frequencies would be expected at Birchgrove Pool if this site were linked to Marton and Fenemere during the time period of B8-B10.

Ulmus continues to occur in all five cores during B10. Its frequency occasionally reaches c.1-2%, but, generally the indication is that elm is relatively sparse in the woodlands of the Baschurch area. Tilia maintains a continuous curve for most of B10 at Fenemere, it also occurs at c.1-2% in seven of the eleven samples from B10 at Marton Pool. At Berth Pool and Birchgrove Pool, however, Tilia occurs infrequently, and always at less than 1%. Lime appears to have been less common in areas closer to Berth Pool and Birchgrove Pool than it was in the wider region around the four sites. As well as including the predominantly cleared areas around Berth and Birchgrove, the pollen source areas of Marton and Fenemere might also have included some tracts of land which remained completely wooded, or perhaps relatively wide areas where the woodland could be described as being very open. There is some evidence in the pollen spectra from the Baschurch Pools to suggest that, providing neither species was selectively cleared lime would tend to be more abundant in the woodland than elm. The Tilia decline at the B6/B7 transition (Chapter 4) could have been a function of selective clearance; Ulmus is relatively well represented at all sites during B7. The evidence at Marton and Fenemere, and at the latter site in particular, does however suggest that as elm became less abundant in the woodland in late B8 lime tended to become more abundant. Elm could of course have been subjected to selective felling in B9-B10, although there are indications at Marton Pool that a slight increase in the representation of Ulmus pollen occurred in B10. Sinker et al (1985) suggest that in Shropshire today elm tends to have a preference for soils rich in Phosphate and Nitrogen whereas lime often occurs on soils with a more moderate concentration of these nutrients. Amongst the brown earth soil groups of Shropshire, the Baschurch Series brown earths are included in a sub-group with a lower base status (Crompton and Osmond 1954), under agriculture, base depletion of these soils can occur. Given that elm tends to be over-represented in the pollen record, and lime under-represented (Andersen 1970, 1973) the contrast in Ulmus and Tilia representation in B10 at Marton and Fenemere does suggest that lime would be naturally more abundant in the woodland than elm, perhaps particularly if a limited decline in soil base status occurred in association with clearance and farming.

Progressive reductions in Quercus occur during B10 at Marton and Fenemere; frequencies are closely comparable between the two sites but remain higher than those observed at Berth and Birchgrove. This contrast in Quercus frequencies suggests that in the localities of Berth Pool and Birchgrove Pool oak was less abundant than it was, on average, over the whole of the pollen source areas of Marton Pool and Fenemere. As Quercus frequencies are reduced at Marton and Fenemere, Fraxinus frequencies also decline. A tendency for Fraxinus to occur less often as B10 progresses can be detected at Berth Pool. Fraxinus is absent at 160cm in Berth II and at 172cm and 176cm in Berth III. Low Fraxinus frequencies occur in early B10 at Birchgrove, although values tend to increase in the latter stages of the phase. Across the whole of the Baschurch area, therefore, ash trees appear to decrease in abundance, Fagus appears in the pollen record only rarely and at Marton Pool and Fenemere Taxus occurs less frequently in the upper levels of B10. Taxus is recorded in B10 at Birchgrove Pool but occurs only once in Berth II and not at all in Berth III. Beech does not appear to have become a significant component of the prehistoric woodlands of the Baschurch area. Whereas yew could have occurred regularly, at least in the areas around Berth Pool and Birchgrove Pool during phases B2 to B7, it is all but eliminated from the woodlands of the region by the end of B10.

During the first half of B10, Alnus frequencies are substantially higher at Marton Pool, in comparison to Fenemere. Alnus increases in the second half of B10 at Berth Pool and rises towards the end of B10 at Birchgrove pool. In comparative terms, the fringing alder woodland around Marton Pool appears to have been less affected by clearance activity throughout most of B10 than the alder fringe around Fenemere. Little change in the abundance of alder occurs closer to Birchgrove Pool but at Berth Pool a limited re-expansion of alder carr is indicated in B10. Clear reductions in Alnus only occur in the uppermost levels of B10 at Marton Pool. At this time, frequencies become more closely comparable to those at Fenemere. Coryloid pollen reductions are evident at all sites, at the end of B10 Corylus/Myrica frequencies at Fenemere are comparable to those at Birchgrove Pool. Extensive woodland clearance and the creation of farmland would inevitably lead to a reduction in the abundance of understorey hazel. Trends in the Coryloid surves at each of the four sites tend to follow trends in the total tree pollen curves and for this reason most of the Coryloid pollen is believed to be Corylus avellana.

In contrast to its occurrence at the other sites, Salix maintains a continuous curve throughout B10 at Berth Pool, at the three other sites Salix occurs throughout B10 and shows a clear increase in frequency in late B10 at Marton Pool. Many species of Salix occupy damper habitats in Shropshire today although the goat willow, Salix caprea is often found on well drained soils and can have a particular preference for soils formerly subjected to intensive disturbance by man. Given the variety of habitats occupied by Salix spp, however, it is not possible to place precise interpretations on the frequencies of undifferentiated Salix pollen. Hedera occurs regularly during B10 at Fenemere pointing to increased colonisation by ivy as light conditions improve as trees are felled and the woodlands are thinned. Enhanced flowering would also be expected amongst ivy populations already established; pollen dispersal conditions would also improve. Frangula occurs more often in early B10 at Fenemere. Initially, alder buckthorn could have increased in abundance on wetter soils from where it was subsequently cleared. Ilex occurs more frequently in later B10 at Fenemere; Ilex pollen is confined mainly to clearance phases at Fenemere, some holly colonisation could be in evidence although dispersal conditions for the large, entomophilous pollen grain would improve as the woodland was opened. Ilex pollen is not held to be well dispersed by the wind. In combination with the low pollen productivity of holly (Godwin 1975) this is likely to lead to a considerable under-representation of holly in the pollen record of larger lakes. Rhamnus, Crataegus and Lonicera also appear in the pollen record from B10 at Fenemere, generally, the indications are that the shrub flora tends to diversify as clearance progresses although an opening out of the high forest canopy will tend to improve the conditions for flowering and pollen dispersal within the shrub layer. Hedera and Ilex appear less often in the pollen record from B10 at Marton Pool. In common with Fenemere, Frangula and Lonicera appear but, in contrast to Fenemere Sambucus occurs in B10 at Marton. Alnus frequencies are higher at Marton pool than at Fenemere in early B10. It is possible that wider tracts of alder occurred in the vicinity of Marton Pool at this time, causing a higher degree of shrub pollen filtering, affecting ivy pollen dispersal in particular (cf Figure 34).

At Birchgrove Pool, the occurrence of Rhamnus, Crataegus, Lonicera and Sambucus later in B10 could be indicative of a reduction in clearance pressure towards the end of the phase. At Berth Pool, Crataegus occurs more regularly in core III, but in both cores Sambucus frequencies are higher than they are at the three other sites. Sambucus occurs at Birchgrove Pool, but at less than 1%, elder thus appears to have been more abundant closer to Berth Pool. The pollen is assumed to be that of S. nigra since S. ebulus is not thought to be native and is probably a Roman introduction and S. racemosa is, again, not a native species in the Holocene in Britain (Godwin 1975, 336). Excavations at The Berth suggest that it was occupied in at least the mid to late Iron Age (5.6.2). Elder has a preference for enriched soils found in human settlements (Godwin 1975, 336) and in Shropshire today is an excellent indicator of enhanced phosphate and nitrate levels in soils around, for example, farm buildings (Sinker et al 1985). A continuous curve for Sambucus spans most of B10 in Berth II, in both cores, peak Sambucus values of just over 2% of the main sum occur in B10.

Heathland expansion in some areas was suggested by increased Ericaceae representation in B8. Ericaceae pollen continues to be recorded in B10, a limited degree of intra-site frequency variation occurs at Berth Pool, with slightly higher Ericaceae frequencies seen in core II. Initially, relatively high Ericaceae frequencies occur in B10 at Fenemere although these are reduced later in the phase, suggesting that heather was actively cleared as the intensity of land use increased. Compared to Fenemere, Ericaceae occurs less frequently at Marton Pool, possibly because clearance activity encroached closer to the former site in early B10. Ericaceae occurs at c.1-2% in at least some samples in all five cores in B10, given that Ericaceae pollen is relatively poorly dispersed by wind (cf Peck 1973), its persistent occurrence in the pollen spectra from B10 suggests that throughout the Baschurch area genuine increases in heather abundance occurred as a result of the clearances of the first millennium bc.

The tendency for higher grass and weed pollen frequencies to occur at the smaller two sites persists into B10. As in B8, the highest Gramineae frequencies occur at Birchgrove pool. Gramineae frequencies decline slightly in B10 at Berth Pool, but similar frequencies appear in both cores. During the later stages of B10 the Gramineae frequencies at Fenemere equal those in late B10 at Berth Pool. The rises in Gramineae frequency are accompanied at all sites by increases in the frequency and regularity of occurrence of open habitat indicator pollen. Plantago lanceolata frequencies are similar at Marton Pool and Fenemere but slightly higher Rumex acet frequencies occur at Fenemere. Tubuliflorae occurs more frequently at Fenemere, in comparison to Marton, and Liguliflorae frequencies are higher at Fenemere. Artemisia appears more often at Fenemere and Chenopodiaceae and Cruciferae appear regularly in both cores. A continuous curve for Liguliflorae spans most of B10 at Birchgrove and Rumex acet frequencies are consistently high at this site. Plantago lanceolata frequencies are higher at the smaller two pools and, at least in early B10, higher at Birchgrove pool in comparison to Berth Pool. Liguliflorae frequencies continue to be highest at Berth Pool and Berth remains the only site where a continuous Cruciferae curve occurs.

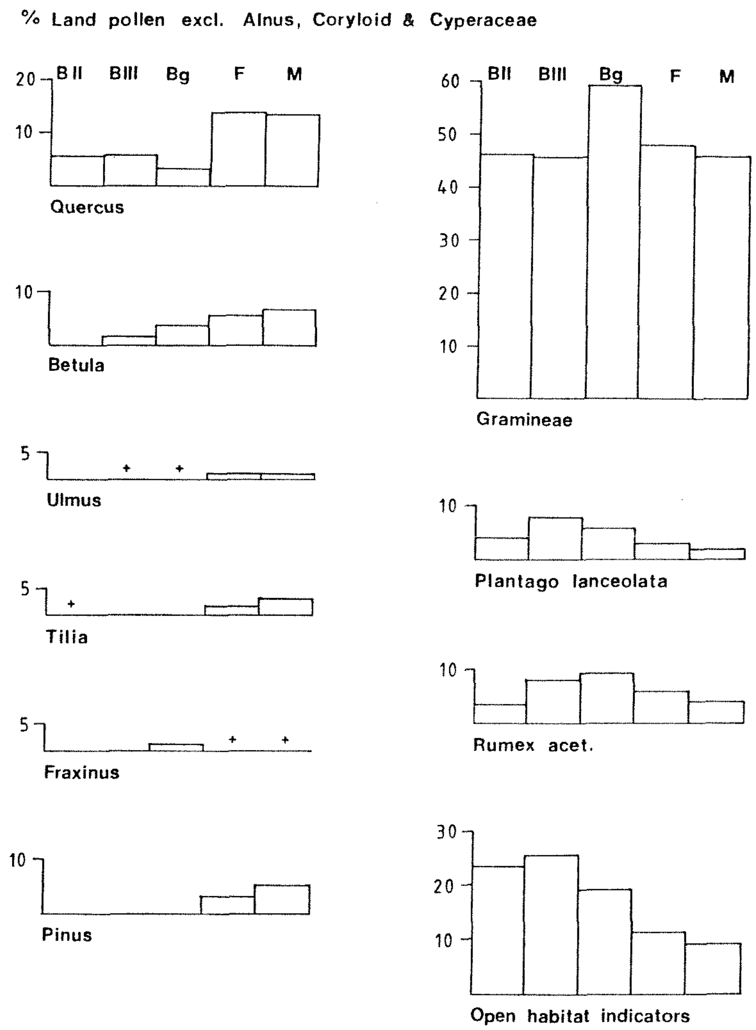
Open habitat indicator frequencies are comparable between both cores form Berth Pool, for example, the slight reductions in Plantago lanceolata and Rumex acet in mid B10 can be traced in both cores. The ratios of dry land trees to open habitat indicators at the horizons of peak Gramineae frequency in B10 are shown in Figure 33. Dry land tree pollen continues to be more abundant than open habitat indicator pollen at Marton and Fenemere, the ratio shifts in favour of open habitat indicators at Birchgrove Pool and at Berth Pool the ratio of trees to clearance indicators is lower than that noted in B8. These ratios could vary within the individual sites (Davis and Brubaker 1973) and suggest that such ratios, when derived from larger sites, are very highly generalised. There is considerable divergence between the ratios from Berth/Birchgrove and Marton/ Fenemere and yet, theoretically, Berth and Birchgrove should be within the pollen source areas of Marton and Fenemere (cf Jacobson and Bradshaw 1981).

If the frequencies of selected tree and herb pollen types are calculated with Alnus removed from the main sum (Figure 29), the higher frequencies of tree pollen at Marton Pool and Fenemere are emphasised and whereas open habitat indicators are more abundant at Berth and Birchgrove, Gramineae values are closely comparable between Berth Pool, Fenemere and Marton Pool.

Cereal (undiff) pollen and Secale pollen occurs during B10 at Birchgrove Pool, Marton Pool and Fenemere and in core II from Berth Pool, only cereal (undiff) occurs in core III.

Arable:Pastoral indexes (Turner 1964a) have been calculated for B10. Given that a trend towards 30% or less can be interpreted as pointing more towards arable argriculture (Turner 1964a, Maguire et al 1983)

Fig 29 B10: Selected Pollen Types

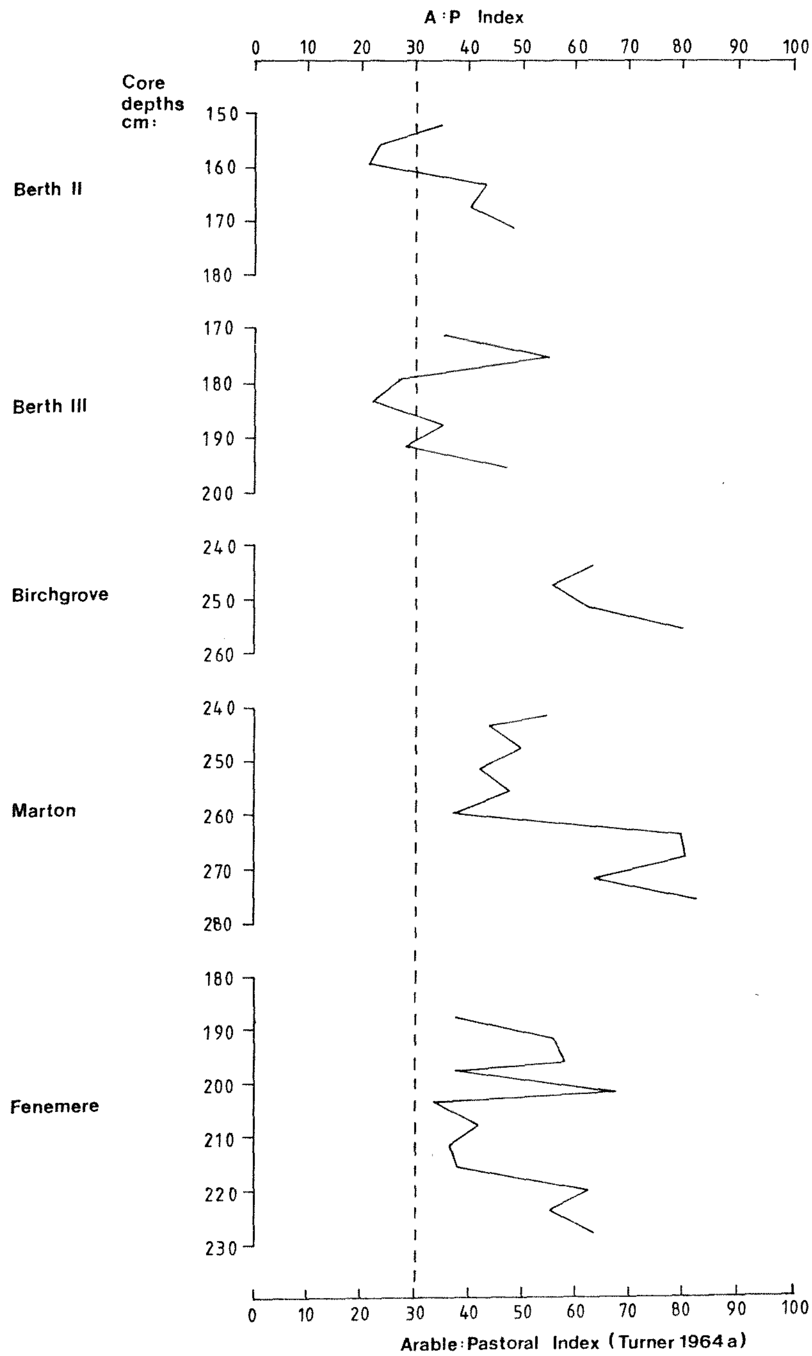


BII	Berth II	160 cm	
BIII	Berth III	196 cm	
Bg	Birchgrove	252 cm	Depths of B10
F	Fenemere	196 cm	Gramineae maximum
M	Marton	244 cm	c 100 bc

there is a considerable degree of variability between the sites in respect of the land use indicated. Evidence already discussed suggests that the pollen source areas of Berth Pool and Birchgrove Pool are relatively limited and therefore the A:P indexes should be less affected by Plantago lanceolata pollen transported relatively long distances to the sites (cf Edwards 1979). The index trends towards 30% or less in both cores from Berth Pool (Figure 30) but remains at c.60% or more at Birchgrove pool. At Marton Pool, the index is reduced in the second half of B10 but is lower in mid B10 at Fenemere. It is possible to suggest that wider tracts of pasture existed closer to Birchgrove Pool than to Berth Pool. It should be noted that higher Gramineae and Pteridium values occur at Birchgrove Pool. At Fenemere, the apparent trend away from lower A:P indexes in later B10 is associated with higher frequencies of Gramineae, Rumex acet and Pteridium, perhaps indicating the establishment of wider areas of grassland. At Marton Pool, however, higher Gramineae Pteridium and Rumex acet values in later B10 are associated with lower A:P indexes. Cereal and Secale occur in horizons with low A:P indexes at Marton Pool and yet at Birchgrove Pool where both Secale and cereal pollen occur in B10, the A:P index is consistently high. The extent to which N.A.P is subject to filtering within any existing woodland belts probably varies from site to site and this will have a bearing on the validity of any A:P indexes.

In general terms, the site to site variations suggest that the open habitat communities were more varied closer to Berth Pool, with Liguliflorae and Cruciferae well represented whilst conceivably areas of rough grazing with some bracken invasion occurred nearer to Birchgrove Pool. At varying times during B10, the evidence suggests that arable farming was practised in the pollen source areas of Marton Pool and Fenemere. Apart from the conventional open habitat indicators, a variety of other herb taxa are represented in the pollen spectra at each of the four sites. The variety and frequency of herb pollen types is more restricted at Marton Pool in comparison to Fenemere. One possible explanation for this is that wider areas of open land existed in closer proximity to Fenemere. Furthermore, clearance activity appears to have occurred at a greater intensity earlier in B10 at Fenemere, compared to Marton Pool. It is interesting to note that whereas the significance of the B9/B10

Fig 30 The Baschurch Pools: Arable:Pastoral Indexes in Phase B10



transition, in palynological terms, is confirmed by the position of numerical zone splits at Fenemere; at Marton Pool zone splits are not made until mid B10. The sand and gravel ridge curving round the south and east of Fenemere could well have been the site of intensive clearance activity in B10. This ridge is separated from the mere by only narrow tracts of peat and thus any fringing alder or willow woodland would only have formed a relatively narrow strip around the mere. The mean Alnus frequency at Marton Pool in B10 is 39.82% (standard deviation = 6.89%), the mean Alnus frequency in B10 at Fenemere is 26.36% (S.D.= 2.76%), the mean frequency at Marton Pool is thus 51.0% higher than the mean for Fenemere. The mean Gramineae frequency for B10 at Fenemere is 29.53% (S.D.= 4.45%), for B10 at Marton it is 20.93% (S.D.= 5.74%); the mean for Fenemere is therefore 41.0% higher than that for Marton. Gramineae (undiff) could include Phragmites, the common reed, but at Fenemere Rumex acet Liguliflorae and Pteridium are consistently higher in B10 in comparison to Marton, herb pollen is also more diverse at Fenemere. Despite the fact that the two sites are both, theoretically, large enough to be dominated by regional pollen (cf Jacobson and Bradshaw 1981) and their proximity is such that the question of water surface coalescence must at least be raised, it is evident that whilst the vegetational history inferred at both sites is essentially similar, the frequencies of certain pollen types clearly vary from site to site and it is possible that more localised pollen sources are more influential at Marton.

Regional pollen might be detectable at Marton but it is debatable as to whether it is dominant (cf Jacobson and Bradshaw 1981, 82).

ZONATION splits are made at the B9/B10 transition at Birchgrove Pool, but the pollen frequency changes are less significant than those which occurred at the B7/B8 and B10/B11 transitions. At Berth Pool, core to core comparisons of the order in which zone splits were made are complicated by the fact that fewer counted levels were present in core III; in core II, changes in pollen content between B8 and B12 are relatively insignificant, compared to other levels in the diagram, for example, the B7/B8 transition. The frequencies of herb pollen types other than those included amongst the conventional open habitat indicators are consistently higher at Berth Pool, in comparison to the other pools. At Berth Pool, continuous curves for Rosaceae, Urtica and Hypericum perforatum type span B10 in both cores, Ranunculaceae is also relatively well represented at Berth Pool. Rosaceae and Urtica occasionally occur at 1-2% at Birchgrove Pool, but Hypericum perforatum type occurs only irregularly and, along with Ranunculaceae, never occurs at or in excess of 1% of the main sum. A wider variety of open habitat thus appears to be present within 100m or so of Berth Pool. Species within the Rosaceae family, for example Potentilla spp are common today on grasslands in Shropshire, including those areas on damper soils. Potentilla spp are often associated with Urtica dioica and Plantago spp (Sinker et al 1985). Amongst the Ranunculaceae, Ranunculus spp are, again often associated with damper soils. Brown earth soils border the northern shore of Birchgrove Pool and it is possible that, in relative terms, drier grassland or arable land occurred closer to Birchgrove than to Berth.

Bracken prefers well drained soils and Pteridium spore frequencies are substantially higher at Birchgrove Pool, in comparison to Berth, although Pteridium frequencies do increase in both cores from Berth Pool during B10. Pteridium frequencies expand during B10 at Marton and Fenemere. At both sites, highest Pteridium frequencies are associated with the highest Gramineae and Rumex acet frequencies and with the lowest tree pollen totals. Bracken could be abundant within more open woodland as well as on tracts of open pasture. Pteridium frequencies tend to be higher at Fenemere than at Marton. Given that Gramineae and herb pollen frequencies tend to be higher at Fenemere it seems possible that bracken is a discriminating indicator of the degree of openness in the vegetation, particularly where the predominance of grassland is indicated. At both Marton Pool and Fenemere Filicales frequencies tend to decline where Pteridium increases. It is possible that other species of fern are failing to compete with bracken where its colonisation is unchecked. The pollen spectra from B10 suggest that, for the "region" as a whole, clearance activity was more extensive in B10, compared to B8; maximum clearance activity, averaged over the widest possible pollen source area, occurred late in B10, c.100 to 200bc. In the uppermost horizons of B10 at Marton Pool and Fenemere distinct peaks in Rumex acet pollen occur. In both cores the Rumex acet peaks occur in the samples immediately above the peak Gramineae values. In the samples immediately above the Rumex acet peaks in both cores palynological evidence for the onset of woodland regeneration is seen. Rumex acetosella and Rumex acetosa are tolerant of at least fairly heavy grazing and Rumex acetosa competes well with grass species (Sinker et al 1985). The Rumex peak is obviously not simply a random fluctuation, confined to one core. Its stratigraphic position, in between levels with peak Gramineae values and levels with evidence for woodland regeneration, suggests that it could reflect a short vegetational phase where grazing pressure was lifted and enhanced flowering of Rumex spp occurred as more plants grew to the flowering stage without being grazed.

Land abandonment at the end of B10 appears, in relative terms, to have been rapid rather than gradual. The inter-site pollen frequency contrasts during B10 at the Baschurch Pools could be interpreted as suggesting that clearance activity was concentrated on land around the western and southern sides of the group as a whole, perhaps with some more land to the north of Marton Pool subject to widespread clearance only late in the phase. At the largest site, Fenemere, total tree pollen declines to its lowest level, c.36% of total determinable land pollen, at 196cm, or c.120bc (Figure 9). This represents the last sample in which Tilia occurs at 1% or more, Quercus and Betula frequencies are low and Ulmus and Fraxinus occur at less than 1%. At least some Pinus pollen could be derived from pines growing on bogs some distance from the pools, but most of the Alnus pollen is probably derived from fringing alder stands around the pools. The open conditions would favour the production and dispersal of pollen from the remaining trees whilst fringing trees around the pools would tend to filter out N.A.P (Tauber 1965, Vuorela 1973, Caseldine 1981). In reality, woodland cover on the drier well drained soils in the Baschurch area could well have been reduced to 10% or less in the latter stages of B10.

Before the full significance of B10 is assessed it is necessary to examine the pollen spectra from Boreatton Moss and to compare these spectra with those from the Baschurch Pools. Phases B8 to B10 are defined at Boreatton Moss on the basis of biostratigraphic correlations with the Baschurch Pools. On biostratigraphic grounds alone, however, it is not possible to confidently separate phases B8, B9 and B10 at

Boreatton Moss. Furthermore, a suggested division cannot be made on chronological grounds since only two adjacent radiocarbon dates are available at Boreatton. Only upper and lower dates for B8 to B10 are suggested at Boreatton Moss, these are based on biostratigraphic similarities to the Baschurch Pools.

5.5 Post 800bc clearance expansion at Boreatton Moss

The transition between phases B7 and B8 is identified at c.138cm at the centre of Boreatton Moss, and c.162cm at the margin. Taking both cores together, only 12-14 samples are assigned to phases B8-B10 at Boreatton Moss, compared to c.75 samples at the Baschurch Pools. The positioning of numerical zone splits at Boreatton Moss shows that, in both cores, a complex series of pollen frequency fluctuations are contained within the series of levels assigned to B8 to B10. Intra-site comparisons of pollen frequencies at Boreatton, and comparisons with the Baschurch Pools are therefore generalised, and based on the main trends in frequency changes.

5.5.1 Main characteristics (Moss centre)

Betula frequencies are initially unaffected, but decline above 132cm. Low *Ulmus* frequencies occur in the central part of the collective phase. *Quercus* declines sharply at the onset of B8-B10, minimum *Quercus* values occur late in the phase. *Tilia* frequencies are low, but this type occurs more often in B8-B10, in comparison to B7. *Alnus* and *Fraxinus* decline, *Fagus* is recorded only twice, at less than 1%. *Corylus/Myrica* values are reduced and *Hedera* and *Ilex* occur less frequently. Gramineae and open habitat indicator frequencies increase and cereal pollen occurs. Apart from the conventional open habitat indicators, other herb pollen types increase in frequency and diversity. Total herb and heath pollen increases to over 50% of total determinable land pollen. *Pteridium* reaches its highest frequencies on the diagram. Cyperaceae, *Hydrocotyle* and *Sphagnum* frequencies increase at the onset of B8-B10 and decline at the end of the phase.

5.5.2 Main characteristics (Moss margin)

The onset of this phase at the margin is less straightforward to define, but is thought to be marked by the slight Gramineae rise at 162cm. *Betula* increases initially but declines at 154cm to 156cm. A continuous *Ulmus* curve spans the phase and *Tilia* occurs at 1-2% for the first time since B5. *Quercus* reaches a minimum in the later part of the collective phase; *Alnus* and *Fraxinus* are also reduced.

Corylus/Myrica declines and Hedera is absent from the upper horizons of the phase. Gramineae increases and an increase in cereal pollen is associated with the initial Gramineae rise at 162cm. Apart from Plantago lanceolata, open habitat indicator frequencies tend to be lower at the margin. The Plantago lanceolata peak at the margin at 154cm is thought to correlate to the peak at 130cm at the centre; in both cores, declines in Rumex are associated with the Plantago peaks. The diversity of other herb types is lower at the margin. Reductions in total tree pollen are less clear at the margin but in common with the central core Pteridium rises during early B8-B10 at the margin. In both cores the peaks in Pteridium occur in samples below the Gramineae peaks. Cyperaceae and Sphagnum increase in frequency but Hydrocotyle is absent.

5.5.3 Phases B8 to B10: Intra-site contrasts at Boreatton Moss

Increases in the frequencies of Cyperaceae, Scheuchzeria, Hydrocotyle and Sphagnum were associated with evidence for increased clearance activity during phase B5 at Boreatton Moss. Frequencies of Hydrocotyle and Scheuchzeria were lower at the margin but, together, these increases in wetland pollen and spore types were interpreted as showing that water runoff to the moss had increased when woodland was cleared in the catchment area of the site (Chapter 3). During B8-B10, increases in the frequencies of wetland pollen and spore types are again associated with pollen evidence for increased clearance activity in the area. Scheuchzeria does not occur in B8-B10 in either core, but it is interesting to note that Hydrocotyle is present in the central core and absent at the margin. Hydrocotyle vulgaris, marsh pennywort, is typically a mesotrophic marsh species in Shropshire today (Sinker et al 1985) and occurs, for example in the mesotrophic mire communities on Brown Moss (Sinker 1962). During B8-B10, marsh pennywort appears to have increased in abundance at the centre of the moss but not at the margin, this could be because the moss had a concave profile and hence runoff would be concentrated towards the centre of the moss.

Contrasts are seen between margin and centre in respect of arboreal pollen representation. Ulmus, Quercus and Fraxinus frequencies are higher at the margin. The Alnus minima are comparable between the cores. The marginal core site is only 22m from the western edge of the moss (Figure 3) and should therefore be more representative than the central core of the vegetation communities on the dry soils at the western side of the moss (cf Edwards 1982). Although, in general, woodland clearance around Boreatton Moss appears to be more extensive in B8-B10, compared to earlier phases, arboreal pollen frequency contrasts between the edge and centre of the moss suggest that a fringing belt of woodland may have remained in position around the moss (cf Caseldine 1981). Elm, oak, ash and probably lime could have continued to grow on the slopes around the moss and contributed more pollen to the marginal core site than to the central core site. The Alnus reductions in both cores point to the clearance of alder woodland on damper soils. Boreatton Moss is entirely surrounded by several square kilometres of well drained brown earth soils (Figure 5) and by the end of B8-B10 the low arboreal pollen frequencies suggest that these soils were predominantly clear of woodland. Damper brown earths adjacent to the moss could have been cleared in places but around parts of the moss some broadleaved trees, including alder, could have continued to provide a localised source for arboreal pollen. Pinus pollen occurs at c.2% in one sample in the marginal core, but in the central core Pinus occurs intermittently in B8-B10 and always at less than 1% of the main sum. Boreatton Moss is, at 7.1ha, large enough to receive a significant proportion of its pollen from regional sources, assuming it remained largely clear of trees during B8-B10 (cf Jacobson and Bradshaw 1981). A phase equivalent to B9 has not been separately identified at Boreatton Moss, however, a reduction in Gramineae occurs at 134cm at the centre, where Quercus temporarily increases; Pinus occurs at less than 1% in B8-B10 at the centre of the moss; details of the raw pollen count for Pinus are as follows :-

cm	Main pollen sum	Pinus	Phase
124	296	-	(B8-B10)
126	288	1	
128	388	1	
130	294	-	
132	333	2	
134	386	3	? B9
136	293	-	
138	317	2	

Precise correlation between the edge and centre of the moss is problematic. It is not known if the Pinus rise at 160cm at the margin relates to the slight Pinus increase at the centre. The highest Pinus frequencies in B8-B10 at Marton and Fenemere occur in B9 and it is possible that a weak regional pollen signal is being picked up at Boreatton and that 134cm does approximate to B9. The contrast between Boreatton Moss, Marton Pool and Fenemere, in respect of Pinus representation, will be examined in 5.5.4. The low Pinus frequencies in both cores, however, suggest that, at Boreatton no significant local source of Pinus pollen existed on the western edge of the moss or on the moss itself, although pollen productivity amongst pines growing on peat is not necessarily high (Bennet 1984). In the early stages of B8-B10, Coryloid pollen frequencies are higher at the margin. In both cores, however, frequencies are reduced to c.20% in the later part of B8-B10. Salix occurs slightly more often in the marginal core. Locally, some willow expansion could have occurred, possibly on damper soils from where alder was removed. Willow could, however, be severely under-represented in the pollen record (Vuorela 1973). Willow occurs in woodland tracts around Berth Pool today, but Salix pollen occurred at less than 1% in a pollen sample from the mud water interface of the sediment. Hedera occurs less often during B8-B10, this could simply reflect a reduction in suitable habitats for ivy as woodland is progressively cleared. Crataegus consistently appears during clearance phases. The pollen type has not been assigned to one species, although it could refer to the hawthorn, Crataegus monogyna a species which can be resistant to grazing pressure once established in pasture (Sinker et al 1985).

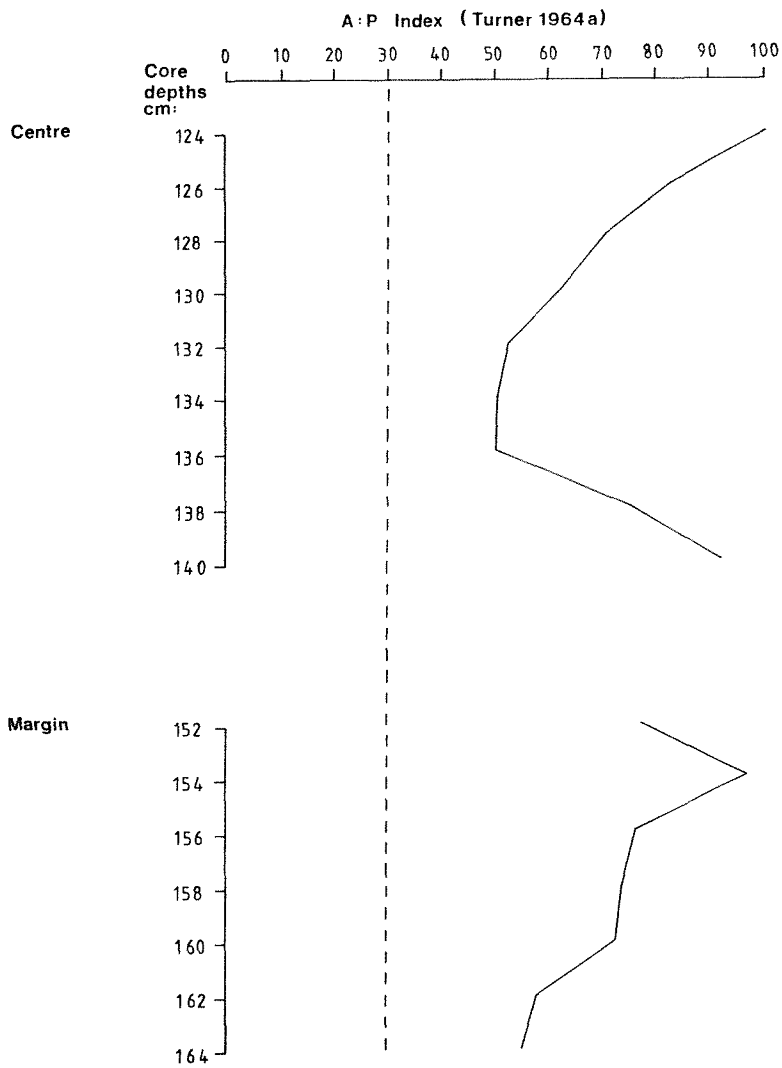
Ericaceae occurs more regularly in the central core, although the small peak late in B8-B10 at the margin has no parallel in the central core. Ericaceous taxa occur on Boreatton today and so its pollen could be derived from both terrestrial and mire habitats and for this reason it is eliminated from the main pollen sum at Boreatton.

Gramineae frequencies tend to be higher at the centre of the moss. The onset of B8-B10 has been identified at 162cm at the margin of Boreatton and 138cm at the centre. In part, this is based on the assumption that the two Gramineae peaks at 166cm and 172cm correspond to the peaks at 144-146cm and 154cm at the centre; given its position in the stratigraphic sequence the peak at 162cm at the margin is thus assumed to correlate to the initial B8-B10 peak at 136cm at the centre. In the earlier part of the phase, clearance activity could have been more extensive further away from the moss; the central core would be expected to be more representative of more distant clearances than the marginal core (cf Turner 1975). In both cores, assuming the proposed correlation is correct, the initial Gramineae rise is followed by a decline before frequencies increase to a maximum. At the Gramineae maxima peak values are higher at the centre and in both cores a steep decline in Gramineae values occurs at the end of B8-B10. Increases in the representation of open habitat indicators are associated with the Gramineae increases in both cores. Higher cereal values occur at the margin at the onset of B8-B10. Some crop growing could have occurred relatively close to the moss in early B8-B10, and the poor dispersal of cereal pollen (Vuorela 1973) could lead to its comparative over-representation in cores closer to the edges of peat mosses. During phase B5, however, frequencies of cereal (undiff) pollen were comparable between the edge and centre of the moss. Slightly higher Secale frequencies occurred at the centre in B5 but Secale pollen is relatively well dispersed by wind (Godwin 1975) and might thus be expected to occur in higher frequencies at the centre of a moss if clearance were more widespread away from the immediate margins of the site. Tubuliflorae, and in later B8-B10, Liguliflorae occur at higher frequencies in the central core. Artemisia and Chenopodiaceae occur more often in the central core, and Cruciferae occurs only in the central core. During early B8-B10, Plantago lanceolata values are comparable between the two cores but the Plantago peak of mid to late B8-B10 is more pronounced in the marginal core. Plantago media/major occurs in mid B8-B10 in both cores and Rumex acet values are slightly higher in the central core. Urtica occurs in both cores, as does Caryophyllaceae, but Campanulaceae and Labiatae occur only at the centre. Leguminosae occurs more frequently at the centre, although it is associated with the first Gramineae peak of B8-B10 at the margin. Polygonum bistorta is recorded only in the centre and Rosaceae is present in late B8-B10 at the centre but not at the margin. Ranunculaceae appears in both cores, but Rubiaceae only in the centre, Umbelliferae appears to occur less often at the margin and Hypericum perforatum type appears only at the centre.

It could be argued that the above contrasts are somewhat artificial since B8-B10 includes fewer counted levels at the margin. Six levels are assigned to B8-B10 at the margin and seven at the centre. It has already been suggested that some tracts of uncleared woodland might have persisted around the margins of the moss, this woodland could have a strong filtering effect on more locally derived N.A.P but would have less of an effect upon N.A.P present in above canopy airstreams (cf Caseldine 1981). The contrasts between edge and centre, in terms of herb pollen representation can be interpreted as confirming the view of Caseldine (1981,23) that more pollen could be transferred to sites surrounded by woodland in the "above canopy" component than Tauber's (1965) model would suggest. Arable:Pastoral indexes have been calculated for the N.A.P spectra (Turner 1964a). The indications are that the mode of land use was predominantly pastoral (Figure 31) although the excellent dispersal of Plantago pollen (Caseldine 1981) could, in theory, lead to the erroneous inference of pastoralism (Edwards 1979); plantain could be present within arable fields left temporarily fallow (Behre 1981). Areas could well have been cleared and farmed in relatively close proximity to the moss but the general picture appears to be one of extensive clearances at some distance from the moss with more restricted clearances closer to it. Clearance activity perhaps encroached closer to the moss later in B8-B10. A localised source of Plantago lanceolata pollen appears to have existed at the margin late in the combined phase.

In both cores, the highest Gramineae values are associated with reduced Pteridium frequencies. There are some indications in the frequencies of cereal and open habitat indicator pollen that a change in land use occurred prior to the appearance of maximum Gramineae frequencies. This land use change could have involved the removal of bracken from open areas which it had colonised. At 132cm at the centre of the moss Tubuliflorae, Rumex acet and Pteridium are present at relatively high frequencies. Plantago lanceolata is moderately high and cereal pollen and Liguliflorae occur at less than 1%. At

Fig 31 Boreatton Moss: Arable:Pastoral Indexes in Phases B8 to B10



130cm, however, cereal pollen occurs at 1%, Tubuliflorae declines to less than 1%, Liguliflorae peaks at 5.1%, Plantago lanceolata reaches a peak, Rumex acet temporarily ceases to be recorded and Pteridium declines. At 154cm at the margin a peak in Plantago is associated with a decline in Pteridium. A change in the character of the herbaceous communities appears to have occurred, with taxa within the daisy family, docks or sorrels and bracken reduced in abundance as plantain and probably Taraxacum spp, dandelions, become more abundant. One possible explanation for this apparent species change could be the replacement of more marginal pasture, with lower grazing pressure, by more intensively grazed land and some arable fields. A relatively coarse inorganic fraction was noted in the peat between 134cm and 138cm at the centre of the moss. In addition to sand particles, small gravel-sized particles occurred at 130cm and 132cm. Only a slight inorganic fraction was noted at 128cm, and no inorganic fraction noted at 126cm. A slight inorganic fraction was also noted in samples from B8-B10 in the marginal core. A coarser inorganic fraction is therefore associated, in the central core, with palynological evidence for a change in the character of land use. In both cores, the highest Sphagnum spore frequencies are associated with the Plantago peaks. The indications are therefore that fairly intensive land use occurred in late B8-B10, involving at least some areas on the slopes leading down to the moss basin itself. An enhanced degree of waterlogging of the moss surface could also be in evidence.

Relatively sharp reductions in herb pollen percentages occur in the latter stages of B8-B10. At 126cm at the centre detectable increases in Betula, Ulmus, Quercus, Alnus and Fraxinus occur and at 124cm total tree pollen amounts to just over 50% of total determinable land pollen. If the designation of phases B8-B10 at Boreatton Moss is correct, then it appears that the peat has accumulated at a rate of c.10-12cm over perhaps 700 to 800 radiocarbon years, an accumulation rate of around 70 radiocarbon years per centimetre, a relatively slow rate (Walker 1970). Given the evidence for inorganic inwashing into the peat, it could be argued that contrasts in pollen frequencies between the edge and centre of the moss should not be viewed as being wholly a function of variations in aerial input since pollen could also have been washed across the surface of the moss. If the higher Tubuliflorae, Liguliflorae and Rumex acet values and the more diverse representation of other herb pollen types in the central core were due to inwashing of pollen from soils around the moss, then higher frequencies of these herb types might be expected to appear in the marginal core, since this part of the moss would also be exposed to pollen inwashing. Some uncertainty surrounds the question of the extent of surface-washing of pollen at Boreatton Moss. The contrasts between the two cores in B8-B10 however suggest that a higher proportion of arboreal pollen arrived at the marginal core site whilst the relative frequency and diversity of herb pollen increased at the central core site. Caseldine (1981) suggested that up to half the Gramineae pollen reaching the centre of Bankhead Moss, which is 150m x 80m compared to the 200m x 400m of Boreatton, had been transported above the canopy. The higher Gramineae frequencies at the centre of Boreatton, particularly early in B8-B10 suggest that the central core had a wider pollen source area than the marginal core. The occurrence of cereal pollen at 1-2% at the margin in early B8-B10 has no parallel at the centre. In this case, the marginal core could be more representative of a localised, possibly small clearance whilst the central core is more representative of areas beyond the immediate margin of the moss (Turner 1964b,1975; Caseldine 1981; Edwards 1982).

Although relatively few samples derive from B8-B10 at Boreatton Moss similarities between this site and the Baschurch Pools are detectable and allow estimates of the extent of the main pollen source area at Boreatton to be made.

5.5.4 Phases B8 to B10: Inter-site comparisons between Boreatton Moss and the Baschurch Pools

Although phases B8-B10 are not separately defined at Boreatton Moss it is considered possible that the initial Gramineae increases, at 138cm and 162cm at the centre and margin respectively, correlate to phase B8 at the Baschurch Pools. The Gramineae reductions at 134cm at the centre and 160cm at the margin have parallels with the Gramineae reductions of B9 at the Baschurch Pools and the Gramineae maxima at 128cm and 156cm at the centre and margin of Boreatton are thought to correlate to the B10 Gramineae maxima at the pools. Boreatton Moss is similar in size to Marton Pool and Fenemere today although in the past the water surface areas of these two pools could have been larger. Devoid of a tree cover, a moss the size of Boreatton, c.7.1ha, should have a pollen source area of at least several hundred metres in diameter (Jacobson and Bradshaw 1981). Theoretically, regional or far-travelled pollen should be well represented at the centre of the moss. Birch is common on the surface of Boreatton today and if any tree cover had been present on the moss in B8 to B10 this would probably have included birch. The reductions in Betula frequencies in B8 to B10 are however similar to the reductions in Betula recorded at Marton Pool and Fenemere. Betula declines to c.4% in B10 at Marton and Fenemere and c.3% at the centre of Boreatton Moss. Betula declines to c.4% in the marginal core at Boreatton. If birch encroachment onto Boreatton had been significant in B8-B10 then higher Betula frequencies would have been expected, particularly in the marginal core (cf Caseldine 1981).

Reductions in Quercus are also comparable between Boreatton and the larger two meres; initially, Quercus is reduced from c.30 to 40% down to c.15-20% and finally to c.10% at the centre of Boreatton Moss. The registration of this regional Quercus decline appears to be delayed at the margin of Boreatton (cf Edwards 1982, 12). Tilia increases were in evidence from late B8 until late B10 at Marton and Fenemere and it is interesting to note that at Boreatton (centre) Tilia occurs more frequently in B8-B10 in comparison with B6 and B7. Fraxinus frequencies decline progressively in early B8-B10 at the centre of Boreatton. Fraxinus values are lowest where Gramineae values are highest. At Marton and Fenemere Fraxinus representation is also progressively reduced, particularly in B10 where Fraxinus declines to less than 1% at Fenemere in association with maximum Gramineae frequencies. Reductions in Alnus are slightly greater at Boreatton Moss in comparison to Marton and Fenemere. Alnus declines to c.20% at Fenemere in B10 and c.15% in both cores from Boreatton in late B8-B10. In contrast to the soil pattern around the Baschurch pools, brown earths continue right up to the margin of Boreatton Moss. The moss surface itself lies at 87m above sea level but within c.30m of most of the moss margin the land rises to 90m and within 50m of the western side of the moss, to 95m. Apart from a small area at the north western edge of the moss, well drained, cultivatable soils occur in relatively close proximity to the whole site. As clearance activity increased in intensity the fringing woodland around Boreatton could well have been more restricted, and with less alder, than that which could be inferred for the margins of Fenemere and Marton Pool. Although Ericaceae pollen is eliminated from the main pollen sum at Boreatton but included at the Baschurch Pools, its frequencies at the pools are very low and its elimination from the main sum at the pools would have very little effect on the relative frequencies of other pollen types. Similarly, if Ericaceae were included in the main sum at Boreatton it would have little effect on the other pollen frequencies during B8-B10. Total tree pollen declines to c.20% in late B8-B10 at Boreatton. This compares to c.15% in B10 at Birchgrove Pool and c.25% at Berth Pool. In contrast to the Pools, Coryloid frequencies are higher at Boreatton Moss. Some Myrica gale could have been present at Boreatton but another possible cause for the higher Coryloid values at Boreatton could be the presence of a denser shrub understorey within any fringing woodland around the site. Hazel occupies damp to dry soils in Shropshire today (Sinker et al 1985) and its presence amongst remaining broad-leaved trees around Boreatton could have had a significant effect upon the lateral transfer of herb pollen from cleared areas to the moss surface. Woodland with a dense understorey can have a substantial filtering effect on all pollen types, particularly N.A.P (Vuorela 1973). The precise character of the fringing woodland around a site is difficult to assess when only one or two cores are available from the site, different woodland patterns could produce similar pollen spectra (cf Oldfield 1970). It could be suggested however that a discontinuous tree belt perhaps including one or two larger tracts of carr woodland would give a tree pollen total of c.20% but would have a less significant effect upon N.A.P transfer than a continuous, if restricted woodland fringe with a well-developed shrub understorey.

Tree pollen totals are clearly comparable between Boreatton Moss, Berth Pool and Birchgrove Pool but non-arboreal pollen types are more diverse at the smaller two pools. Generally, N.A.P frequencies are also higher at the pools although the high Gramineae and *Plantago* values at Boreatton confirm these two pollen types as being among the most abundantly produced and efficiently dispersed N.A.P types (*cf* Edwards 1979, Caseldine 1981, Tinsley and Smith 1974). Contrasts between the edge and centre of Boreatton Moss in B8-B10 suggested that the central core was deriving pollen from a wider area than the marginal core (5.5.3). Given the size of Boreatton Moss, this wider area should be comparable in its extent to the pollen source area of at least Marton Pool if not the larger Fenemere.

The continuous *Pinus* pollen curves which span phases B8 to B10 at Marton and Fenemere have no parallels at Boreatton Moss. *Pinus* reaches peak values for B8 to B10 at Marton and Fenemere in late B9, In the central core from Boreatton Moss *Pinus* occurs intermittently, and at less than 1%. *Pinus* pollen is normally regarded as being freely produced and widely dispersed (Godwin 1975, Bennet 1984, Bradshaw and Webb 1985) although Williams (1985, 41) disputes this view. Pollen diagrams from Crose Mere (Beales 1980),Whixall Moss (Turner 1964a, 1965) and Wem Moss (Slater 1972) all exhibit continuous curves for *Pinus* pollen during phases believed to be equivalent to B8-B10 (Figure 19). The inter-site variability in *Pinus* frequencies between Boreatton Moss and Marton/Fenemere could be explained in terms of the existence of a very restricted or negligible open area on the surface of Boreatton Moss (*cf* Jacobson and Bradshaw 1981). Boreatton could have been acting as a "small" site. *Pinus* pollen carried in the above-canopy regional air streams would thus overshoot any small open areas on the moss surface (Tauber 1965, 1967). *Betula* frequencies, particularly at the margin of the moss appear to be too low to immediately suggest that birch had encroached onto the moss surface (*cf* Caseldine 1981). Alder has colonised the peat surface of New Pool (Plates 3 and 4) and some of the *Alnus* pollen at Boreatton could be derived from trees growing out onto the moss surface. The intra-site contrasts in arboreal and non-arboreal pollen frequencies at Boreatton do however suggest that above-canopy airstreams were depositing some pollen in the central part of the site. The contrasts in *Pinus* frequencies between Boreatton and Marton/Fenemere could point to a more localised origin for the above-canopy pollen arriving at the moss. Jacobson and Bradshaw (1981, 82) suggest that regional pollen derived from rainout and above-canopy airstreams will predominate at sites in excess of c.5ha in extent. The partial encroachment of trees around the perimeter of the peat surface of Boreatton could have restricted the open area towards the centre of the moss to less than 5ha, whereas in the past the water surfaces of Marton Pool and Fenemere could have been slightly larger. The peat at Boreatton today extends to c.7.1ha; humification contrasts between the central and marginal cores during phase B5 (Chapter 3) suggest that, in relative terms, the degree of waterlogging was less at the margin of the moss. The marginal zones of meres and mosses in Shropshire today are colonised by alder, willow and birch (Sinker 1962, Sinker et al 1985) and if trees had encroached only 30m out from the margin of the moss this would have had the effect of reducing the open area on the moss to c.4ha.

At Boreatton, a phase equivalent to B9 is not immediately identifiable although the short lived Gramineae decrease at 134cm at the centre is associated with a temporary rise in Quercus. At the Baschurch Pools, the reduction in clearance intensity c.500bc is most clearly marked at Marton Pool and Fenemere, less marked at Birchgrove Pool and barely identifiable at Berth Pool. It is considered possible that in the middle phase of the first millennium bc a temporary shift in the focus of land use occurred involving a move away from the lower-lying cleared areas. At Marton Pool and Fenemere Sphagnum spores appear more frequently from late B8 onwards; increased runoff during phases of clearance activity could have resulted in increased waterlogging of the peats in between Marton, Fenemere and Birchgrove although at Marton Pool Sphagnum is recorded at 1-2% in two levels from late B9 and early B10 when the intensity of clearance was low and when the diversity of aquatic pollen types was reduced. Macro-fossil evidence from raised bogs and other peatlands in Britain suggests that deteriorations in climate occurred during the first millennium bc (Godwin 1975, Simmons and Tooley 1981). Sphagnum increases in frequency in mid CMCP8 at Crose Mere, levels thought to be equivalent to B9, hydrological changes, perhaps associated with attempts at drainage are suggested by Beales (1980, 152) as possible causes for the Sphagnum spore rise. Unhumified peat above a recurrence surface at Chat Moss (Figure 1) has a date of 2645$\pm$100bp (Q-683). One consequence of climatic deterioration could be a shift in land use away from the damper low lying soils around the meres (Beales 1980, 156). The Baschurch Pools lie on the edge of a belt of brown earth soils, wide tracts of gley soils border this belt to the east (Figure 5). Land closer to Berth Pool and Birchgrove Pool is a higher elevation than that closer to Marton and Fenemere; Boreatton, surrounded entirely by brown earth soils stands at a higher elevation than the Baschurch Pools (Figure 3). Any increases in rainfall in the area during the first millennium bc could have resulted in soils closer to the extensive peat margins around Marton and Fenemere becoming waterlogged, whilst soils on the slightly higher sand and gravel ridges closer to Berth Pool and Birchgrove Pool and around Boreatton Moss remained relatively well drained.

During phase B10, increased anthropogenic impact could have resulted in some wetter soils being re-cleared of regenerated woodland. Uncertainty will surround attempts to relate changes in human impact in the prehistoric period to climatic effects (Bradley 1978). The variations in the intensity of land use in the Baschurch area c.500bc need not be related to climatic effects at all. The possibility is, however, considered to be worth noting since the indications are that reductions in clearance intensity c.500bc are less evident at the sites closer to the higher areas of sand and gravel.

After c.500bc, however, the pollen evidence from Marton Pool, Fenemere and Birchgrove Pool points to a further expansion in the area of cleared land. A rise in *Alnus* at Berth Pool has the effect of reducing relative herb and heath pollen totals during B10. The Gramineae peaks at 128cm at the centre and 156cm at the margin of Boreatton Moss are believed to correlate to the B10 herb maxima and arboreal pollen minima at Birchgrove, Fenemere and Marton Pool. The date of peak clearance intensity around Boreatton Moss is thus thought to be c.100bc. At Boreatton, arboreal pollen increases can be seen at 126cm at the centre, immediately above the Gramineae peak. At Marton Pool, arboreal pollen increases occur at 242cm, immediately above the B10 Gramineae peak. Compared to the duration of phase B10, thought to be c.350 radiocarbon years, the time period over which land abandonment occurred appears to have been relatively short. At Fenemere the age/depth profile suggests c.50bc as the time of land abandonment. Assuming the biostratigraphic correlations between the five sites in the Baschurch area are correct, the pollen evidence marks B10 as the phase of prehistoric land use where the widest area of land was cleared and farmed. Taking all five sites together, and allowing for some local over-representation of *Alnus* pollen, the area still under woodland in the vicinity of Baschurch in late B10 can be estimated at no more than 10-20% of the whole area, possibly with some parcels of land completely open whilst some broadleaved woodland remained uncleared on poorly drained soils or in areas peripheral to any settlement foci.

5.5.5 Magnetic measurements

5.5.5.1 Fenemere

χ, ARM and SIRM remain low, although values are slightly increased in comparison to B9 (Figure 22). χfd measurements are unreliable, but ARM/χ and SIRM/χ remain low, SIRM/ARM declines at the level of maximum clearance expansion. Reverse field ratios denote a comparatively hard magnetic response, although IRM_{-100mT} and IRM_{-200mT} show a slightly "softer" response at 198-200cm; the Gramineae peak at Fenemere occurs at 196-198cm. The coercivity curve for the sample from 198-200m shows that a magnetic remanence continues to be retained at comparatively high reverse fields (Figure 26). The coercivity of remanence for the sample from B10, 36mT, is the highest for the four samples from Fenemere for which coercivity profiles are presented, a harder iron mineralogy is indicated (*cf* Oldfield et al 1985a) compared to the samples from B6, B7 and B9, although the coercivity of remanence is not as high as that for the sediment from B9 at Berth Pool, 42mT (Figure 25). Samples from B10 plot to the lower left of a graph of χ versus SIRM (Figure 23) and to the lower left of the plot of SIRM/χ against 'S' (Figure 24) although the sample from 198-200m has a lower 'S' ratio than the other two samples from B10.

In combination the mineral magnetic measurements point to the inwashing of, mainly, magnetically hard antiferromagnetic minerals into the lake sediment (Oldfield et al 1985a, Hirons and Thompson 1986). Peak non-arboreal pollen frequencies at Fenemere occur between 196cm and 198cm. The magnetics sample from 198cm to 200cm differs from the other two samples in that it is characterised by slightly higher χ, ARM and SIRM values, higher ARM/χ, and SIRM/χ ratios and lower SIRM/ARM. High reverse field ratios show a "softer" response at 198cm to 200cm, but IRM_{-40mT} increases, this could point to a limited amount of topsoil erosion, particularly given the slight increase in χ (Oldfield et al 1985a). Substrate iron mineral sources are thus still in evidence in B10, but limited concentrations of topsoil minerals are also indicated.

5.5.5.2 Berth Pool

Two samples are assigned to B10, 160 to 162cm and 164 to 166cm. ARM is reduced, in comparison to B9 but χ and SIRM increase slightly at 160 to 162cm. χfd is low, ARM/χ is initially low but increases sharply at 160 to 162cm, SIRM/χ remains low but SIRM/ARM continues to increase. IRM_{-20mT}, IRM_{-40mT} and IRM_{-100mT} or 'S', all increase IRM_{-200mT} increases very slightly at 160-162cm but values for B10 are comparatively high (Figure 21). Samples from B10 plot to the lower left of a graph of χ versus SIRM (Figure 23) and, due to their low 'S' ratios, to the left of samples from B9 on a plot of SIRM/χ versus 'S' (Figure 24). Inwashing of haematite -rich sediment is indicated. This would be derived from the Triassic parent material (Oldfield et al 1985a, Smith 1985). Sub-soil erosion thus appears to continue during B10; the reverse field ratios and plotting positions in Figures 23 and 24 point to the presence of antiferromagnetic minerals, such as haematite (Oldfield et al 1985a, Thompson and Oldfield 1986, Hirons and Thompson 1986). Neither Berth Pool nor Fenemere are believed to have had inflow streams during the prehistoric period and therefore the sources of substrate iron oxides would be expected to be terrestrial as opposed to stream bank or stream bed sources. In the catchments of both pools anthropogenic activity is thought to be responsible for the exposure of sub-soils to erosion during B10.

5.5.6 Sediment loss on ignition (Figure 13)

Percentage loss on ignition of the sediment from Fenemere declines slightly during B10 although in late B10 L.O.I is still around 60%.

The sediments are thus highly organic, although in part this organic component could be allochthonous in origin (*cf* Beales 1980). The radiocarbon age of a sediment sample from 190 to 200cm at Fenemere was calculated as 2940±60 (SRR 2921), this is 1050 radiocarbon years older than the age of the sample from 170 to 180cm, 1890±50bp (SRR 2920). The sample from 190 to 200cm is believed to have included a significant allochthonous carbon component. The peat deposits around the pool represent a potential source of old carbon and it is thought that inwashing of this old carbon is responsible for reversing the radiocarbon date (*cf* Pennington et al 1976). Sediment loss on ignition from Berth Pool II in late B10 is around 50%. The sediments in Berth Pool, at least prior to B13 at Berth (Chapter 7), appear to be marginally more inorganic than those at Fenemere from B6 to B11. The fluvioglacial hillock occupied by The Berth could be acting as an important local source for inwashed inorganic sediment at Berth Pool.

5.5.7 The regional significance of phase B10

The pollen diagrams from the Baschurch area in phase B10 can be correlated, on biostratigraphic grounds, to the spectra from late CMCP8 at Crose Mere (Beales 1980). Above c.230cm at Crose Mere relatively high *Pinus* frequencies are combined with low *Ulmus* and *Quercus* frequencies and reduced *Fraxinus* values. *Corylus avellana* is relatively low and Ericaceae, Gramineae and *Pteridium* are relatively high. In contrast to the pollen spectra from Marton and Fenemere, where minimum A.P and maximum N.A.P frequencies occur in B10, at Crose Mere the lowest A.P values in CMCP8 occur early in the phase in levels equivalent to B8. At Crose Mere slightly higher shrub frequencies and slightly lower herb and *Pteridium* frequencies occur in late CMCP8. A total pollen sum is used at Crose Mere (Beales 1980). Relative increases in *Corylus avellana* at Crose Mere could be responsible for the slight suppression of other frequencies. Also Pteridophytes are included in the summary diagram for Crose Mere (Beales 1980 Figure 4) but are excluded from the Baschurch area diagrams. Despite differences in the respective pollen sums, contrasts between Crose Mere and the larger two Baschurch pools are relatively slight. The Pinus curve at Marton and Fenemere is thought to be essentially regional in character (*cf* Jacobson and

Bradshaw 1981, Prentice 1985, Bradshaw and Webb 1985; the Pinus decline in late B10 at Marton and Fenemere has a clear parallel in late CMCP8 at Crose Mere. Beales (1980, 157) suggested that the radiocarbon date at the Pinus decline horizon c.200cm at Crose Mere, 2310±85bp (Q-1233) was too old; extrapolation of the upper and lower radiocarbon dates at Fenemere points to a date for the Pinus decline of c.2000bp (Figure 9). Turner (1964a, 1965) suggested a date of c.250bc for the start of section H in the pollen diagram from Whixall Moss and c.50bc for section I. On dating grounds, B10 in the Baschurch area must be seen as being chronologically equivalent to G/H/I at Whixall Moss (Figure 19). At the H/I transition at Whixall, Betula increases, Pinus declines, Fraxinus increases, Gramineae, Plantago and Pteridium all decline and total tree pollen increases (Turner 1965, 347). On chronological and biostratigraphic grounds, correlations can be proposed between late B10, late CMCP8 and Section H/I. Beales (1980, 156) suggested a possible correlation between section F at Whixall and the CMCP8/9 boundary at Crose Mere. There are similarities, but the dates from the Baschurch area suggest that AP increases in F at Whixall correspond to AP increases in B9 at Baschurch and to AP increases in Mid CMCP8 at Crose Mere. It is the I regeneration at Whixall which probably correlates to the B10/B11 and CMCP8/CMCP9 transition. N.A.P. frequencies are lower at Whixall in Sections G and H than they are in B10 or late CMCP8.

Significant deteriorations in climate are believed to have occurred in the first millennium bc. The evidence for this has been recently reviewed in Simmons and Tooley (1981) and examined by Wimble (1986) and Haslam (in prep). Lower lying tracts of gley soils around Whixall Moss (Crompton and Osmond 1954) could have been abandoned as the climate deteriorated in the second half of the first millennium bc and soils around the margins of the moss became increasingly waterlogged.

A pine stump layer occurs within the peat at Whixall (Hardy 1939), Turner 1964a). A pine stump from this layer, where trees might have been killed by a rise in the water table, has a date of 2307±110bp (Q383, Turner 1964a). Pines growing on the moss could effectively filter out a certain amount of N.A.P derived from beyond the moss (cf Tauber 1965). In combination, clearance contraction around the moss and N.A.P filtering across the moss could be responsible for the relatively low N.A.P values in sections G and H at Whixall (Turner 1964a, 1965), assuming that is that G/H, B10 and late CMCP8 are approximately equivalent.

It thus appears that in mid to late Iron Age times, c.400bc to c.50bc wide areas of the Shropshire lowlands were deforested. Low lying areas around the meres and mosses might well have remained largely wooded but the dry well drained soils could have been predominantly free of woodland. Correlations between the Baschurch area diagrams and those from Lancashire/Cheshire (Birks 1963-4, 1965) are difficult to discern, due to the relatively wide sampling intervals used at the latter sites, Chat Moss, Holcroft Moss and Lindow Moss. Beales and Birks (1973, 15) refer to a clearance phase C4 which is assigned to the Iron Age. This is separated from a Romano-British phase, C5, by a regeneration phase R4; conceivably, the C4/R4 transition corresponds to B10/B11, CMCP8/9 and H/I at Baschurch, Crose Mere and Whixall respectively (Figure 19). In general terms, however, the pollen evidence from the region points to progressive land abandonment beginning in the mid to late 1st Century bc.

5.6 Archaeological evidence c.800bc to c.50bc

5.6.1 Phases B8 and B9, c.800bc to c.400bc

Clear evidence for human activity in the region c.800bc is seen at the Breiddin hillfort, 24km west of the Baschurch area (Figure 1 and Section 2.1.7). Charcoal samples from the bases of post-holes in the earliest ramparts yielded dates of 828±71bc and 800±41bc (Musson 1976, 296-297). An occupation soil at the site yielded a date of 868±64bc (Musson 1976, 298). These dates can be compared with the date of 800bc for the significant tree pollen decline at the onset of phase B8. In archaeological terms, the onset of phase B8 appears to be broadly coincident with the transition between the late Penard and early Isleham periods of the later Bronze Age (Burgess 1980). Cemetery BI at Bromfield, near Ludlow was still in use at this time (Stanford 1982). Hilltop settlements of the later Bronze Age occur throughout the midlands and the Marches (Megaw and Simpson 1979). Increasing population pressure and a higher degree of territorial organisation could be in evidence in the building of the hillforts (Megaw and Simpson 1979, 288; Bradley 1984, 132). The development of hillfort building in the Welsh Marches has been examined by Stanford (1972a, 1972b, 1982) and Savory (1976). Stanford (1972b) identifies an "intrusive" element in the Marches, responsible for the construction of characteristic rectangular dwellings within hillforts such as Croft Ambrey. The earliest date of these rectangular buildings was estimated by Stanford (1972b) to be 600bc. A more detailed radiocarbon chronology from the Marches hillforts would obviously facilitate more detailed correlations with the vegetational history; at this stage, only speculative links can be proposed. The apparent expansion of cleared land at the onset of B8 could have links with an enhanced degree of territorial organisation associated with later Bronze Age hilltop settlements. The apparent reduction in clearance intensity in B9 could be associated with the consequences of social fragmentation and conflict which are thought to have characterised the earlier Iron Age (Bradley 1984). The date of the earliest occupation of the site of The Berth is not known (Gelling and Stanford 1965). The magnitude of the tree pollen reductions in early B8 is greater at Berth Pool than at Birchgrove and palynological contrasts between Berth and Birchgrove include the occurrence of higher frequencies of Liguliflorae and Urtica pollen at Berth Pool, Sambucus pollen is also continuously recorded at Berth from late B8 until late B12. Taraxacum spp (dandelion) Urtica dioica (common nettle) and Sambucus nigra (elder) are taxa which can be associated with repeatedly trampled ground (Taraxacum) and soils enriched by nutrients derived form human habitation sites (Urtica dioica and Sambucus nigra).

If there was a perceived necessity to occupy defendable sites during B8 (cf The Breiddin), then The Berth could have been occupied during the later Bronze Age. Human settlement at The Berth in B8 could account for the relatively high representation of the above pollen types at Berth Pool. In contrast to the other three Baschurch Pools, Berth Pool exhibits no clear evidence for a reduction in clearance intensity during B9, it is possible that The Berth continued to be occupied from c.600bc to c.400bc. It is not, however, known with certainty when the ramparts and causeways visible at the site today were constructed (Plates 13 and 14).

5.6.2 Phase B10 c.400bc to c.50bc

An increase in the degree of vegetation clearance occurs in this phase and clearance appears to be more extensive, in comparison with phase B8. Evidence from the hillforts of the Welsh Marches (Stanford 1972b, Savory 1976) suggests that c.300bc to 400bc a large area of the west Midlands came under the same rule (Savory 1976, 266). It is not known whether the date quoted above refers to the radiocarbon or calendar timescale, but, conceivably, the establishment of a wide-ranging new authority in the mid Iron Age in the Marches could have contributed to greater social and economic stability. This, in turn could have resulted in the planned re-expansion of cleared land indicated in B10. Iron Age occupation at The Breiddin hillfort is proven by radiocarbon dates for roundhouses of 479±55bc, 460±100bc, 375±63bc, 320-80bc, and for four-posted buildings, 294±40bc, 240±80bc and 238±70bc (Musson 1976). Late Iron Age occupation is postulated at The Berth by Stanford (1972a). Studies of the pottery types from the Marches (Peacock 1968, Morris 1980) have shown that ceramic wares manufactured in the vicinity of the Malvern Hills were distributed throughout the central Marches during the Iron Age (Stanford 1972a). A type of coarse pottery, termed Very Coarse Pottery or VCP, was found at The Berth by Gelling and Stanford (1965) and described as being the fragments of Iron Age baking ovens. Morris (1080) attributes VCP to the trading of salt in the Marches and believes that VCP represents the fragments of salt-carrying vessels. Gelling and Stanford (1965) state that the earliest occupation layer which they uncovered at The Berth had been "flooded by the rising waters of the artificial lake which surrounded the site" (Gelling and Stanford 1965, 82). Berth Pool is obviously not artificial and Gelling and Stanford do not postulate the existence of any artificial means of raising the water level around the site. It has been suggested above (Chapter 4 and this Chapter) that clearance activity around the meres could have resulted in a rise in water level in the meres. It is possible that early clearance activity associated with occupation of lower-lying ground at The Berth led to this ground being flooded (cf Plate 12).

The population of the Country is thought to have been expanding in the latter stages of the first millennium bc (Fowler 1983) and the degree of agricultural organisation is believed to have been sufficient to enable the production of an agricultural surplus (Fowler 1983, Bradley 1984). The estimated date of c.100bc for the maximum clearance expansion of B8 to B10 in the Baschurch area is thus in keeping with local and national evidence for the presence of a highly organised and increasingly numerous society in Britain in the late Iron Age. The Berth was occupied in the late Iron Age (Stanford 1972a) and quite possibly in the later Bronze Age and early Iron Age (above, 5.6.1). Further investigations at the site combined with radiocarbon dating would permit a more accurate series of links to be made between the history of man's occupation of the site and the local vegetational history.

5.7 Summary: phases B8 to B10

The correlation and comparison of phases B8-B10 in the Baschurch area represents a useful addition to the understanding of the chronology and nature of the vegetational changes of the first millennium bc in north Shropshire. A reassessment of the chronology of vegetation change given in Beales (1980) is necessary. Broadly, the phases of vegetation clearance correlate chronologically with archaeological evidence for phases of intensified human activity; c.800bc and c.400bc appear to be significant dates, both in archaeological terms (Stanford 1972a, 1972b, Savory 1976) and in vegetational terms.

Inter-site contrasts in pollen frequencies in the Baschurch area tend to confirm the validity of the pollen source area model of Jacobson and Bradshaw (1981) although contrasts between Marton Pool and Fenemere suggest that the potential for localised influences should not be overlooked at sites c.5 to 10ha in size. The end of phase B10 is marked by increases in arboreal pollen frequencies and inter-site contrasts during the succeeding phase B11 provide further evidence for the presence of very restricted pollen source areas at Berth Pool and Birchgrove Pool.

CHAPTER 6

WOODLAND REGENERATION IN THE LATE IRON AGE AND EARLY ROMAN PERIOD

6.1 Introduction

Pollen evidence for an expansion in the area of cleared land around the Baschurch Pools between c.400bc and c.100bc is succeeded, c.50bc, by evidence for the re-establishment of deciduous woodland in some previously cleared areas. A radiocarbon date from Fenemere places the mid-point of the regeneration at 1890±50 bp (SRR 2920) or c.60ad. At Birchgrove Pool, where the regeneration phase is shown in its entirety renewed clearance activity is indicated c.150ad. Evidence for the re-establishment of deciduous woodland begins to appear at the following levels at the Baschurch Pools and Boreatton Moss:

Fenemere	188cm to 184cm
Marton Pool	242cm to 238cm
Birchgrove Pool	248cm to 244cm
Berth Pool II	156cm to 152cm
Berth Pool III	c. 172cm
Boreatton (centre)	126cm to 124cm
Boreatton (margin)	152cm

The evidence at Berth Pool is very limited. A true regeneration phase cannot be precisely identified and phase B11 at Berth Pool is therefore defined mainly on chronological grounds (Figure 8).

6.2 Phase B11: Woodland regrowth in the Baschurch Area, c.50bc to c.150ad

Fenemere c.188cm to c.164cm c.50bc to c.150ad (Figure 9)

Betula and *Fraxinus* increase initially, followed by *Quercus*, lower *Betula* values are associated with peak *Quercus* values. *Pinus* declines and *Tilia* is not recorded between 168 and 176cm. *Fagus* occurs in consecutive samples between 172cm and 180cm and *Carpinus* occurs for the first time. *Corylus/Myrica* increases, high *Corylus/Myrica* values are associated with higher *Quercus* and lower *Betula* frequencies. Salix increases after the initial Betula/Fraxinus increases, the diversity of shrub pollen is reduced, only Coryloid and Salix pollen occur at 176cm and 184cm. Ericaceae and Gramineae decline, Gramineae increases again at 164cm, equivalent to 150ad. Cereal, Secale and Cannabis type occur in B11, but, overall the frequency and diversity of open habitat indicators are reduced. The diversity of other herb pollen types is also reduced, although a slight increase in Urtica occurs. Total tree pollen exceeds 60% of total determinable land pollen and Pteridium declines to less than 1% for the first time since B7. Filicales values are also reduced. The 2nd and 3rd numerical zone splits are made, respectively, by SPLITINF and SPLITLSQ at the onset of B11, indicating the significance of the pollen frequency changes.

Marton Pool c.242cm to c.220cm
c.50bc to c.150 to 200ad

Betula, Fraxinus and Quercus increase; reduced Betula values are associated with peak Quercus frequencies. Pinus declines and Tilia is absent from the central levels of B11, Fagus occurs more frequently in B11. Peak Corylus/Myrica values occur after the Betula peak at 232cm. Shrub pollen diversity is reduced, only Coryloid and Salix occur at 224cm and 228cm, higher Salix frequencies are recorded earlier at Marton Pool, in comparison to Fenemere. Ericaceae and Gramineae are reduced in frequency but cereal and Secale occur. The frequency and diversity of open habitat indicator and other herb pollen types are reduced. Total tree pollen increases to c.60--65%, Pteridium and Filicales decline to less than 1%. In both zonation statistics, the 2nd zone splits are made in early B11.

Birchgrove Pool c.244cm to c.232cm
c.50bc to c.150ad

Quercus, Alnus and Fraxinus increase initially, at 244cm, Betula increases at 240cm. Tilia is not recorded during the regeneration but Fagus appears in consecutive samples 232cm to 240cm. Corylus/Myrica and Salix increase, shrub pollen diversity is reduced at 240cm. Ericaceae and Gramineae decline but Cereal and Secale pollen occur in consecutive samples throughout B11. Liguliflorae, *Plantago lanceolata* and *Rumex acet* are reduced although *Rumex* continues to occur at c.3%, *Artemisia* occurs in consecutive samples throughout the phase. The frequency and diversity of other herb pollen types are reduced, total tree pollen exceeds 55% at 240cm and *Pteridium* frequencies are substantially reduced. In both zonation statistics, the 2nd zone splits occur at the start of B11.

Berth Pool II c.153cm to c.145cm
c.50bc to c.150ad

The depth measurements above have been read off from the age/depth profile for Berth Pool II, phase B11 at this site is defined primarily on chronological and not biostratigraphic grounds.

Betula increases slightly at 152cm to 156cm, *Tilia* ceases to be regularly recorded above 152cm. *Quercus* remains low but *Alnus* increases. Little change occurs in Coryloid frequencies but *Salix* clearly declines. *Sambucus* continues to occur but Ericaceae declines. Gramineae frequencies are reduced very slightly at 148cm, Cereal pollen occurs at 148cm and 152cm. Amongst the open habitat indicators only Cruciferae exhibits a marked decline at the onset of B11. Leguminosae ceases to be regularly recorded from early B11 and Rosaceae, Ranunculaceae and *Hypericum perforatum* type decline at the same time as Cruciferae; *Urtica* increases during B11. Total tree pollen increases during B11, but remains at less than 30%. A slight reduction in *Pteridium* occurs and *Sphagnum* is recorded more frequently. No zonation splits are made between 136cm and 160cm.

Berth Pool III c.172cm to c.164cm

B11 in Berth III is defined by biostratigraphic correlation to B11 in Berth II.

Betula increases at 172cm, a slight increase in *Quercus* occurs at 172cm, but frequencies remain generally low, higher *Alnus* frequencies occur. *Corylus/Myrica* frequencies are unchanged but *Salix* does not decline until the end of the phase. *Sambucus* declines in early B11; in contrast to Berth II, Ericaceae frequencies are initially low at the onset of B11 and so no decline can be discerned. A slight increase in Gramineae is seen in core III in B11, as in core II, cereal pollen appears in the lower two samples of the phase. Liguliflorae increases slightly, but a clear decline in Cruciferae is seen at the onset of B11. Leguminosae is recorded less regularly from early B11 and Hypericum perforatum type declines at the same time as Cruciferae. Rosaceae exhibits no clear decline, Ranunculaceae values are slightly lower in late B10 in Berth III, no 'decline' can thus be seen; Urtica increases during B11. Total tree pollen increases but values do not exceed 30%. Pteridium values are already low in late B10 but a clear decline in Filicales frequencies occurs at the onset of B11. Sphagnum appears to occur more regularly from mid B11. Zonation splits do not occur at the onset of B11.

Boreatton Moss (centre) c.124cm and above

C.124cm is assumed, on the basis of biostratigraphic correlation to Fenemere, Marton Pool and Birchgrove Pool, and also to Crose Mere (Beales 1980) and Whixall Moss (Turner 1964a, 1965), to date to c.50bc.

Betula, Ulmus, Quercus, Alnus and Fraxinus increase. At 108cm reductions in Betula and Fraxinus are associated with the higher Quercus frequency. High Corylus/Myrica values are associated with the higher Quercus values above 118cm. Ericaceae increases during B11 but a substantial reduction in Gramineae occurs, the Gramineae frequency at 114cm is the lowest since phase B4 (Chapter 3). The diversity of open habitat indicator pollen is reduced. Only Plantago lanceolata occurs at 114cm and 118cm; the diversity of other herb pollen types is also reduced, only Cyperaceae occurs at 116 and 118cm. Tree and shrub pollen accounts for almost 90% of total determinable land pollen between 108cm and 118cm. Pteridium does not occur at 116cm, the first time since the early B1 Ulmus decline when it is not recorded. Both zonation statistics make the 2nd zone split between 124cm and 126cm, the onset of B11.

Boreatton Moss (margin) c.152cm to c.148cm

The phase is identified by biostratigraphic correlation to the central core and to the diagrams from the pools.

Betula, Quercus, Alnus and Fraxinus increase at 152cm. Betula increases further, and Tilia and Quercus increase clearly at 150cm. Reductions in Betula and Fraxinus are associated with the peak Quercus frequency at 148cm. Corylus/Myrica increases and Salix decreases, Ericaceae does not occur at 150cm, where Gramineae reaches a minimum. The diversity of open habitat indicators is reduced at 150cm. Amongst the other herb pollen types, only Cyperaceae occurs at 150cm. Tree and herb pollen account for over 90% of total determinable land pollen at 150cm, where Pteridium occurs at less than 1%. The 2nd and 3rd zonation splits are made respectively in SPLITLSQ and SPLITINF between 150cm and 152cm.

Amongst the aquatic pollen types recorded at the Baschurch Pools, Sparganium/Typha frequencies are reduced at Marton Pool at the B10/B11 transition, but other aquatic types continue to occur. No clear reduction in aquatic pollen diversity is evident at Fenemere in B11, but Sparganium/Typha declines at Birchgrove Pool at the B10/B11 transition. The curve for Sparganium/Typha remains unbroken during B11 at Berth Pool, although in core II, Potamogeton temporarily ceases to be recorded from the onset of B11. Some reductions in reedmace or burr-reed populations could be in evidence, possibly due to increased shading of shallow water areas by alder and willow around Fenemere, Marton Pool and Birchgrove Pool.

6.3 Inter- and intra-site variation in phase B11

The re-expansion of woodland in the Baschurch area in phase B11 appears to have taken place over a period of c.200 radiocarbon years, between c.2000bp and c.1800bp, or c.50bc and c.150ad. Calibration of the radiocarbon date 1890±50 (SRR 2920) using the curves in Pearson et al (1986) gives a median date of 110AD (Figure 10).

Land abandonment thus appears to occur in the late Iron Age, the landscape appears to remain predominantly forested for the first two centuries of the present millennium. In the early stages of regeneration, a pioneer woodland of birch, ash and some oak is indicated. Alder colonisation is indicated around Berth Pool, Birchgrove Pool and, to a limited extent, Fenemere; Alnus does not increase appreciably at Marton Pool. At Boreatton Moss, alder expansion is also indicated, but not apparently on land on the western side of the moss. Following the earlier pioneer stage of regeneration, a return to high deciduous forest is indicated, with birch and ash becoming less abundant, and, possibly, regrowth of hazel as an understorey shrub. Regeneration over a wider area is indicated by the pollen spectra at the larger two sites (cf Jacobson and Bradshaw 1981, Prentice 1985) and woodland appears to regenerate in the locality of Birchgrove Pool but, apart from limited regrowth of alder, no substantial woodland regrowth is indicated at Berth Pool. Given that Berth Pool and Birchgrove Pool are only 400m apart (Plate 2), this striking inter-site contrast in B11 appears to confirm earlier indications (Chapter 5) that the dominant pollen source areas of Berth Pool and Birchgrove Pool are very restricted, perhaps to within 200m or so of the margins of each site (cf Tauber 1965, 32; 1977,77; Berglund 1973, 122; Jacobson and Bradshaw 1981; Prentice 1985).

The magnitude of the initial Betula increases is similar at Marton and Fenemere but Fraxinus representation is higher at Marton. Alnus frequencies continue to be higher at Marton Pool. At both Marton and Fenemere, Pinus declines to less than 1% in association with the Betula peaks at 176cm at Fenemere and 232cm at Marton. Deciduous woodland colonisation of the area could have affected the dispersal of Pinus pollen from sources at a distance from the pools. The degree of openness in the vegetation in the dominant pollen source areas of Marton and Fenemere will be much reduced in B11, regrowth of broadleaved trees could lead to a greater degree of filtering of Pinus pollen (Tauber 1967, 1977), also, some pines in heathland areas could have been shaded out by birch, oak and ash. At Fenn's Moss (Figure 1) a recurrence surface in the peat has radiocarbon dates of 1842±100bp below the surface and 1670±110bp above (Godwin and Willis 1960) and wood from a pine stump on Whixall Moss has a date of 2307±100bp (Turner 1964a). The pines on Whixall (Hardy 1939) could have been killed by a rise in the water table on the Moss (Barber and Twigger 1987); additional work on the stratigraphy of Whixall Moss is currently in progress (Haslam, in prep.). If pines growing on peat surfaces elsewhere in north Shropshire were also killed by rising water tables, this could lead to a reduction of Pinus pollen in the regional pollen rain. Not only could broadleaved regrowth be restricting the dissemination of Pinus pollen, but, in addition, the relative influence of more localised pollen sources would tend to increase as regeneration of woodland progressed in the vicinity of the pools (cf Tauber 1965, 33; 1967, 139).

Betula frequencies are lower at the onset of B11 at Birchgrove, in comparison to Marton and Fenemere. This appears to be due to a steep, early rise in Quercus between 240cm and 244cm at Birchgrove Pool. Quercus remains high at 232cm and 236cm at Birchgrove whilst Betula is reduced at 232cm. In relative terms, birch could have been less abundant, locally, around Birchgrove Pool. A similar pattern of regeneration is indicated at Birchgrove, Marton and Fenemere, with a progression from birch - oak - ash woodland to mainly oak woodland with, probably, a hazel understorey. A very slight increase in Betula frequencies is in evidence in early B11 at Berth Pool, a marginal rise in Quercus can be discerned in Berth III, but this has no clear parallel in Berth II. Fraxinus occurs at c.1% in one sample from B11 in Berth III, but its occurrence is otherwise intermittent.

The Alnus rise at Berth Pool could be attributable to a local increase in the abundance of alder at that site but it is considered probable that the very slight, and insignificant increases in Betula, Quercus and Fraxinus pollen are attributable to pollen transport from beyond the immediate margins of Berth Pool; the drier cleared areas appear to remain open around Berth Pool throughout B11. Maximum Betula frequencies at Boreatton Moss (centre) are comparable to those at Birchgrove Pool, and lower in comparison to Marton and Fenemere, Betula peaks at c.15% at 150cm at the margin of Boreatton, a comparable frequency to those seen in the central core.

Fraxinus frequencies suggest that ash was an important woodland component in the earlier stages of regeneration. This was also indicated in the regeneration phases of B7 (Chapter 4). Ash trees can be under-represented in pollen spectra (Andersen 1970, 1973), although precise pollen correction factors will vary from place to place and over time (Oldfield 1970, Birks and Gordon 1985, Bradshaw and Webb 1985). Ash is a ready coloniser of areas which have been cleared and where a reduction in human activity follows a phase of clearance (Godwin 1975). Betula can be over-represented in pollen spectra (Andersen 1970, 1973) and it is possible, during B11 in the Baschurch area, that birch and ash were equally abundant in the regenerating woodland. In contrast to its representation at the Baschurch Pools, Ulmus exhibits relatively high frequencies at Boreatton Moss in B11. Elm could have been locally more abundant at the edge of the moss, in comparison to the edges of the pools. Elm has a preference for more fertile, less acid soils and usually drier soils (Sinker et al 1985). Peat deposits separate drier brown earth soils form the edges of the Baschurch Pools, but these soils actually border Boreatton Moss (Figure 5). Tilia ceases to be recorded in consecutive samples from the onset of B11 at Marton and Fenemere, a similar effect is indicated at Birchgrove and in Berth II although Tilia representation was initially more intermittent at the latter two sites. At Fenemere, Tilia was reduced to less than 1% at the clearance peak in B10, the abundance of lime was thus probably reduced prior to the onset of regeneration. Tilia pollen could be filtered to a greater degree within the regenerating woodland (Tauber 1967a), also, if lime trees were more abundant away from the immediate margins of the pools, Tilia representation would decline in relative terms, even if no lime trees were felled, since pollen from regenerated woodland closer to the sites would increase its relative representation as woodland once again surrounded the sites (cf Tauber 1965, 33; 1967, 139). Tilia occurs irregularly at the centre of Boreatton Moss in B11, but a short-lived Tilia peak marks B11 at the margin. This peak probably reflects the presence of lime on brown earth soils adjacent to the western side of the moss. The relatively low Alnus frequency at 150cm at the margin at Boreatton suggests that dry land trees predominated in the vegetation at least on the steeper slopes on the western side of Boreatton. It is clear at Fenemere and Marton Pool that Fagus occurs more regularly than Tilia in early B11, a similar pattern is indicated at Birchgrove Pool and at Berth Pool Tilia ceases to occur regularly from the onset of B11 in Berth II. A single Fagus pollen grain appears at the start of B11 in Berth III. Beech can take advantage of woodland regeneration following Bronze Age and Iron Age clearances (Godwin 1975, 276), also, beech is normally better represented than lime in pollen spectra (Andersen 1970, 1973). A limited amount of beech growth could thus be occurring in B11, although the tree does not appear to become a significant component of the woodland. No clear pattern can be discerned in the occurrence of Taxus, it occurs in B11 at Marton and Fenemere, but not in the central part of B11 at Birchgrove Pool. It does not appear in B11 at Berth Pool or Boreatton Moss. Yew appears to be very infrequent in the vegetation of the area in early Roman times.

Corylus/Myrica frequencies are comparable at Marton, Fenemere and Birchgrove Pool in late B11, but frequencies are higher at Boreatton Moss. A more complete woodland regeneration could have occurred at Boreatton, although Coryloid frequencies are lower in B11 at Boreatton in comparison to B1 to B7 at that site. A slight decline in Corylus/Myrica frequencies occurs in B11 in both cores from Berth Pool. Tree and shrub pollen totals from the five sites can be compared:

Fenemere	c 79%
Marton Pool	c 86%
Birchgrove Pool	c 73%
Berth Pool II	c 33%
Berth Pool III	c 36%
Boreatton (centre)	c 90%
Boreatton (margin)	c 92%

% of total determinable land pollen, the highest values for B11 are shown.

Woodland regeneration appears to have been near-complete around Boreatton Moss, dominant around Marton and Fenemere, but slightly less so around Birchgrove Pool and, apart from alder regrowth, absent around Berth Pool. Reductions in shrub pollen diversity are associated with Coryloid and Salix increases at Marton Pool, Fenemere, and Birchgrove Pool, pointing to the exclusion of other shrub taxa by hazel and willow within the regenerated woodland. Salix representation varies slightly between the two cores at Berth

Pool, a decline occurs in early B11 in Berth II, but in early B12 in Berth III, willow is probably present as a carr-woodland component, as it is around the site today. Sambucus continues to occur throughout B11 at Berth Pool but is absent in B11 at Birchgrove, suggesting that alder is more common closer to Berth Pool. Reductions in the abundance of heath taxa are suggested by reductions in Ericaceae frequencies in B11 at Fenemere, Marton and Birchgrove, an Ericaceae decline is seen in B11 in Berth II, but frequencies were initially low in Berth III. Ericaceous taxa could be growing on the moss surface at Boreatton; contrasts between the edge and centre might suggest that ericaceous taxa were more abundant towards the centre of the moss, although inferences are uncertain since heath species could be present both around the moss and at the core sites themselves. Generally, a regional reduction in heather abundance can be postulated in B11. Marked reductions in Gramineae occur in B11 at all sites except Berth Pool. At Fenemere and Marton Pool Gramineae values in B11 are comparable to those which occurred during the clearance episodes of B7, at Birchgrove Pool, the reduced Gramineae values of B11 are almost twice as high as those which occurred in the B7 clearances. Gramineae frequencies remain relatively high at Berth Pool at c.35 to 40% whilst at the centre of Boreatton Moss Gramineae declines to c.5% or less. In regional terms, some land still appears to be open in B11. Moderately extensive tracts of more open woodland could exist in some areas or, alternatively, the remaining open areas could be relatively confined. Berth Pool and Birchgrove Pool are, respectively, c 1.5km and c 0.7km from Fenemere. Theoretically, Berth and Birchgrove should both be within the dominant pollen source area of Fenemere (cf Jacobson and Bradshaw 1981). Cleared areas within a few hundred metres of Fenemere, and possibly Marton Pool, could have been completely abandoned, but herb pollen from open areas closer to Berth and Birchgrove would continue to be transported to Marton and Fenemere in above-canopy airstreams (cf Tauber 1977). The centre of Boreatton Moss is only c 1.5km from the edge of Berth Pool, approximately the same distance away as Fenemere and Marton (Plates 1 and 2), and yet at 118cm at the centre of Boreatton Moss the only herb pollen types recorded are Gramineae, at c 6%, Plantago lanceolata, at c 1%, and Cyperaceae, at less than 1%. Tree colonisation of the moss surface of Boreatton could be restricting any open areas at the centre, causing pollen in the above-canopy airstreams to overshoot the moss (cf Tauber 1977). The contrasts between Berth and Boreatton in B11 could suggest that not only is the dominant pollen source area at Boreatton relatively restricted, but also, despite the apparent presence of open land around the site, the dominant pollen source area of Berth Pool is also restricted. Given that the two sites are c 1.5km apart, it could be argued that at both sites, the effective pollen source areas have radii of c.500m or less (cf Berglund 1973, 122, Table 2). It could be argued that the Gramineae pollen in B11 at Birchgrove Pool is derived in part from cleared areas close to Berth Pool. At Birchgrove Pool, however, Secale is consistently recorded during B11, pointing to a local source for open habitat pollen types; Secale is absent in B11 at Berth Pool. Secale occurs in B11 at Marton and Fenemere and thus open land around Birchgrove Pool could be contributing to the pollen rain at Marton and Fenemere. The relatively high arboreal pollen frequencies at Birchgrove suggest that open land around Birchgrove was very restricted, perhaps to a single small enclave. Conceivably part of the sand and gravel ridge in between Berth and Birchgrove (Plate 2) continued to be farmed in B11 whilst land around the western and southern margins of Birchgrove and closer to Marton and Fenemere (Figure 34) became forested. The contrasts, particularly in arboreal pollen frequencies between Berth and Birchgrove suggest that the pollen source areas of these two sites are largely independent of one another (cf Bennett 1986). Turner and Hodgson (1981) have demonstrated significant inter-site pollen frequency contrasts at a spatial scale of c.3-6km, the data from the Baschurch area show that substantial contrasts can occur over c.1km or less.

The representation of the main open habitat indicator pollen types tends to decline during B11 at Boreatton Moss, Marton Pool, Fenemere and Birchgrove Pool but not, with the exception of Cruciferae, at Berth Pool. The clearest reductions in the diversity and frequency of open habitat indicators occurs at Boreatton Moss. This is consistent with the occurrence of minimal Gramineae frequencies at that site. At Marton and Fenemere Plantago lanceolata and Rumex acet decline to less than 1% during B11. At both sites the Plantago decline occurs first.

Plantago lanceolata also declines to less than 1% at Birchgrove but, although it exhibits a substantial decline, Rumex acet continues to be recorded at c.3%. In the central part of B11 at Fenemere, Tubuliflorae, Liguliflorae, Chenopodiaceae and Cruciferae are temporarily absent. Liguliflorae, Chenopodiaceae and Cruciferae also temporarily cease to occur in mid B11 at Marton Pool, at Birchgrove Pool, the occurrence of Tubuliflorae, Liguliflorae, Chenopodiaceae and Cruciferae becomes more intermittent in B11. The pattern of occurrence for Artemisia however, at least at Fenemere and Birchgrove, and possibly at Marton Pool is different from the pattern of occurrence of the above open habitat indicators. Artemisia occurs irregularly prior to B11 at Fenemere, but in consecutive samples in B11. Artemisia occurs more regularly from late B10 to early B12 at Birchgrove Pool, in comparison to its occurrence in B7 and B8. Arable agriculture appears to have aided the spread of Artemisia spp in the subatlantic period (Godwin 1975, 345). B11 is confined mainly to the early stages of Roman occupation in Britain, the more frequent occurrence of Secale in B11, particularly at Marton and Birchgrove could point to the cultivation of rye in the area (cf Godwin 1975, 414).

At Berth Pool, a reduction in Cruciferae is associated with slight Betula and Alnus increases in early B11, this Cruciferae reduction is seen in both cores, Liguliflorae, Plantago lanceolata and Rumex acet frequencies remain relatively high throughout B11 in both cores. Reductions in Hypericum perforatum type occur at the same horizons as the Cruciferae reductions at Berth Pool, reductions in Rosaceae and Ranunculaceae are evident in Berth II, but not Berth III. Rosaceae does decrease in both cores at the end of B12 (Chapter 7). In both cores at Berth Pool, increases in Urtica occur in B11. Urtica pollen is probably mostly derived from the common nettle, Urtica dioica (Godwin 1975, 242), a taxon which, in some cases inhabits fen woodlands but is also associated with nutrient-rich soils around human settlements (Godwin 1975, 242; Sinker et al 1985, 236). Alnus increases in B11 at Berth Pool and therefore nettle expansion in fen woodlands appears unlikely, since the degree of shading would increase in fen areas around the pool. It is conceivable that human occupation of The Berth persisted during B11; if the site had been completely abandoned, birch, oak and ash regrowth would have occurred on the dry soils of the hillock (Plate 6) and provided a localised source for dry land tree pollen.

Changes in the species composition of the open areas around Berth Pool can be postulated on the basis of reductions in the frequencies of Cruciferae, Leguminosae, Hypericum, Rosaceae and Ranunculaceae. Conceivably some rough grassland on wetter soils could have been shaded out by alder and willow regrowth. Alternatively, the intensity of land use could have increased so that only the more resilient taxa such as Taraxacum spp and Plantago spp persisted without decreasing in abundance. Apart from the open habitat indicators, the frequency and diversity of other herb pollen types are reduced at Birchgrove Pool in B11. Urtica is in fact absent in late B11 at Birchgrove Pool in direct contrast to its high frequencies at Berth Pool. Ranunculaceae and Filipendula occur in B11 where the majority of other herb types are absent; some damper grassland could be persisting close to the site. Filipendula continues to occur in B11 at Marton and Fenemere, as does Rosaceae. Relatively high Urtica frequencies persist at both these sites in B11. Alnus frequencies do not increase in early B11 at Marton and Fenemere, so nettles could be persisting in more open fen habitats. The occurrence of Secale, Artemisia and Rumex acet during B11 at Marton and Fenemere could however point to the presence of some human activity closer to those sites. The Urtica pollen at Marton and Fenemere is not necessarily derived from areas close to Berth Pool. If this were so, then higher Liguliflorae and Plantago frequencies might be expected at Marton and Fenemere since frequencies of these types remain high at Berth Pool in B11.

A reduction in sedge colonisation is indicated by Cyperaceae reductions at Fenemere, Marton and Birchgrove, but not at Berth Pool. Cyperaceae frequencies decline at Boreatton Moss in B11. This could possibly be due to a reduction in surface runoff to low lying soils at the edge of the moss as woodland becomes re-established, although woodland regrowth would in any case tend to shade areas where sedge colonisation would otherwise be expected. A slight rise in Gramineae and Plantago lanceolata occurs at 120cm at the centre of Boreatton, possibly indicating brief anthropogenic interference in the woodland but, apart from this, grass and herb frequencies remain low. A slight re-increase in Gramineae occurs above 112cm at the centre of Boreatton. Liguliflorae, Artemisia Chenopodiaceae and Rumex acet occur and Plantago lanceolata increases; Leguminosae, Rosaceae, Umbelliferae and Filipendula occur amongst the other herbs and slight increases in Cyperaceae and Pteridium occur. The diagram from the centre of Boreatton could be reaching the early stages of the B11/B12 transition at c.110cm. Comparisons between the edge and centre of Boreatton Moss are necessarily limited by the fact that only the sample at 150cm in the marginal core is thought to belong to B11 proper. Strong local sources for Tilia and Quercus can be postulated in the woodland closest to the marginal core site. The low grass and herb frequencies in both cores however suggest that Boreatton Moss and its surrounding brown earth soils were beyond even the periphery of cleared areas which persisted near to the Baschurch Pools in the early Roman period.

In previous phases of clearance and regeneration, Pteridium frequencies appeared to provide a discriminating index of the degree of openness in the vegetation. Inter-site variability in Pteridium frequencies in B11 tends to confirm the assertion that some areas were largely re-afforested whilst others remained partially or completely open. At Marton, Fenemere and Boreatton Moss, Pteridium is recorded at less than 1% in the central stages of B11. Pteridium frequencies decline markedly in early B11 at Birchgrove Pool, but a continuous curve persists throughout the phase. Continuous curves for Pteridium are seen in both cores at Berth Pool, although slightly lower Pteridium frequencies occur in both cores in early B11 and a Filicales decline is evident in Berth III. Filicales (undiff) tended to increase during B9 at Fenemere and Marton Pool, where a reduction in clearance intensity was postulated (Chapter 5) but in B11 progressive decreases in Filicales frequencies occur. The reason for this variation in Filicales frequencies could be that phase B9 was characterised by the presence of more open woodland whilst in B11, closed woodland predominates. Under a more open canopy, shade tolerant pteridophytes including those growing on trees, could persist, and spores could be easily dispersed. A more closed woodland would limit the abundance of all pteridophytes and restrict spore dispersal (Beales 1980, 152).

Apart from Berth Pool and Birchgrove Pool, open habitat indicator frequencies are too low for the realistic calculation of Arable: Pastoral ratios during phase B11. Precise sample to sample correlation cannot be claimed at Berth Pool, but the ratios are as follows (after Turner, 1964a):

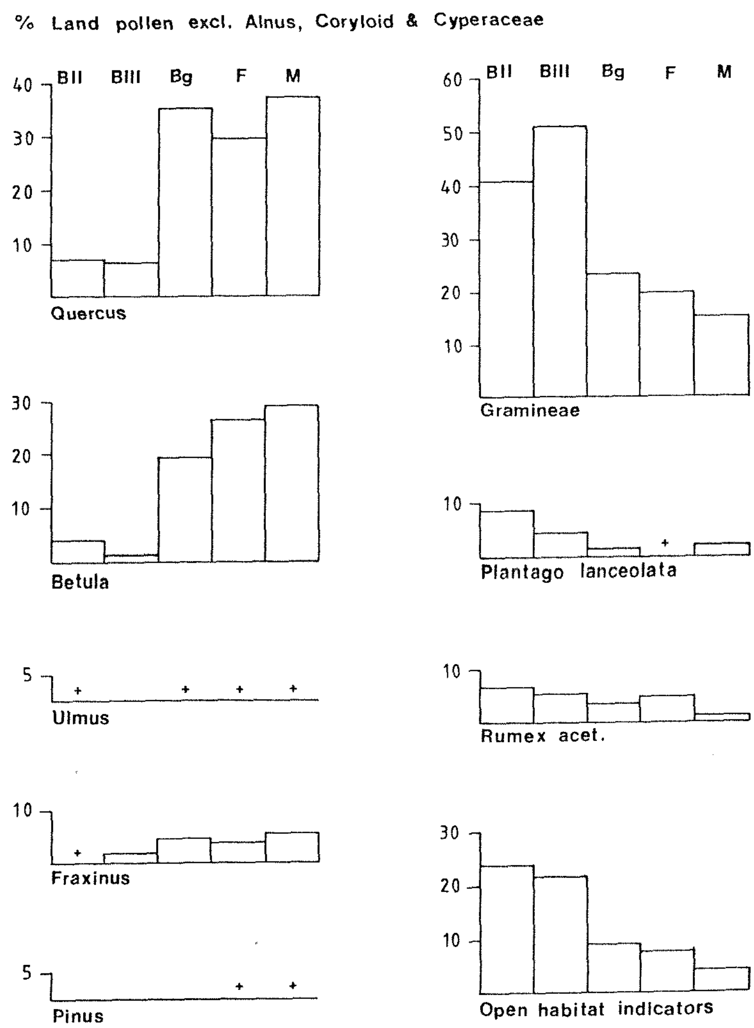
SITE	DEPTH	A/P INDEX	NO. POLLEN GRAINS
Berth II	148cm	51.0%	47 grains
Berth III	168cm	28.2%	39 grains
Birchgrove Pool	236cm	35.2%	17 grains

At the other sites:

Fenemere	172cm	25.0%	8 grains
Marton Pool	228cm	71.4%	7 grains
Boreatton (centre)	114cm	100.0%	11 *Plantago* only
Boreatton (margin)	150cm	33.3%	3 grains

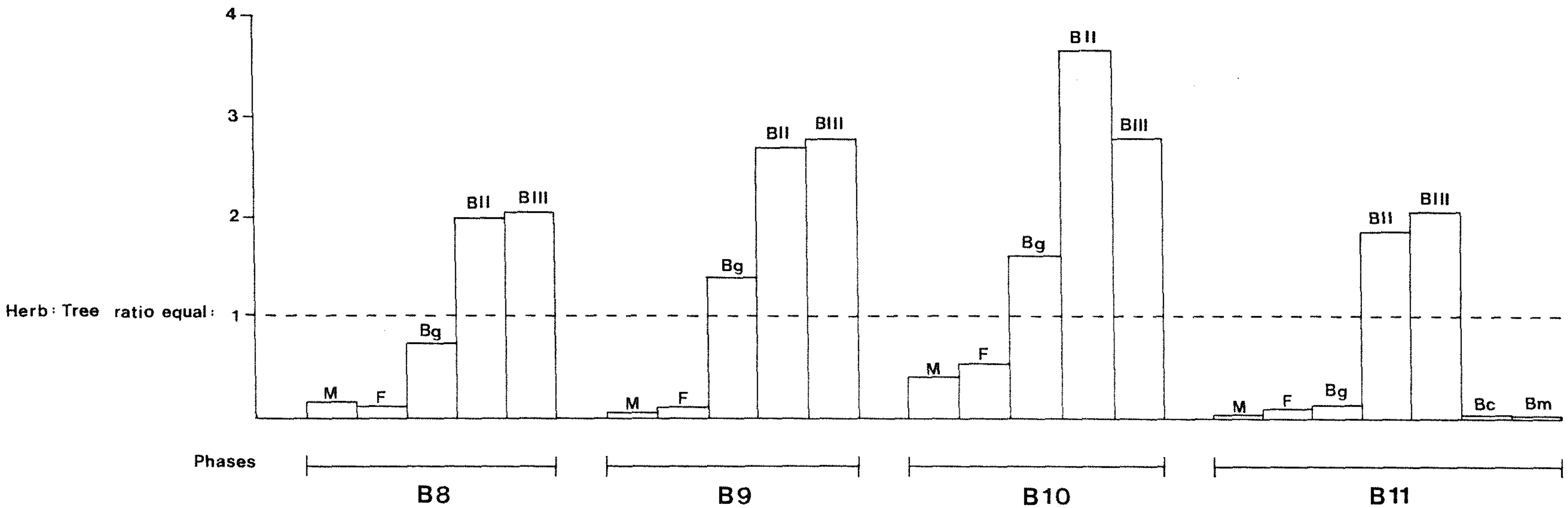
The A:P indexes are calculated for horizons where Gramineae values reach a minimum, the mid-point horizons have been used at Berth Pool in B11. No clear pattern is seen, although the relatively low indexes at Birchgrove Pool and in Berth III could point to the presence of some arable agriculture. The ratio of dry land tree pollen to open habitat indicator pollen varies considerably from site to site (Figure 33). Ratios are comparable between Fenemere and Birchgrove Pool suggesting that in a regional sense, and in some particular localities a very limited herb flora persisted during B11, tree pollen predominates to an even greater extent at Marton Pool and Boreatton Moss. At Berth Pool, however, open habitat indicator pollen continues to be recorded more frequently than dry land tree pollen. The exclusion of *Alnus* from the main pollen sum at the Gramineae minima of B11 accentuates the high tree pollen frequencies at all sites except Berth Pool (Figure 32). Inferences about the vegetational pattern of the region which were based only on evidence from the largest site, Fenemere, could only be very highly generalised. Therefore it could not be known, for example, whether the woodland around the site contained several smaller clearings, or a single large cleared enclave in a specific locality. During B11, it is thought that a settlement existed close to Berth Pool, probably at The Berth itself and a smaller

Fig 32 **B11: Selected Pollen Types**



BII	Berth II	148cm	
BIII	Berth III	168cm	
Bg	Birchgrove	236cm	Depths of B11
F	Fenemere	172cm	Gramineae minimum
M	Marton	228cm	c 60ad

Fig 33 Herb: Tree Ratios in Phases B8 to B11



Histogram bars represent ratio of herb pollen to tree pollen (selected taxa)

Trees: Ulmus Quercus Tilia
Fagus Fraxinus Betula

Herbs: Plantago Rumex Cereal
Artemisia Cruciferae
Compositae Chenopodiaceae

M Marton
F Fenemere
Bg Birchgrove
B II Berth II
B III Berth III
Bc Boreatton centre
Bm Boreatton margin

Sample depths as shown in figures 27-29 and 31 cleared enclave occurred close to Birchgrove Pool, but the remainder of the area around Baschurch became re-afforested. Even the belt of brown earth soils surrounding Boreatton appears to have been completely abandoned (Figure 34).

Fluctuations in aquatic pollen frequencies have already been noted (6.2); reductions in Sparganium/Typha frequencies at Fenemere, Marton and Birchgrove could be due to contractions in emergent reed stands within regenerated alder woodland at the mere margins, although substantial Alnus increases in early B11 are confined to Birchgrove Pool and Berth Pool. At Fenemere and Marton, Sphagnum occurs less frequently in B11, compared to B10. Sphagnum is present in B10 at Birchgrove, but not in B11. Reduced flooding of the mere margins, and reduced wraterlogging of the peats around the pools could be in evidence; Sparganium/Typha does not decline at Berth Pool where the land remains open in B11. Sphagnum and Cyperaceae frequencies are also reduced at Boreatton Moss in B11. Sphagnum and Cyperaceae frequencies also declined during the early Bronze Age phases of reduced clearance activity, B4 and B6. Man does appear to have affected the hydrology of the meres and mosses during the prehistoric period; Reynolds (1979) suggests that the present eutrophic state of the meres had its origins during the early stages of prehistoric woodland clearance.

6.4 Sediment loss on ignition

6.4.1 Berth Pool

Extrapolation of the data points at 140cm and 160cm (Figure 13) suggests that the sediments in Berth Pool remained predominantly organic in B11, substantial inorganic inwashing does not occur until B13 (Chapter 7).

6.4.2 Fenemere

A slight increase in % L.O.I occurs in mid B11 (Figure 13), where the sediment is c.70% organic. This L.O.I rise could be due to a reduction in sediment inwashing from the mere catchment. The radiocarbon date from 170cm to 180cm, 1890±50bp (SRR 2921) for

190 to 200cm. SRR 2921 is thought to have been reversed by old carbon inwashing (Pennington et al 1976, Edwards and Rowntree 1980), the temporary rise in L.O.I at Fenemere could point to a reduction in inwashing, and for this reason SRR 2920 is thought to be acceptable. L.O.I rises to just over 70% in mid CMCP9 at Crose Mere (Beales 1980), the regeneration phase which is thought to be chronologically equivalent to B11. L.O.I in CMCP9 at Crose Mere peaks above the level at 192cm to 201cm which was radiocarbon dated to 2310±85 (Q-1233). The validity of this date is questioned by Beales (1980, 153), it is suggested (6.6) that SRR 2920 is a more acceptable date for CMCP9/B11.

6.5 Archaeological and Historical evidence

Extrapolated dates at Fenemere (Figure 9) suggest that, in radiocarbon years, B11 began c.50bc and ended c.150ad. The calibrated age/depth profile for Fenemere (Figure 10) suggests that land abandonment occurred c.20-40BC and that clearance activity had begun again by 200AD.

It is evident from the pollen record that land occupation continued throughout the first and second centuries AD in the vicinity of Berth Pool. It is considered probable that The Berth itself was occupied at this time, although not necessarily as a fortified site. Some Roman pottery, and a timber building, thought to date to the 4th century AD have been excavated at The Berth (Gelling 1962, 1964; Tyler 1981). At the promontory hillfort of Oliver's Point, on Nesscliffe Hill (Figure 2) evidence was found for occupation in the 2nd century AD (Chitty 1956). Changes in economy and society occurred in the British Isles in the early to mid first century BC and these social and economic changes could have had a bearing upon the pattern of land use. Bradley (1984, 144) defines the period 100 BC to AD43 as one of "Incorporation and social change". At this time, the expansion of the Roman empire in northern Europe could have precipitated political alliances between Britain and Gaul, alliances cited as a cause for Caesar's intervention in Britain in 55BC (Bradley 1984, 145). A process of tribal reorganisation within Britain is postulated for the period between the two Roman incursions of 55BC and 43AD (Bradley 1984, 147) and during this time, larger tribal kingdoms appear to have emerged. It is conceivable that a certain restructuring of land use patterns accompanied political and social change at this time. Whereas lowland Shropshire was largely denuded of woodland at the time of the first Roman incursion, it appears to have been almost completely re-afforested by the time of the second. Some Marches hillforts were abandoned at the time of the Roman conquest but re-occupied in the later Roman period (Lloyd Jones 1984). It has been suggested that The Berth was abandoned at the time of the Roman conquest (Lloyd Jones 1984, 53), although the pollen evidence suggests that open land persisted in at least the vicinity of Berth Pool throughout the Roman period. The Berth only occupies part of the pollen source area of Berth Pool although this pollen source area is thought to be relatively restricted. If the drier soils on the summit and slopes of The Berth had been abandoned, more substantial rises in Betula should have occurred in early B11, increases in Quercus, Fraxinus and Corylus/Myrica should also have been in evidence.

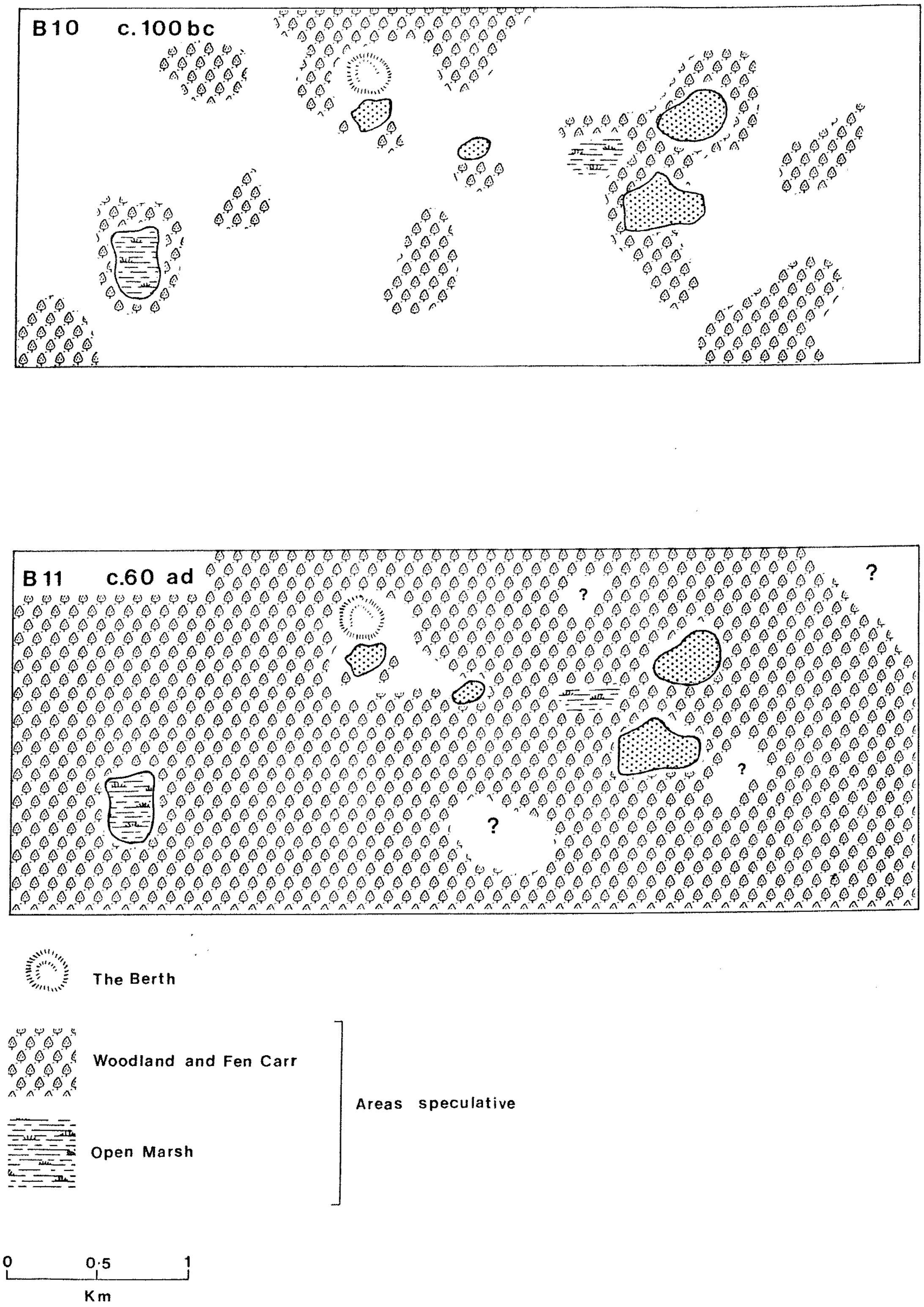
The demolition of hillfort defences is documented in Wales and the Marches, but it is not always clear whether this was due to inter-tribal warfare or the Roman campaigns of the 1st century AD (Savory 1976, 282). Not all occupied sites would have been fortified. A weakly defended homestead, New Pieces, near to The Breiddin was possibly occupied throughout the Iron Age and up to the 3rd century AD (Lloyd Jones 1984). During the 1st century BC, a new range of imported goods reflect increasing continental contacts in southern Britain (Cunliffe 1978), imported goods include La Tene III brooches (Cunliffe 1978) one of which was found at The Berth (Tyler 1981). During the Roman period, Shropshire appears to have lain on the edge of the Civil Zone (Chitty 1956) and crop mark evidence attests to the presence of Roman forts and marching camps in the County (Rowley 1972, 34 - 35). The only excavated hillforts in the area with Roman pottery are The Berth, The Breiddin and Oliver's Point (Stanford 1980). During the time period of B11, Wroxeter (Figure 1) was established as a military base prior to the Roman conquest of Wales (Rowley 1972, 35), in the latter part of the 1st century AD the town became the capital of the Cornovii tribe (Rowley 1972, 35; Richmond 1963). Cornovian territory included

The Berth and The Breiddin (Webster 1975). If the chronology of B11 is correct, land abandonment at the onset of the phase was a late Iron Age phenomenon and thus the Romans would have arrived in the area in the mid 1st century AD and found lowland north Shropshire to be mainly forested.

6.6 Regional correlations

Phase B11 has biostratigraphic parallels with postulated woodland regeneration phases at Crose Mere (Beales 1980), Whixall Moss (Turner 1964a, 1965), the Lancashire-Cheshire Mosses (Birks 1963-4, 1965; Beales and Birks 1973) and, further afield, sites in the south-east Lake District (Oldfield, 1963). B11 in the Baschurch area is thought to correlate to CMCP9 at Crose Mere (Beales 1980), that is, the same phase is represented in both cases. On biostratigraphic grounds, the radiocarbon dated level at 192cm to 201cm at Crose Mere, 2310-85 (Q-1233), corresponds to c.180cm at Fenemere, at these levels at both sites *Betula*, *Quercus* and *Fraxinus* increase and *Pinus*, Gramineae and *Pteridium* decline. The onset of woodland regeneration is also seen in sections I and J in the pollen spectra at Whixall Moss (Turner 1964a, 1965). In these horizons, initial increases in *Betula* and *Fraxinus* accompany declines in *Pinus*, Gramineae, *Plantago* and *Pteridium*, subsequently *Betula* and *Fraxinus* are reduced and *Ulmus*, *Quercus* and Coryloid increase. An extrapolated date of 50BC is assigned by Turner (1965, 347) to the initial *Betula*/*Fraxinus* increases; sections I and J are thus taken to be equivalent to B11 and CMCP9. The suggestion by Beales (1980, 156) that the CMCP8/CMCP9 transition at Crose Mere parallel the F/G regeneration phase at Whixall must therefore be reassessed with reference to the results from the Baschurch area (Figure 19). At Holcroft and Lindow Mosses (Figure 1), Birks (1965) identified a regeneration phase, R4, which appears to be late Iron Age and early Roman in date (Beales and Birks 1973). In the south east Lake District, Oldfield (1963) identified a phase of woodland regeneration, Episode D, which preceded a re-expansion in clearance which was assigned, with reference to a radiocarbon date, to the Roman period. Prior to the Episode D regeneration, the pollen diagrams from the area show evidence for woodland clearance and there are biostratigraphic parallels with B8 and B10 at Baschurch and CMCP8 at Crose

Fig 34 Cleared Areas in B10 and B11



Mere (Beales 1980, 156).

Across north west Britain, therefore, the vegetational history is characterised by a phase of extensive clearance, dating to the later Bronze Age and early Iron Age followed by a phase of land abandonment and woodland regeneration, apparently in the later Iron Age and early Roman periods,and succeeded by a re-expansion of clearance in the later Roman period. The pollen diagram from Berth Pool is clearly anomalous and provides evidence that important localised variations in the general vegetational pattern can occur.

6.7 Summary: phase B11

Towards the end of the Iron Age, the population of Britain is thought to have reached the 2 million mark (Fowler 1983, 33). The country itself could even have been over-exploited at this time, possibly "on the verge of a major political, social and technological collapse" (Taylor 1984, 82). If the processes of growth and decline which affected the development of economy and society in prehistoric Britain were indeed cyclical (Bradley 1984, 165) and Iron Age Britain was actually approaching a state of economic collapse in the late first century BC (Taylor 1984, 83), then perhaps the hillfort culture of the Welsh Marches experienced a major political upheaval at this time. The onset of the major clearance phase, B10, appears to correlate to the establishment of a new authority in the Marches c.400bc (Savory 1976, 266; section 5.15.2 above) and the end of this clearance phase could correlate to the demise of that authority late in the 1st century BC. B11 appears to have lasted just long enough for high forest to have become re-established in the Baschurch area (Figure 34). In the 2nd century ad this forest was cleared and by the 4th century ad, the Baschurch area was once again denuded of woodland; this renewed clearance activity is examined in the next chapter.

CHAPTER 7

CLEARANCE AND FARMING IN THE ROMANO-BRITISH, ANGLO-SAXON AND LATER HISTORICAL PERIODS

7.1 Introduction

The Romano-British clearance phase, B12, appears in its entirety at Birchgrove Pool, Berth Pool and possibly at the margin of Boreatton Moss. The diagrams from Fenemere, Marton Pool and, possibly, the centre of Boreatton only show the early indications of renewed clearance activity c.150ad. Phases B13 and B14 only appear at Berth Pool and no inter-site comparisons are therefore possible and these phases are dealt with briefly.

7.2 Phase B12: Romano-British farming, c.150ad to c.400ad

The woodland regeneration phase, B11, is succeeded at Birchgrove Pool and Boreatton Moss (margin) by a re-expansion of cleared land dated, by extrapolation, to the Romano-British period. The land around Berth Pool continues to be predominantly clear of trees. The following horizons in the diagrams from the Baschurch area are assigned to phase B12:

Fenemere:	c.164cm and above
	164cm = c.150ad (Figure 9)
Marton Pool:	above c.220cm
	220cm = c.150ad (Figure 11)
Birchgrove Pool:	c.230cm to c.216cm
	c.150ad to c.400ad (Figure 12)
Berth Pool II:	c.145cm to c.135cm
	c.150ad to c.400ad (Figure 8)
Berth Pool III:	c.164cm to c.156cm
	biostratigraphic correlation to Berth II
Boreatton Moss (centre)	c.108cm
	biostratigraphic correlation to Baschurch Pools
Boreatton Moss (margin)	above 148cm
	biostratigraphic correlation to Baschurch Pools.

Fenemere: 164cm and above

Quercus frequencies are comparatively high, but Betula and Fraxinus are reduced. A short-lived Pinus peak occurs at 168cm to 164cm. Shrub pollen diversity increases at 164cm and Gramineae increases, Secale occurs at more than 1% at 164cm and 160cm. Tubuliflorae occurs in consecutive samples above 168cm and increases occur in Plantago lanceolata and Rumex acet. Herb pollen diversity is generally low but total tree pollen declines and an increase in Pteridium occurs. A single ZONATION split is placed at 164cm to 168cm but, in relative terms, pollen content changes are slight.

Marton Pool above c.220cm

Quercus declines, a short-lived Pinus increase is seen but Betula and Fraxinus remain relatively high. A slight increase in Gramineae occurs above 220cm, Secale occurs in consecutive samples, open habitat indicators diversity and Plantago lanceolata and Rumex acet increase. Total tree pollen declines and Pteridium increases. ZONATION splits do not occur.

Birchgrove Pool c.230cm to 216cm

Betula, Quercus, Alnus, Fraxinus and Corylus/Myrica decline. Ericaceae and Gramineae increase and peaks in cereal (undiff) and Secale occur. With the exception of Rumex, open habitat indicators increase in frequency other herb pollen diversifies and Cyperaceae increases. Total tree pollen declines, Filicales increases, but rises in Pteridium are relatively restricted. ZONATION splits occur in both statistics at 230cm, indicating the significance of the changes in pollen content.

Berth Pool II c.145cm to 135cm

A slight reduction in Quercus occurs at 144cm, Betula declines at 140cm and Alnus is also reduced at 140cm. Increases in Corylus/ Myrica and Sambucus occur and Gramineae increases. Liguliflorae increases and Artemisia occurs in successive samples. Rosaceae increases and Urtica remains relatively high. Total tree pollen declines, mainly as a result of the Alnus decrease and the increase in Gramineae. ZONATION splits occur in both statistics between 132cm and 136cm.

Berth Pool III c.164cm to 156cm

Betula declines slightly at 156cm, but a peak in Quercus occurs at 160cm; Alnus frequencies decline gradually. Corylus/Myrica values remain unchanged but Salix declines. A small Sambucus peak occurs at 160cm and Gramineae increases. In both cores, Secale only appears in the sample which marks the B12/B13 transition. Liguliflorae declines slightly and Artemisia does not occur; Plantago lanceolata increases. Urtica remains relatively high. A slight dip in the Urtica curve occurs at 160cm before the frequency peaks at 156cm, this feature has parallels at 140cm and 136cm respectively in core II. Total tree pollen is reduced at 156cm, in core III, a Pteridium rise occurs. A ZONATION split in SPLITLSQ occurs between 160cm and 164cm.

Boreatton Moss, centre 108cm

Quercus reaches a maximum but slight increases in Gramineae, Plantago lanceolata and Pteridium occur, these pollen frequency changes could mark the onset of B12.

Boreatton Moss, margin above 148cm

Betula, Ulmus, Tilia, Quercus and Alnus decline; peat accumulation appears to have been slow at this time at the margin; the Betula and Fraxinus declines are possibly strictly B11 features. Gramineae increases and substantial peaks in cereal (undiff) and Secale pollen occur. Tibuliflorae and Liguliflorae increase but, initially, Plantago lanceolata remains low and the diversity of other herb types is low. Total tree pollen declines and Pteridium increases. Dating is uncertain, if peat accumulation remained slow for several centuries, the cereal peaks at 144cm could be early Anglo-Saxon features.

In contrast to the pattern in previous clearance phases, the diversity of aquatic pollen is reduced at Birchgrove Pool in B12. At Fenemere an increase in Nymphaea is associated with a rise in Cyperaceae and a reduction in Alnus. Nymphaea also increases at Marton Pool, although Alnus rises slightly.

7.2.1 Inter- and intra-site contrasts, phase B12

The initial reductions in Betula at 172cm at Fenemere and 228cm at Marton Pool appear to be linked with the establishment of a high forest in the area, where birch become less abundant under an extending oak canopy. Further reductions in Betula however, above 170cm at Fenemere appear to be linked with renewed clearance activity, slight rises in Betula at Marton Pool above 224cm could reflect a re-establishment of birch in newly created clearings. Woodland regeneration thus appears to have lasted just long enough for high forest to have become re-established before man once again became active in clearing the woodland. At Birchgrove Pool, Gramineae begins to increase at the point where Betula declines and Quercus is still high; maximum regeneration and the onset of renewed clearance appear to have been broadly coincident in that fully regenerated woodland does not appear to have persisted for any length of time. The slight Betula reductions at Berth Pool could relate to birch clearance near to that site but could equally be linked to birch reductions closer to Birchgrove Pool, although Betula fluctuations between B8 and B13 at Berth Pool are, in relative terms, minimal, and pollen sources beyond the margins of the site do not appear to have been significant. Realistic comparisons between the centre of Boreatton Moss and the Baschurch Pools cannot be made since it is not known for certain if 108cm is equivalent to early B12. At the margin, an increase in Gramineae and cereal pollen representation coincides with the peak Quercus value; if peat accumulation is slow, a single 0.5cm thick peat sample could contain the intermixed pollen input from many decades but, nevertheless, the indications at Boreatton are that the onset of renewed clearance activity coincided with the final stages of the succession to high forest.

The earliest stages of renewed clearance activity could be in evidence at 168cm at Fenemere and 220cm at Marton Pool where small Pinus peaks occur. Pinus continued to occur at both Fenemere and Marton during B11. Possibly, some pine persisted in the dry land vegetation communities and pollen dispersal conditions improved as the high forest canopy was re-opened. Pinus also occurs in consecutive samples at the B11/B12 transition at Birchgrove Pool. Ulmus frequencies are relatively low at the Baschurch Pools in B11 but at Boreatton where frequencies are higher, Ulmus declines at the B11/B12 transition in the marginal core. In the same core, Tilia also declines at the B11/B12 transition. The Tilia decline in particular probably represents the clearance of lime from the dry ground on the western edge of Boreatton. Tilia is absent at Berth and Birchgrove in B12 but re-appears in early B12 at Marton and Fenemere. Again, early canopy opening could be assisting the dispersal of pollen from lime trees which persisted in the vegetation throughout B11. Fagus ceases to be recorded in consecutive samples in B11 at Marton and Fenemere at the horizons where Pinus re-appears at more than 1%. Tilia occurs at both sites in the second sample of the Pinus peak; Gramineae also increases at this time. There is thus a high degree of biostratigraphic correlation between Marton and Fenemere at the B11/B12 transition.

Locally, alder and ash appear to have been more abundant closer to Marton Pool. Alnus increases slightly and Fraxinus remains relatively high at Marton Pool at the B11/B12 transition; Alnus and Fraxinus decline at this time at Fenemere. Low Fraxinus values occur in B12 at Birchgrove, and Alnus also declines. Salix declines at the onset of B12 at Birchgorve. Fresh inroads could have been made into the damper woodland around that site. At the end of B12 at Birchgrove all arboreal pollen frequencies are reduced although total tree pollen does not fall to B10 levels. Quercus and Alnus frequencies are slightly higher in late B12, compared to mid B10, Corylus/Myrica is also slightly higher in late B12, compared to B10 and some woodland appears to have persisted around Birchgrove Pool throughout B12. Alnus declines throughout B12 in Berth III, but the Alnus decline in mid B12 in Berth II is followed by a sharp peak in Alnus. This Alnus peak in Berth II is probably anomalous and the same could also be true of the mid B12 Quercus peak in Berth III although with a 4cm sampling interval and the relatively slow accumulation rate at Berth Pool, precise level to level correlation will not be achieved, and short-lived Alnus and Quercus rises could be present, respectively, in cores III and II. Total tree pollen declines at Berth Pool in B12 but, as at Birchgrove Pool, values are not as low as those in B8 to B10; the pollen source areas of these two sites appear to have been more open in the Iron Age than in the Roman period.

The tree pollen total at 144cm at the margin of Boreatton Moss is the lowest recorded on the diagram for that core site. Quercus and Alnus are substantially reduced and Betula is the only other arboreal pollen type to occur. Betula values in B12/?B13 at the margin of Boreatton are relatively high in comparison to late B8-B10. Some birch colonisation of the edge of the peat surface could be in evidence here.

Uncertainty surrounds the age of the horizon at 144cm at the margin of Boreatton Moss. High Secale values occur in B13 at Berth Pool, although a Cannabis type peak occurs in B13 at Berth and no Cannabis was recorded at Boreatton. The Arable:Pastoral index (Turner 1964) changes dramatically at 148cm and 144cm at the margin of Boreatton Moss:

140cm	81.2%
144cm	4.1%
148cm	5.5%
150cm	only Secale (2 grains) and Plantago (1 grain) present

If 144cm does date to the Romano-British period, crops must have been grown at the side of Boreatton Moss at this time.

Secale appears in B12 at Marton, Fenemere and Birchgrove, rising to more than 1% at the latter two sites. There are grounds therefore for accepting 144cm as a B12 horizon but inter-site correlations are problematic since the date is uncertain. The rises in Secale at Fenemere and Birchgrove Pool are thought to have occurred at the same time. At Fenemere Secale increases to more than 1% in the second sample of the Pinus peak, a marked increase in Gramineae also occurs at this time. At Birchgrove Pool, an early B12 Secale rise occurs at 228cm. Pinus occurs in two consecutive samples at Birchgrove at 232cm and 228cm; Fagus ceases to be recorded in consecutive samples when Pinus appears at 232cm, an obvious biostratigraphic correlation to the spectra at Fenemere at 168cm to 172cm.

An increase in shrub pollen diversity occurs at 164cm at Fenemere, although Corylus/Myrica and Salix remain relatively high. Salix is also well represented at Marton Pool and a slight increase in Corylus/Myrica occurs at 212cm and 216cm at Marton Pool. Apart from Corylus/Myrica only Salix and Hedera both at less than 1% occur in early to mid B12 at Birchgrove Pool. The frequencies of Corylus/Myrica at Birchgrove, Fenemere and Marton could point to an enhanced flowering of hazel under a more open canopy. This could be particularly true at Birchgrove Pool where Corylus/Myrica remains high for most of B12. Between 164cm and 156cm in Berth III, Corylus/Myrica rises very slightly; a clearer rise is evident in Berth II although values are substantially lower in comparison to the three other pools. Apart from alder, tree and shrub abundance close to Berth Pool appears to be very limited. The slight Sambucus increase could point to the presence of elder on settlement soils. B12 is not shown in its entirety at Marton and Fenemere and therefore a local rather than regional reconstruction of the vegetation can be made here.

Early Gramineae and open habitat indicator rises are in evidence at Marton and Fenemere suggesting that the clearance re-expansion is indeed a regional phenomenon. Locally, the full extent of the N.A.P increases can be appreciated at Birchgrove Pool. Gramineae increases but not to B8 or B10 levels. The Secale rise has already been noted, a short-lived Tubuliflorae peak occurs and a marked rise in Liguliflorae can be seen. The Plantago lanceolata increase is relatively restricted and Rumex acet remains relatively low. Other herb pollen types diversify; those types associated with the B8 and B10 clearance expansions re-appear in B12; Caryophyllaceae, Campanulaceae, Labiatae, Rubiaceae and Umbelliferae occur and a distinct rise in Rosaceae is seen. The mean Arable:Pastoral index for 216cm to 232cm at Birchgrove Pool is 31.1%, with a standard deviation of only 5.1. Compared to the A:P indexes in B10 (Figure 30; Chapter 5) a trend towards arable farming is indicated in B12 around Birchgrove Pool (cf Maguire et al 1983). Not only are Gramineae, Plantago lanceolata and Rumex acet values lower in B12 at Birchgrove, compared to B8-B10 but Pteridium values are substantially lower in B12. It could be that arable land rather than rough grassland surrounds Birchgrove Pool in B12 whereas land around Birchgrove was cleared to provide pasture in the Iron Age; it appears to have been cleared to make way for cropland in the Romano-British period. The mean A:P index for B12 in Berth II is 46.0%; = 5.16, in Berth II, the mean index is 53.5%; = 5.71. The character of the open habitats around Berth Pool in B12 appears to be similar to that in B11. In both cores from Berth Pool, Gramineae rises in mid B12 but *Secale* is absent and cereal (undiff) pollen only occurs in Berth II. Liguliflorae continues to occur in both cores, although in B12 frequencies are slightly higher in Berth II. *Plantago lanceolata* and *Rumex acet* representation remains relatively constant, slight increases in *Plantago* can however be discerned in both cores. Other herb pollen types previously associated with clearance activity continue to occur, for example, Caryophyllaceae, Campanulaceae, Labiatae, Rosaceae, Ranunculaceae, Rubiaceae and Umbelliferae. Interestingly, *Artemisia* occurs in consecutive samples in Berth II but is absent in Berth III. Gramineae and Liguliflorae are higher in Berth II. Obviously some intra-site variability in herb pollen representation can be expected, although the differences tend only to involve minor frequency fluctuations. Relatively high *Urtica* values persist into B12 and peak at the end of the phase, possibly reflecting colonisation by nettles of "settlement soils" close to Berth Pool. In comparison to the occurrence of *Urtica* frequencies of c.5-8% at Berth Pool, *Urtica* only occurs in one sample, at less than 1%, at Birchgrove Pool. Fen peats, which could have been colonised by *Urtica dioica*, exist around both sites and the contrast between the sites in *Urtica* frequencies might indeed relate to the presence of a settlement site close to Berth Pool.

The *Pteridium* increase in Berth III has no clear parallel in Berth II, but *Pteridium* frequencies are comparable to those in B12 at Birchgrove Pool, where a reduction in the importance of rough grassland is postulated in B12. In late B12 at Birchgrove Pool, a reduction in *Secale* is associated with limited increases in Gramineae and *Pteridium*. These changes have biostratigraphic parallels above 144cm at the margin of Boreatton Moss, reductions in cereal representation are associated with increases in Gramineae and *Pteridium*. An Ericaceae increase occurs in late B12 at Birchgrove and at 140cm at the margin of Boreatton. Correlation between the two sites is uncertain, but if correct suggests that some farmland was abandoned late in the Romano-British period and allowed to revert to rough pasture, with some bracken and heather colonisation.

The end of phase B12 is characterised at Berth Pool by several marked pollen frequency changes. The samples at 136cm and 156cm in Berth II and III respectively mark the uppermost horizons of B12, in the horizons immediately above these, Quercus increases and Alnus declines substantially, Secale and Cannabis type increase in frequency and, among the other herb types, Liguliflorae and Urtica are reduced. The end of B12 at Berth Pool thus marks the end of a long period over which the pollen frequencies of several taxa remained largely unchanged. In Figure 35 mean frequencies of selected pollen types from Berth II and Berth III are shown. The mean values are calculated using those counted levels over which the types exhibited little apparent fluctuation in frequency. Continuous curves for Cruciferae and Hypericum perforatum type end at the B10/B11 transition. Means for the other types are calculated using the curves present from B8 to B12. For all the pollen types shown in Figure 35, the mean pollen frequency in one core lies within one standard deviation of the mean in the other core, a clear indication of the degree of core to core pollen frequency replicability. Berth II and Berth III are both deep-water cores, although the pool would only have been c.5m to 6m deep when the sediments in question accumulated. Within-group homogeneity in pollen spectra has been demonstrated for deep water short-cores (R.B. Davis et al 1969), although significant differences in the pollen content between deep and shallow water short-cores can occur (Davis et al 1969, Davis et al 1971, Davis and Brubaker 1973). Over a longer timescale however, pollen frequency variations between deep and shallow water cores do not appear to have a significant effect upon the interpretation of the pollen spectra (Edwards and Thompson 1984, Tolonen 1984).

Apart from the B10/B11 Alnus rise at Berth Pool, probably reflecting a highly localised alder carr expansion, the character of the vegetation across the dominant pollen source area of Berth Pool appears to have changed little over a period of c.1000 radiocarbon years, from the end of the later Bronze Age to the end of the Romano-British period. At Birchgrove Pool, the start of B13 could just be in evidence in the upper horizons of the pollen diagram where Cannabis type appears, although this is not certain. During B12, the pollen spectra at Birchgrove Pool and Berth Pool have several features in common, Alnus is progressively reduced and Gramineae, Liguliflorae, Plantago lanceolata and Pteridium frequencies are comparable between the sites. During B8 to B10, the spectra at Birchgrove Pool were more dissimilar, with higher Gramineae, Plantago, Rumex and Pteridium frequencies when compared to Berth Pool. During B10, the land around Birchgrove Pool appears to have been dominated by rough, open grassland, possibly representing the open grazing areas on the periphery of a farmed area which had The Berth at its centre. In B12, similar land use practices appear to have affected both Berth Pool and Birchgrove Pool although higher Urtica and Sambucus frequencies could point to the existence of a settlement closer to Berth Pool (cf Godwin 1975, Sinker et al 1985).

7.2.2 Sediment loss on ignition

The % loss on ignition of the Berth Pool sediments remains at c.50% to 60% in B12; the sediment continues to be mainly organic (Figure 13). Between 140cm and 260cm in Berth II, mean L.O.I is 53.9%, with a standard deviation of only 3.78%; anthropogenic activity in the catchment area of Berth Pool does not appear to have resulted in substantial inorganic inwashing into the pool over this period, covering phases B2 to B12. A slight decline in L.O.I occurs in early B12 at Fenemere pointing to an increase in inorganic inwashing.

7.2.3 Archaeological and Historical evidence

Palynological evidence from the Shropshire lowlands suggests that, in the early Roman period in the area, wide tracts of land supported a regenerated woodland cover. By the time of the start of the 3rd century AD, this woodland appears to have been extensively cleared.

The civil town of Viroconium (Wroxeter), some 7km south east of Shrewsbury, was the fourth largest in Roman Britain (Chitty 1956, 181). It was handed over by the army to the civil authorities by the end of the 1st century AD and was a prosperous town in the 2nd and 3rd centuries AD (Rowley 1972, 38). Some Romano-British villa sites are known in Shropshire but, generally, settlement evidence from the countryside is lacking (Rowley 1972, 40). Viroconium formed the tribal capital of the Cornovii; Cornovian territory covered the whole of the Cheshire-Shropshire lowland, and included therefore The Berth. The size of Viroconium itself has led to the suggestion that an uneasy security existed in the Cornovian territory in the later Roman period (Richmond 1963, 261), with the landowners residing in the garrisoned town whilst peasant farmers tilled the land. Recent estimates of the population of Roman Britain point to a figure of 5 million; where evidence from air photographs and from excavations is avilable, a high density of rural settlements is indicated (Fowler 1983, Taylor 1984). A planned re-organisation of the landscape could have occurred in parts of Britain in Roman times, perhaps with the widespread establishment of new tenurial units (Taylor 1984, 104-105). During the 2nd and 3rd centuries AD, therefore, it is possible that Viroconium lay within an extensively cleared, re-organised and intensively farmed landscape, a different picture to that which emerges in the 1st century AD (Chapter 6).

7.2.4 The regional vegetation pattern in the later Roman period

B12 is thought to correspond to zone CMCP10a at Crose Mere (Beales 1980) and to the clearance episode C5 defined for the region by Beales and Birks (1973). A decline in the tree pollen total and a rise in *Pteridium* late in Section J at Whixall Moss (Turner 1964, 1965) is thought to correspond to early B12 in the Baschurch area. Gramineae increases and herb pollen types diversify in the upper horizons of CMCP9 at Crose Mere. Further increases in Gramineae and in cereal pollen characterise the onset of CMCP10a. *Pteridium* increases only slightly in CMCP10a, values are lower in comparison to CMCP8. Beales (1980, 157) suggests a late Roman date for CMCP10a and suggests the presence of a more arable-orientated land use regime. There is thus a good agreement, in terms of chronology and vegetational inference, between the results from the Baschurch area and from Crose Mere. The radiocarbon date for the renewed forest clearance at Crose Mere, 2086$\pm$75bp (Q-1232) does appear to be "anomalous" (Beales 1980, 156). The regeneration phase CMCP9 is believed, on the basis of the evidence considered above (Chapter 6) to commence c.2000bp and to end c.1800bp; CMCP9 does not date to the time of the maximum expansion of the Welsh Marches hillfort culture (*cf* Beales 1980, 156). Extensive farming is postulated for the Romano-British period by Beales and Birks (1973, 15) in a clearance episode designated C5. Extensive forest clearance and widespread farming activity occurred in the later Roman period in north west Britain, for example, in the south east Lake District (Oldfield 1963). Turner (1979) showed that in north east England landscapes which were largely wooded in the Iron Age had lost most of their tree cover by the end of the Roman period; these clearances are also discussed by Donaldson and Turner (1977). Intensive agricultural activity occurred in Wales in the Iron Age/Roman period (Moore and Chater 1969, Price and Moore 1984); Jones et al (1985) showed that agricultural activity in the Roman period in south Wales had affected sedimentation in Llangorse Lake.

Peat above a recurrence surface at Fenn's Moss, part of the Whixall Moss complex in north Shropshire/Powys has a radiocarbon date of 1670±110bp/280ad (Godwin and Willis 1960). At Whixall Moss itself, peat above a recurrence surface has a date of 1750±60bp (SRR 3035; Haslam, in prep). These dates point to a climatic deterioration in Roman times in Shropshire and in the west Taylor (1980) refers to a phase of environmental stress which developed in Wales at the end of the Iron Age.

7.2.5 Summary: phase B12

For the later prehistoric and earlier historic periods the chronology of vegetational change which is indicated by the radiocarbon dates from Fenemere is in closer accord with the archaeological evidence than the chronology indicated by the radiocarbon dates in Beales (1980). Biostratigraphic correlations between the Baschurch Pools and Crose Mere point to the establishment of arable farming across much of the Shropshire lowland in the Romano-British period, this is in contrast to the mainly pastoral character of the landscape between 800bc and 50bc. The next phase of vegetational change, B13, appears in its entirety only at Berth Pool. During this phase a new system of arable farming is established in the catchment area of Berth Pool. The impact of this farming system is sufficient to cause substantial erosion in the catchment.

7.3 The post-Roman period

This period is divided into two phases, these are only represented in full in Berth Pool II. They will be briefly outlined and discussed. No inter-site comparisons can be made and discussion of the two phases serves to place the more fully examined prehistoric phases in context. A major stratigraphy change occurs at 119cm in Berth Pool II (2.2.1) and above 50cm samples are taken from a mini-Mackereth core which spanned the mud water interface in the same coring locality in which the Russian core, Berth II, was taken. Extrapolation of the age/depth profile thus becomes relatively speculative above 199cm. The estimate is however that the B13 stratigraphy change occurs c.800ad and the B13/B14 transition dates to c.1000ad.

7.3.1 The Anglo-Saxon period: phase B13

Main characteristics

Berth Pool II c.135cm to 88cm
c.400ad to c.1000ad (Figure 8)

Betula frequencies are initially slightly higher but decline later in the phase where increases in *Pinus* occur. *Quercus* increases at the onset of the phase but subsequently declines. A sharp reduction in *Alnus* characterises the onset of the phase. *Fraxinus* increases slightly and *Corylus/Myrica* tends to decline. Peak values of *Secale* and *Cannabis* type occur early in the phase, Gramineae increases and total tree pollen declines to B9 levels. A progressive decline in *Pteridium* occurs.

Berth Pool III c.152cm

Sampling of this core ceased when the *Cannabis* rise was encountered, other correlations between the two cores include a marked increase in *Quercus* and a decline in *Alnus*; *Secale* increases and Liguliflorae and *Urtica* decline.

Birchgrove Pool ?216cm to 212cm
212cm = c.480ad (Figure 12)

On the basis of the extrapolated dates, these samples are strictly post-Roman. Cannabis type appears at 216cm and a substantial rise in Cannabis could be present above 212cm. Correlation with early B13 at Berth Pool is uncertain and therefore these samples are not included in an inter-site comparison.

7.3.2 The Anglo-Saxon period at Berth Pool

Previous palynological contrasts between Berth Pool and the other Baschurch Pools have indicated a very restricted pollen source area for Berth Pool. The pollen frequency changes at the B12/B13 transition and above are therefore taken to be mainly representative of vegetational changes occurring within c.200m to 300m of the edge of the pool. Substantial changes are indicated in the vegetation communities in the vicinity of Berth Pool c.400ad to 500ad. The changes appear not to be gradual, but to be rapidly implemented. Very slight increases in Betula occur in both cores at the onset of B13. These increases are probably linked with increases in Quercus which occur early in B13 in both cores. Both cores confirm sharp decreases in Alnus. Fraxinus re-appears in consecutive samples in Berth II. Frequencies are slightly higher in Berth III. Taxus appears in two consecutive samples in early B13 in Berth II and Carpinus appears for the first time in core III. A degree of woodland recolonisation could be occurring on some previously cleared soils, involving mainly oak, but with some birch and with ash possibly important. Hornbeam, Carpinus betulus, does not appear to have been important as a native tree in Shropshire (Sinker et al 1985), but Carpinus pollen occurs more regularly in zones CMCP10a and above at Crose Mere (Beales 1980). If limited tracts of drier soils were subject to some oak, ash and birch recolonisation, wide tracts of damper soils appear to have been almost completely cleared of alder. The low pollen frequencies suggest that only a few individual trees remained in the pollen source area of the pool. The low Corylus/Myrica frequencies could point to the persistence of a few individuals of hazel, but amongst the other shrubs only willow appears to remain. The end of a continuous record of Sambucus suggests that, locally, elder was completely removed. An alteration in the vegetation pattern around Berth Pool can be envisaged which involves a change from the pre-existing pattern, with open land surrounding an alder fringed pool, to a new pattern with the pool surrounded by open peat areas with some woodland regrowth on the formerly open, drier soils. Compared to B12, Gramineae values are slightly lower in early B13 and cereal undiff pollen occurs occasionally. The high frequencies of Secale and Cannabis type which occur between 120cm and 132cm are thought to date to between c.500ad and c.760ad. Thus, the Anglo-Saxon cultivation of rye and hemp is thought to be in evidence in early B13 at Berth Pool. Godwin (1967) notes that high frequencies of Secale are consistently associated with high values of Cannabis from the Anglo-Saxon period onwards. Rye is thought to have been present as a crop and at 128cm the occurrence of two grains of Fagopyrum esculentum pollen could point to the cultivation of buckwheat; buckwheat is typically cultivated on light sandy soils (Godwin 1975, 234) and these are present in the pollen source are of Berth Pool. The Cannabis type pollen at Berth Pool has not been positively identified as belonging to Cannabis sativa. Male hop, Humulus, plants are not extensively grown where hops are cultivated (Godwin 1975, 242) and high frequencies of Cannabis-Humulus type pollen are assumed to point to hemp cultivation, particularly if the high frequencies are associated with high frequencies of Secale and the occurrence of Linum. Linum pollen is not recorded at Berth Pool but at Birchgrove Pool Secale, Cannabis type and Linum bienne type occur in samples thought to date to early B13. Hemp grows well in heavier and deeper soils and the multiple ox-teams used to draw ploughs in the Anglo-Saxon period would have permitted the cultivation of these heavier soils (Godwin 1975, 243). The Alnus decline could thus be due, in part, to the removal of alder from soils which were then turned over to hemp cultivation. Hemp itself is prepared for extraction of the fibre by immersion in water so that rotting or "retting" of the extraneous plant material occurs. Artificial or natural pools could be used as "retting" pools (cf French and Moore 1986). Some alder could have been cleared away from the margins of Berth Pool to allow ease of access to water's edge where the hemp grown around the site could have been immersed for "retting".

Changes in species abundance amongst the herb flora are indicated at the B12/B13 transition. Curves for Liguliflorae and Urtica end with the appearance of Cannabis type and Secale; Caryophyllaceae occurs less frequently and Campanulaceae ceases to be recorded. Leguminosae (undiff) and *Trifolium* type occur less regularly, Rosaceae declines and Rubiaceae appear less frequently. *Artemisia*, Chenopodiaceae and Cruciferae occur occasionally and *Rumex acet* declines. *Plantago lanceolata*, however, increases in frequency after an initial reduction at 132cm. The herb flora around Berth Pool appears to have become less diverse in early B13. Compared to a mean Arable:Pastoral index (Turner 1964a) of 46.0% for B12, the index declines to 23.2% at 132cm and 39.1% at 128cm before increasing to 72.3% at 112cm and 72.5% at 96cm; the index for 152cm in Berth III is 33.3%. There thus appears to be a trend away from arable farming in the later stages of B13. *Betula* and *Quercus* tend to decline and Gramineae frequencies expand. The rise in *Fraxinus* could point to the persistence of ash as a hedgerow taxon (*cf* Cameron and Pannett, 1980; Sinker et al 1985). The postulated establishment of rye and hemp cultivation appears to have been to the detriment of taxa such as dandelions, bellflowers, nettles and rosaceous herbs. Conceivably, there was a reduction in the area of wasteland associated with any settlement sites. Some of the last herb diversity seems to be regained later in the phase. Liguliflorae increases, *Trifolium* type occurs. Again, Umbelliferae appears in successive samples and *Filipendula* increases. Open pasture, with reduced bracken colonisation appears to characterise the later Saxon period in the area. A limited re-expansion of alder is indicated following the arable phase. *Pinus* increases in mid to late B13 could point to the development of heathland, perhaps at some distance from the pool. *Sparganium/Typha* is temporarily absent at the *Alnus* decline horizon at 132cm. A diversification of aquatic pollen occurs above this level with *Myriophyllum* and *Nymphaea* regularly recorded. The reduction in *Sparganium/Typha* could be linked to clearance activity involving the fen or marsh areas adjacent to the edge of the pool. Clearance of burr-reed or reed mace appears to have led to a short-lived increase in colonisation or flowering amongst *Potamogeton* spp. At 104cm, tree and shrub pollen combined amounts to less than 20% of total determinable land pollen. In the late Saxon period therefore the landscape around Berth Pool appears to have been as open as it is today, although a similar degree of clearance occurred in the mid Iron Age.

7.3.3 Magnetic measurements: Berth Pool (Figure 21)

Four sediment samples were selected for analysis from B13, in order to assess the significance of the sedimentological changes which take place in this phase; an increased clay fraction is deposited in the sediment immediately below 120cm, at 119cm the brown detritus mud of the earlier phases gives way to a lighter brown fine, clay-rich detritus (2.2.1).

Slight increases in χ, ARM and SIRM occur below 120cm, above this level further increases are in evidence. Also, above 120cm, χ fd increases; ARM/ χ remains relatively low, SIRM/ χ is higher in comparison to B10, but SIRM/ARM is reduced. "Softer" high reverse field ratios are encountered but above 120cm a harder response occurs at the lower reverse fields. Samples from B13 plot to the lower left of the graph of χ against SIRM (Figure 23) but plot above and to the right of samples from B8 to B10 on the graph of SIRM/ χ versus "S" or IRM_{-100mT} (Figure 24). Increased χ , χfd, ARM and SIRM above 120cm point to an increased concentration of finer grained secondary ferrimagnetic minerals, such as magnetite, in the sediment. These minerals are characteristic of the upper horizons of topsoil (Le Borgne 1955, Mullins 1977, Oldfield et al 1985a, Smith 1985, Thompson and Oldfield 1986). In this case, surface soil erosion into the pool is indicated (Oldfield et al 1985a, 39). In the upper horizons of soils around Newton Mere, Shropshire (Smith 1985) high SIRM/ χ values were associated with high χ values. An increase in SIRM/ χ is associated with increased χ above 120cm at Berth Pool, an increase in the deposition of finer magnetic grains is indicated by the reductions in SIRM/ARM (Thompson and Oldfield 1986). A coercivity profile for the sample from 112cm (Figure 25) shows that the applied forward field is lost from the sample at lower backfield strengths in comparison to the sample from B9. Although the samples from B13 plot to the lower left of the graph of χ versus SIRM (Figure 23) the two samples from above 120cm plot above the main lower group. The B13 samples occupy an intermediate position on the plot of SIRM/χ against 'S'. There are indications therefore that the B13 samples, whilst not closely similar to those from B6 and B7, tend to be more indicative of the inwashing of softer magnetic minerals in comparison to the samples from B8 to B10.

Thus, a shift in sediment sources is indicated in B13, with topsoil sources rather than substrate sources being important (<u>cf</u> Oldfield et al 1985a). Topsoil inwashing in the latter stages of the Anglo-Saxon arable episode is indicated; loss on ignition measurements complement the inferences made from the magnetics data.

7.3.4 Sediment loss on ignition: Berth Pool (Figure 13)

Percentage loss on ignition declines markedly across the B13 stratigraphy change at c.119cm. Compared to a mean of 53.9% between 140cm and 260cm, L.O.I declines to 36.9% at 120-122cm, where clay inwashing is in evidence and to 17.5% at 106-108cm. Substantial inorganic inwashing is clearly indicated (Allen 1974), corresponding to mineral magnetic evidence for topsoil inwashing. Inorganic inwashing appears to have increased whilst rye and hemp were being grown c.800-900ad. erosion however continued in later B13, where Betula, Quercus and Corylus/Myrica decline and Gramineae, Liguliflorae and Plantago lanceolata increase. Possibly, the cutting of drainage ditches in the catchment of Berth Pool occurred in Saxon times and this could have contributed to enhanced inorganic inwashing into the pool.

7.3.5 Historical evidence

Rowley (1972, 43) follows Chitty (1956, 182) in suggesting that The Berth was an important site in Saxon times, possibly succeeding Viroconium as a trade and administrative centre for the Welsh border before Shrewsbury itself was established. The Berth could have been the site of Pengwern, home of a chieftain of Powys who was slain in the 7th century AD (Rowley 1972). There are still doubts, however, about whether The Berth was Pengwern (Stanford 1980, 178). The palynological and sedimentological evidence from Berth Pool points to intensive agriculture in the catchment area of the pool during the Anglo-Saxon period, and occupation at The Berth is certainly a possibility. Some, as yet unassessed features at The Berth could date to the post-Roman period (Tyler 1981, 17). Further excavation at the site could resolve the question of Anglo-Saxon occupation. Smith (1907) reported the discovery of bronze "cauldron" close to the point where the outflow from the pool cuts through the causeway linking The Berth to higher ground to the east (Plate 14). This "cauldron", suggested by Smith (1907) to be a "water clock" has been variously referred to as late Roman (Tyler 1981), sub-Roman or

Romano-British (Chitty 1956) or sixth century (Rowley 1972). The end of phase B13 is tentatively dated to c.1000ad; Rowley (1972, 68) reports that the Domesday survey of 1086 "shows that the basic settlement pattern of (Shropshire) had been established by the 11th century AD". Actual settlement evidence from Saxon Shropshire is rare, although a few Saxon churches survive (Rowley 1972, 45). A new farming system appears to have been established in Saxon times. Wide areas were cleared and cultivated although many "Saxon" villages possibly had earlier origins (Rowley 1972). Recent interpretations of the onset of the Saxon period (Taylor 1984) suggest that rather than marking a time of wholesale folk migrations into Britain, the early Saxon period was characterised by the "political take-over of a disintegrating society" (Taylor 1984, 111), a take-over perhaps effected by a few thousand individuals in a country whose population might have numbered up to five million (Taylor 1984). Place-name evidence in Shropshire is indicative of active woodland clearance in Saxon times (Rowley 1972, 49) although across much of north west Shropshire the lowland forests had been temporarily cleared in the Iron Age and Roman periods.

7.3.6 Regional correlations (Figure 19)

The pollen spectra from B13 at Berth Pool are essentially local in character and biostratigraphic correlations to sites further afield are thus speculative. B13 would correlate, on chronological grounds, to episodes R5 and C6 as defined by Beales and Birks (1973) for the Shropshire-Cheshire Plain. R5 corresponds to a forest regeneration phase in early Anglo-Saxon times in the 6th to 8th centuries. A limited regeneration of oak, and possibly birch, ash and hazel is indicated at Berth Pool in the 6th to 8th centuries AD and some weed pollen reductions do occur although arable cultivation appears to have occurred in very close proximity to the pool at this time. C6 dates to the 9th and 10th centuries and is characterised by the clearance of woodland and increased weed pollen values. *Quercus*, *Betula* and *Corylus/Myrica* decline in late B13 and there are increases in grass and weed pollen values at Berth Pool. There are thus chronological and biostratigraphic grounds for suggesting that B13 is equivalent to R5/C6. There are biostratigraphic parallels between B13 at Berth Pool and early CMCP10b at Crose Mere (Beales 1980). CMCP10a is assigned to Roman times (Beales 1980, 157) and thus the Cannabiaceae increase at the start of CMCP10b could be Anglo-Saxon. Pinus frequencies increase in CMCP10b, there could be parallels here with the tendency for Pinus to appear more frequently from B13 onwards at Berth Pool. The date of the end of CMCP10b is estimated at c.1600AD, obviously after the end of B13; hemp growing could have persisted for a longer period closer to Crose Mere and it is interesting to note that during CMCP10b at Crose Mere a major lithological change occurs in the sediment, loss on ignition is reduced from c.40% to c.20%. Given the estimated date of c.1600AD for the end of CMCP10b, this stratigraphy change would appear to have occurred later at Crose Mere, in comparison to Berth Pool, although at both sites the lithological change could be linked to hemp cultivation.

7.3.7 Summary: phase B13

The onset of B13 marks the end of an extended period of c.1200 radiocarbon years during which little change appears to have occurred in the open vegetation communities which surrounded Berth Pool. Soil erosion is indicated during the prehistoric period but it is in the first three to four centuries of the Saxon period when the impact of man becomes sufficient to cause a major lithological change in the sediments of the pool. By the end of B13, the land around the pool has once more become pastoral in character, by this time, "the basic settlement pattern of the county had been established" (Rowley 1972, 68). The importance of The Berth in Saxon times is still open to debate (cf Stanford 1980) although the palaeoecological evidence is such that human settlement close to Berth Pool can be confidently inferred in the early Anglo-Saxon period.

7.3.8 Phase B14: The later historic period at Berth Pool

The B13/B14 transition is defined with reference to numerical zone splits in the pollen spectra of Berth Pool II. The chronology of the phase is speculative and the upper horizons of the pollen diagram, above 50cm, represent samples taken from a mini-Mackereth core which spanned the mud-water interface in the same coring locality as the Russian core, Berth II. Apart from relatively recent tree pollen reductions, and a concomitant expansion in grass pollen, the pollen spectra from B14 show that in general terms the character of the vegetation around Berth Pool today is closely similar to that indicated in late B13.

Main characteristics

Betula persists throughout the phase but frequencies remain low. *Pinus* is recorded more consistently in comparison to B10 to B12 and an *Ulmus* peak occurs in the latter half of the phase. *Tilia* occurs in successive samples in early B14 in contrast to its absence throughout B11, B12 and B13. *Quercus* frequencies remain relatively constant and are comparable to those seen in B8 to B12. *Alnus* increases and Fagus occurs in the horizons where *Ulmus* increases. Increases in Gramineae later in the phase are associated with reductions in *Plantago lanceolata* and *Rumex*. Total tree pollen increases in mid B14 and the continuous curve for *Pteridium* ends at the onset of the phase.

7.3.9 Phase B14: Vegetation and land use

Previous palynological contrasts between Berth Pool and the other Baschurch Pools suggested that the pollen source area of Berth Pool was no more than c.1km^2 in extent, even when tracts of open land surrounded the site (*cf* Tauber 1965). During historic times, the cutting of drainage ditches into the Pool would change it from a closed basin to an open basin and this would influence the extent of the dominant pollen source area at the site (Pennington 1979). *Betula* frequencies remain low throughout B14, pointing to the persistence of only a few individuals in the local vegetation or alternatively to the continued abundance of birch on some unexploited soils beyond the immedite environs of Berth Pool (cf Oldfield 1970). The Pinus pollen in B14 has probably been carried to the site from sources at some distance, perhaps from pine growing on heaths, on thin sandy soils on the higher sandstone ridge crests or on peat mosses (Sinker et al 1985, 178). In contrast to its infrequent occurrence in B13, Ulmus appears regularly in B14 and exhibits a peak above 40cm. Fagus appears in consecutive samples where Ulmus increases and the planting of elm and beech could be indicated here. Extrapolation of the age/depth profile from the 800ad stratigraphy change to the mud surface (Figure 8) suggests a 16th century ad or 17th century ad date for the Ulmus peak. Quercus remains at c.5% throughout B14, variations in oak abundance around Berth Pool appear to have been relatively slight, following the Quercus decline at c.800bc. Re-expansions in the area of alder woodland at the edge of Berth Pool appear to occur in late B13 and early to mid B14; the Alnus rise follows a reduction in Cannabis type, conceivably some damp soils which had been utilised for hemp cultivation were abandoned and allowed to regenerate alder cover. In the more recent past, probably in the 18th centurey, Alnus declines, probably as a result of grassland expansion onto the peats around Berth Pool as land drainage improved. The occurrence of Fagus is mainly confined to the levels of the Ulmus peak, low frequencies of Fraxinus persist and Taxus appears more frequently late in the phase. The Fraxinus frequencies probably point mainly to the survival of ash as a hedgerow taxon (Cameron and Pannett 1980, Sinker et al 1985); the open landscape in late B14 is probably favouring the dispersal of Taxus pollen. Yew appears to be a relatively high pollen producer (Andersen 1970, 1973) and is frequent throughout Shropshire today as a planted and native tree (Sinker et al 1985). Yew is not present in the woodland fringe around Berth Pool today although it obviously has the status of a regionally frequent taxon. At some point in phases B13 or B14 the drainage ditches leading in and out of Berth Pool would have been constructed, a 1794 parish map of Baschurch shows that they were in existence by that time (Shropshire C.R.O.,Hunt collection). The effect of ditch cutting would be to increase the pollen source area of Berth Pool and to cause streamborne pollen to become an important component of the pollen input (Pennington 1979). Thus, at some point in the historical period the pollen source area for Berth Pool widened from c.1km^2 to perhaps, several square kilometres. A restricted shrub flora is indicted in B14 with total shrub pollen reduced to less than 1% of total land pollen at 16cm. The intermittent occurrence of Salix could however be a considerable under-representation of the importance of willow in the local vegetation, willow is frequent at the margins of Berth Pool today and yet Salix pollen occurs at less than 1% in the mud-water interface sample at 0-2cm. Salix fragilis, crack willow, is common today by rivers, ditches and pools and in damp woodlands in Shropshire. Most of the plant material examined by Sinker et al (1985, 240) was female and that furthermore, S. fragilis can be propagated from selfstruck cuttings. Another common willow from moist soils, S. alba, white willow, is again predominantly female in Shropshire today (Sinker et al 1985, 240). Clearly, the balance of male to female individuals amongst Salix spp could be a crucial unknown factor when attempts are made to infer willow abundance from the pollen spectra. The low Ericaceae frequencies in B14 suggest that, locally, significant heather colonisation did not occur after the end of the late Iron Age. From late B13 until mid to late B14 Gramineae frequencies remain at c.55% to 60% but increase considerably in the final stages of B14. Secale and Cannabis type continue to occur into B14 although this could simply indicate the persistence in the local vegetation of a few individuals which were relics of former cultivation. A Gramineae peak at c.60cm accompanies a relatively short-lived rise in cereal pollen representation but, above this, cereal and Secale pollen occur only intermittently. Crop land will tend to be under-represented in the pollen record (Vuorela 1973), particularly where self pollinating cereals are involved. Pastoralism is thus not necessarily the only type of land use to be present around Berth Pool in B14, but there are clear indications that it was dominant.

The high frequencies of Gramineae, values remain above 50% from mid B13 onwards, are associated with high frequencies of Plantago lanceolata. Throughout most of B13 and B14 values are higher than those observed in B8 to B12 at Berth Pool. Plantago lanceolata could be present as a field-edge weed (Edwards 1979) and it is accepted that modern weed communities may not be analogous to past communities (Behre 1981). However, historical evidence from Shropshire points to the importance of pastoral farming in the later historic period (7.3.10). The herb communities in the area around Berth Pool appear to become less species rich as B14 progresses. Tubuliflorae and Liguliflorae persist, but curves are discontinuous, Artemisia fails to appear after mid B13 and Chenopodiaceae ceases to occur after early B14; Cruciferae occurs intermittently and the curve for Rumex acet becomes broken. Plantago media/major tends to occur more often in B14; P. major, greater plantain, and P. media, hoary plantain, can tolerate heavy grazing and trampling and could, in this case, suggest that grazing pressure is increasing in the herb communities; P. lanceolata is very tolerant of heavy grazing (Sinker et al 1985). Plantago lanceolata declines in late B14, where Gramineae increases further. This could point to an increase in the area of ploughland, as opposed to pasture, on the drier brown earth soils of the area. Streamborne Gramineae pollen from pastureland to the north west of Berth Pool (Plates 1, 2 and 13) could be responsible for the final Gramineae rise above 20cm.

Other herb pollen types which occurred frequently in later prehistoric clearances and which are absent or occur less frequently in B14 include Caryophyllaceae, Campanulaceae, Leguminosae (undiff), Rosaceae Rubiaceae and Urtica. The persistence of Ranunculaceae and Filipendula suggests that damper grassland areas were present, although Cyperaceae frequencies are reduced. Pteridium values were reduced in late B13, and the continuous curve for this spore type ends in early B14. Low frequencies of Filicales persist, but pteridophyte colonisation generally appears to be reduced in B14. Sparganium/Typha declines, probably reflecting improvements in drainage and the drying out of areas close to the pool margin. The diversity of floating-leaf macrophytes appears to decline. Shading by algal blooms could be a possible cause (Sinker et al 1985) as the process of eutrophication advances with increased nutrient inwashing under a more intensive farming regime (cf Reynolds 1979).

The pollen evidence from B14 thus points to an increase in the importance of pastoralism, some tree plantation in the later historic period and, recently, further expansions of grassland, probably on more effectively drained peat soils. From 180cm to 0-2cm, that is, from the late Bronze Age to the present day, total tree pollen amounts on average to only 21.38% of total determinable land pollen. The range of values at one standard deviation being 16.36% to 26.40%; the real range is 11.3% to 29.8%. This variation appears to be mainly due to localised fluctuations in the area occupied by alder. The square kilometre or so of land around Berth Pool has remained as open as it is today (Plates 1 and 2) for approximately 2800 years.

7.3.10 Sediment loss on ignition (Figure 13)

The lowest recorded L.O.I value at Berth Pool occurs in early B14 with the organic content of the sediment declining to only 12.8%. A slight L.O.I increase occurs above this but values do not rise above 16%. The sediment is clay-rich and predominantly inorganic. Loss on ignition declines to c.20% in the upper sediment horizons at Crose Mere (Beales 1980) which date to the later historic period. An enhanced degree of soil inwashing is almost certainly responsible for the low L.O.I values in B14 at Berth Pool, reflecting an intensification in land use in the catchment area of the site; it is probable that the drainage ditches leading into Berth Pool were all constructed during the time period of B14,which approximates to c.10000 ad to the present.

7.3.11 Historical evidence

By the end of the 16th century Shropshire was a predominantly pastoral county and had been mostly enclosed by Parliamentary Act (Rowley 1972). During the 17th century, seven out of the eighteen livestock markets in Shropshire specialised in cattle, pointing to the pastoral character of much of the county. The land adjoining the northern margin of Berth Pool, including the site of The Berth was enclosed in an award dated to November 6th 1821 (held in Shropshire C.R.O). The total cost of enclosure was £238. 0s. 8d. of which £150. 1s. 4d. represented the cost of additional drainage works; prior to enclosure this tract of land was referred to as "Beastes grasse". Drainage and reclamation of the Shropshire moss lands intensified in the second half of the 16th century, and some pools were drained completely and converted to farmland (Rowley 1972, Hey 1974). Pastoralism appears to have been the mainstay of the rural economy in Shropshire from the earliest historical times (Crompton and Osmond 1954, 39); the brown earth soils appear to have been preferred for cultivation. The great majority of manors recorded in the county in the Domesday

Survey, whose locations can be identified today, were sited on the brown earth soils (Crompton and Osmond 1954). Only a minority of the Domesday Manors appear to have supported woodland. The emergence of the iron and glass industries in the county in the 16th and 17th centuries led to timber shortages and the creation of newly planted coppices (Rowley 1972, 217). The Ulmus peak and the appearance of Fagus in mid B14 could reflect woodland plantation.

Drainage of the flat peatlands to the north of Berth Pool, attested to in the 1821 Enclosure Act, would almost certainly have permitted more intensive grazing of these pastures; the expansion of grassland probably occurred as swamp and carr areas were cleared and this could be in evidence in the Gramineae increases at the end of B14 at Berth Pool. Although place-name evidence points to woodland clearance in Saxon times (Rowley 1972) and woodland appears to have been cleared from the best soils by the time of the Norman Conquest (Crompton and Osmond 1954) there is little doubt that many of the brown earth tracts were widely cleared in the late Iron Age and in some localities widely cleared in the late Bronze Age. Much of the woodland which existed on drier soils in north Shropshire in Saxon times would have been occupying land which had been farmed for centuries in the Iron Age.

7.3.12 Regional correlations

If the chronology suggested for B14 at Berth Pool is broadly correct then this phase can be correlated to later CMCP10b and to CMCP10c at Crose Mere (Beales 1980) and to the regional episodes R6 to C7B (Beales and Birks 1973, 15). The CMCP10b/10c transition at Crose Mere is dated to c.1600AD (Beales 1980, 157); higher Ulmus frequencies occur late in CMCP10b, a possible parallel with the B14 Ulmus increase at Berth Pool. The Pinus rise in CMCP10c is not clearly discernable at Berth Pool and suggests that the pollen spectra at Berth Pool are, in the main, local in character. Late in CMCP10c a substantial rise in Gramineae and Plantago lanceolata occurs and cereal pollen occurs less frequently. At both Berth Pool and Crose Mere the pastoral character of the Shropshire landscape is clearly in evidence in later historic times (Barber and Twigger 1987). Beales and Birks (1973) define a brief forest regeneration phase, R6, in the

11th century when areas were laid waste at the time of the Norman Conquest. Dating at Berth Pool is relatively speculative after mid B13 but at the B13/B14 transition, thought to date to the 11th century ad, there is a diversification in the tree pollen spectra and Gramineae declines.

In C7A and C7B, dating to the 12th to 19th centuries (Beales and Birks 1973) progressive deforestation occurs and moss lands are reclaimed. C7B thus correlates to late CMCP10c and to the upper horizons of B14 where the Alnus decline and sharp Gramineae increase at 14-16cm suggest that peatlands were drained, cleared and turned over to pasture.

7.3.13 Summary: phase B14

Together with B13, phase B14 represents a useful addition to the information available on land use changes in the historical period in Shropshire. The pollen spectra at Berth Pool are probably, at least in contrast to Crose Mere, local in character but conform to a general pattern which is typical for the region as a whole (cf Beales and Birks 1973). The deposition of a mainly inorganic sedimentary unit in Berth Pool, derived at least in part from topsoil sources, attests to the impact of man on the catchment of the pool in the historic period, although comparison of the pollen spectra of B14 with those of B8 to B10 serves to illustrate the fact that in Shropshire the creation of deforested landscapes was not confined to the last two millennia.

CHAPTER 8

CONCLUSIONS

8.1 Pollen profile replicability

The extent to which this study has shown that pollen profiles can be reliably replicated can be illustrated with reference to selected examples from the study area.

8.1.1 Berth Pool

The two deep water cores from this site show that over time, similar relative proportions of each pollen type are deposited at separate locations on the sediment surface beyond the immediate margins of the pool. This is in line with the findings of Davis (1968), Berglund (1973), Tauber (1977), Edwards and Thompson (1984), Tolonen (1984) and Davis et al (1984). The similarity in pollen frequencies is exemplified by Figure 35 and involves both arboreal types and non-arboreal types. Precise replication has not been achieved, for example, the Ericaceae curve in B10-B11 in Berth II is not paralleled in Berth III; the cereal and Fraxinus increases at the start of B13 in Berth III are not observed in Berth II. In terms of the overall interpretation of the pollen spectra, however, these differences are relatively minor. Ericaceae is still recorded continuously in B10 to B11 in Berth III and cereal pollen also appears in early B13 in Berth II. The pollen profile replicability observed at Berth Pool concerns the taxa represented in each core, trends in pollen frequencies and the comparability of the frequencies. The intra-site comparability of long profiles has been demonstrated by Edwards and Thompson (1984). The results from Berth Pool show in detail how relatively minor fluctuations in pollen representation can be replicated from core to core, for example, herb pollen frequency variations at the B10-B11 transition.

8.1.2 Boreatton Moss

The same sequence of pollen frequency changes can be identified in both cores although there are between-core variations in the diversity of pollen types and in the frequencies of individual pollen types. Certain pollen types appear to be more abundant in the central core, for example, Tubuliflorae and Liguliflorae in B5 and B8-B10, and Gramineae in B8-B10. Apart from open habitat indicators, the diversity of other herb pollen types is lower in the marginal core. The variations could be explained in terms of pollen transfer processes (Tauber 1965, 1967a, 1967b, 1977), and imply the existence of a more diverse herb flora beyond the immediate margins of the moss. A high degree of intra-site correspondence in pollen frequencies has been observed by Turner (1975) and Barber (1981) at moss sites, although there is an apparent need for the closer inspection of cores taken from only a few, or a few tens of metres out from the edges of peat mosses (Edwards 1982). At Boreatton Moss, there are many close similarities between the two cores although the differences are such that significant variations in the contributions of different pollen sources can be inferred. Localised pollen sources appear to be important at the marginal core site and more distant sources important at the centre, although the low Pinus frequencies suggest that these sources are still sub-regional. Comparison of the two cores from Boreatton Moss suggest that the effects of smaller/local as opposed to wider/regional clearances can be discerned (cf Turner 1965, 1970, 1975) but only if marginal cores are no more than c.20m from the edge of a moss (cf Edwards 1982). At the onset of B8-B10, higher grass and herb pollen frequencies and lower tree pollen frequencies occur at the centre whilst higher cereal pollen frequencies occur at the margin. Boreatton Moss does not appear to have been a raised moss during the time period under study and therefore pollen frequency variations across its surface are not necessarily wholly attributable to variations in aerial transfer. However, the palynological variations which do occur suggest that where a fringing woodland belt is indicated at a moss (cf Caseldine 1981) pollen diversity will be lower at the margin.

8.1.3 Marton Pool and Fenemere

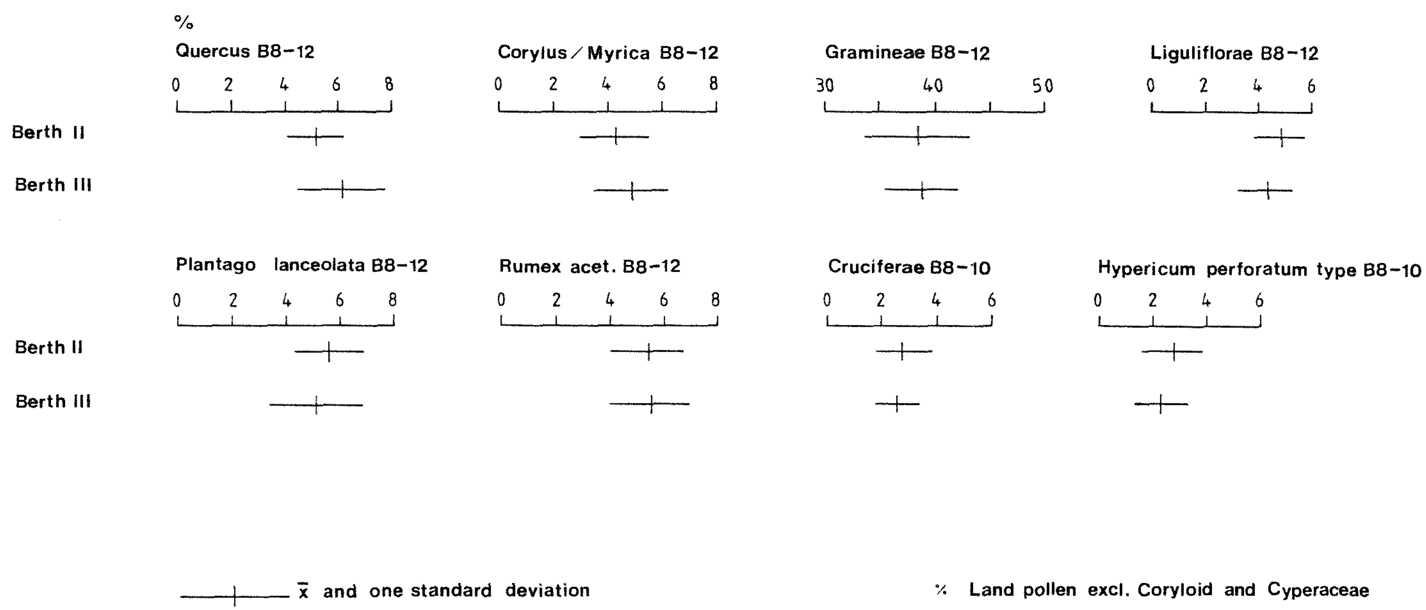
Limited water surface coalescence could have occurred between these two sites during the time period under study, although this would only have involved the presence of a shallow strip of water some 200m wide, flooded across an area of fen or carr. Very little inter-basin sediment movement would be expected under these circumstances. Once Berth Pool and Birchgrove Pool were linked by ditch cutting to Marton and Fenemere, and additional field drains were cut directly into Marton, water surface coalescence would have tended to occur more frequently (2.2.1).

The pollen diagrams from Marton and Fenemere are thus presented as having been derived from separate basins which have not experienced significant sedimentary interchange. The pollen spectra indicate near-identical vegetational histories for the two basins, although there is evidence to suggest that Marton Pool was more responsive to more localised pollen sources, in comparison to Fenemere. Numerical zone splits occur at the B9/B10 transition at Fenemere, but not at Marton. Clearly important variations in pollen content can occur between lakes which are theoretically large enough to have mainly regional pollen spectra and which are only c.200m apart. The presence of well-drained soils close to the southern and eastern shores of Fenemere could be an important factor in the improved representation of clearance indicators at that site, in comparison to Marton Pool. Thus, relatively localised vegetational influences appear to be potentially important, despite the size of the two sites. Given the results from Marton and Fenemere, there appears to be no reason to question the estimate of Jacobson and Bradshaw (1981) that long-distance or regional pollen will begin to predominate in the sediments of lakes c.5ha or more in area, although more localised influences appear to be important at Marton Pool, 6-8ha in extent today. A site size of c.9ha or more would be needed to give a predominantly regional picture (cf Bradshaw and Webb 1985). Clearly, the same sequence of pollen frequency variations can be identified at both Marton Pool and Fenemere; the representation of individual taxa varies to a certain extent from site to site but not to the extent that substantial differences in vegetational history could be inferred. Given that the two basins are more than c.5ha in extent, and no more than c.200m apart they would be expected, on theoretical grounds (Jacobson and Bradshaw 1981; Prentice 1985) to produce near-identical pollen spectra; in reality there are contrasts.

8.1.4 Pollen profile replicability: general conclusions

A number of studies (Chapter 1) have shown that, within the water column and at the sedimenting surface of lakes the pollen content is generally well mixed, although a degree of inter-basin variability in the intensity of sediment mixing and redeposition is to be expected (Davis, 1973, 52). In a study at Crose Mere (Bonny and Allen 1984) pollen proportions were found to be "fairly similar" over most of the mud surface, with some suggestion that high local imputs could be preserved at the margins. Limnological variables can combine to reduce the overall representativity of a standard deep water core (Davis et al 1971, 463) although a variety of studies continue to suggest that cores taken throughout a basin will be adequately representative of the basin as a whole (8.1.1). If centre-lake, deep water cores were not subject to the comprehensive mixing, integration and averaging of their pollen content then the two cores from Marton and Fenemere would have been extensively dissimilar. There are variations between the two cores from Berth Pool, but these are not sufficient to demand the reconstruction of different vegetational histories for each core. Even where the precise replication of low frequency curves has not occurred at Berth Pool, e.g. Ericaceae in B10-B11, the pollen type in question still occurs in consecutive samples in Berth III. Where a number of sites are available in the same locality, the precision of any vegetational reconstruction will be affected by factors which remain unknown. For example, how has the pollen productivity for the entire population of a single taxon varied over time? Precisely where in the vegetation were particular taxa located? (cf Oldfield 1970). When factors as important as this are unknown, of what benefit is precise profile replication as opposed to "adequate" profile replication? For lake sediment profiles, adequate replication could be defined in the way shown in Figure 35, where the mean frequency of type a in core i falls within one standard deviation of the mean of a in core ii. The data presented here suggest that pollen profiles from the deep water zones of lakes will be closely comparable to one another and comparable profiles can also be obtained from large lakes in close proximity. Pollen profile similarity has been demonstrated from the central parts of peat mosses (Turner 1975, Barber 1981). The results presented here however suggest that the effects of pollen transfer processes on the pollen spectra from marginal and near-marginal cores need to be more fully examined (Caseldine 1981, Edwards 1982).

Fig 35 Berth Pool: Average Pollen Frequencies in Phases B8 to B12



8.2 Inter-site variability

Pollen frequency changes from the series of phases between B1 and B14 can be identified at all six study sites, although the full series of phases is not represented at all the sites (Figure 16). Inter-site variations in pollen frequencies give indications of the probable extent of the dominant pollen source area at each site.

8.2.1 Berth Pool and Birchgrove Pool

Both cores form Berth Pool confirm that there are reductions in certain herb pollen types in horizons taken, on chronological grounds to be equivalent to phase B11. Apart from very limited increases in Betula and a slight rise in Alnus thereare no clear indictions of woodland regeneration around Berth Pool in B11, at least on the drier soils in the proximity of the site. Woodland regeneration is however clearly indicated around Birchgrove Pool although some farming activity evidently persists in the vicinity of the site during B11; the inter-site contrasts between Berth Pool and Birchgrove Pool, particularly during B11 are such that the dominant pollen source areas of these two sites cannot be said to overlap to any significant degree. Non-overlapping of pollen source areas at sites in close proximity has been inferred in East Anglia (Bennett 1986), although the sites concerned were some 3km apart compared to 400m between Berth and Birchgrove; the two sites examined by Bennett were Hockham Mere, 56ha, and The Mere, Stow Bedon, 6ha. It was suggested (Bennett 1984, 617) that the two sites were representative of the vegetation over an area of no more than 2 to 10 square kilometres. Arguably, Berth and Birchgrove are representative of, respectively, no more than 1km^2 and no more than 0.5km^2. Today, Berth Pool is c.220m x 170m, or 2.9ha in extent; prior to drainage activity it was probably c.3.0ha or so in extent although the minimal Pinus frequencies suggest that it did not reach c.4-5ha in extent (cf Jacobson and Bradshaw 1981).

According to the theoretical relationship of pollen source area to site size, proposed by Jacobson and Bradshaw (1981, 82) Berth Pool should be dominated by extra-local pollen, with regional pollen at least making a contribution to the total pollen input; extra-local pollen is described as that which is derived from c.20m to several hundred metres from the basin margin. It is suggested here that at sites up to c.3ha in extent, which do not have inflowing streams, are mainly representative of a pollen source area which is no more than 200-300m in radius. Even if areas around the site are cleared regional pollen does not appear to make a clearly discernable contribution to the pollen input. Had Birchgrove Pool alone been used to assess human impact at and in the vicinity of The Berth it is evident from the results of this study that an inadequate picture would have emerged of the chronology and extent of human impact at or close to the site.

8.2.2 Marton Pool, Fenemere and Birchgrove Pool

Palynological contrasts between these three sites, where the sequences of clearance and regeneration in zones B7 to B12 are seen, are consistent with the view that Fenemere and Marton are receiving most of their pollen from a wider area than Birchgrove. There are contrasts between Marton and Fenemere which suggest that their water surfaces were independant during the time period under study (8.1.3). In early B10, higher frequencies of *Pinus*, *Tilia*, Gramineae, Liguliflorae, *Rumex*, other herbs and *Pteridium* occur at Fenemere. Lower *Pinus*, Gramineae, herb and *Pteridium* values are seen at Marton in association with higher *Alnus* values. At Fenemere the 2nd and 3rd numerical zone splits in SPLITLSQ and SPLITINF respectively are placed at the B9-B10 transition. In direct contrast, no zonation splits occur at the B9-B10 transition at Marton Pool. This is a clear statistical expression of the contrasts between the two sites at this time. If Fenemere is responsive to local and extra-local effects, Marton Pool certainly is; the well drained soils rising to the south and east of Fenemere could have provided a more localised source of dry-land clearance indicator pollen. The indications that local, or at least extra-local pollen sources are important at Marton Pool tend to bear out the theoretical relationship given for basin size and pollen source area by Jacobson and Bradshaw (1981, 82); Marton Pool is c.300m x 200m or 6.8ha in extent and the model predicts that local and extra-local pollen combined could contribute up to 50% or so of the total pollen input at Marton Pool. Fenemere which is 400m x c.250m, or 9.4ha in extent, should, theoretically be less susceptible to more localised influences and dominated more by regional pollen inputs and there are indications that this is the case, with a tendency for higher Pinus and lower Alnus values to appear in early B10 at Fenemere, in comparison to Marton Pool. Birchgrove Pool is 800m from Fenemere and 950m from Marton Pool and Birchgrove Pool should thus be within the regional pollen source areas of the latter two sites (cf Jacobson and Bradshaw 1981, Prentice 1985); Birchgrove pool, however, does not appear to have had a significant regional pollen input. In phases B8 to B10 at Birchgrove Pool, Pinus pollen occurred in 5 out of 11 samples, in three of these samples only one pollen grain was encountered, although three grains occurred at 260cm, equivalent to the B9-B10 transition. High ground rises up to the north and south of Birchgrove Pool and to a certain extent this may have accentuated the importance of local pollen sources at the site since trees and shrubs could flower more vigorously on the south facing slope adjacent to the northern shore and regional pollen could tend to overshoot the hollow in which the pool lies (cf Tauber 1965, 31).

High Pinus frequencies occurred in late B9 at Marton Pool and Fenemere and therefore some long-distance pollen does appear to have occurred at Birchgrove Pool,although proportions appear to have been minimal. Contrasts between Marton/Fenemere and Birchgrove in respect of Quercus and Alnus, particularly in B9-B10, again suggest that Birchgrove is representative of only its local environment. Contrasts between these three sites therefore indicate the validity of the theoretical model given in Jacobson and Bradshaw (1981) although contrasts between Berth and Birchgrove suggest that an assumption of extra-local dominance could in some cases, tend to result in an over-estimate of the extent of the dominant pollen source area.

8.2.3 Marton Pool, Fenemere and Berth Pool

Many of the contrasts in arboreal pollen representation between Marton/Fenemere and Birchgrove Pool are also common to Marton/ Fenemere and Berth Pool. These contrasts are exemplified by the poor representation of Pinus at Berth pool although, as at Birchgrove Pool there are indications that Pinus occurs more often at the time of B9. Berth Pool is 1400m from Fenemere and 1500m from Marton Pool thus Berth Pool could be within the dominant pollen source area of Fenemere (cf Jacobson and Bradshaw 1981, Prentice 1985) although it might only be peripheral to the dominant pollen source area of Marton Pool (cf Berglund 1973). Potentially, therefore, sites with regional pollen spectra can have within their dominant pollen source areas other sites which yield markedly different pollen spectra. Accurate inferences about land use patterns are arguably impossible to make where only one regional site is available and an acceptable characterisation of a region is only possible where a variety of sites of different size have been examined (cf Jacobson and Bradshaw 1981, 83). The inter-site contrasts amongst the Baschurch Pools during B8 to B11 are clear, however, the similarities between the sites during B7 should not be overlooked. It is evident that the dominant pollen source areas of the Baschurch Pools vary in extent from pool to pool, and will also vary in extent over time, depending upon the degree of vegetation clearance close to the individual sites (Tauber 1965, 33; 1967b, 139). It is therefore interesting to note that despite differences in pollen source area, there are many similarities in pollen frequencies at the four sites during B7 suggesting that the intensity of the clearance activity in B7 was similar over a wide area, perhaps $10km^2$ or more. Again, a variety of sites must be examined before realistic inferences can be made regarding clearance intensity (cf Turner 1979).

8.2.4 The Baschurch Pools and Boreatton Moss

8.2.4.1 Marton Pool, Fenemere and Boreatton Moss

The diagrams from Marton and Fenemere begin in phase B6, at levels approximately equivalent to 160cm at the centre of Boreatton Moss and c.174cm at the margin. During B7, there are many palynological similarities between Fenemere, Marton Pool and Boreatton, allowing for the fact that Ericaceae has been excluded from the main pollen sum at Boreatton. At the B8 to B10 clearance peak at the centre of Boreatton total tree pollen declines to c.20% of total determinable land pollen. This compares to c.35% at Fenemere and c.45% at Marton Pool; the area of damper soils around Boreatton was probably more restricted in comparison to that around Fenemere and Marton and allowing for this, clearance intensity in the late Iron Age was probably similar over c.10-20km² in the Baschurch area. The clear contrast in Pinus frequencies between Marton/Fenemere and Boreatton could be evidence for tree or shrub encroachment onto the moss. Boreatton Moss is similar in size to Marton Pool but Pinus appears only at less than 1% in B8 to B10 at Boreatton; interestingly, 2 or 3 Pinus pollen grains appear, respectively at 132cm and 134cm at the centre of Boreatton, levels which could correspond to B9 (Chapter 5); at 126cm and 128cm only single Pinus grains appear. Boreatton thus does not appear to have trapped a significant proportion of the far-travelled, or regional pollen component, and its open area must have been restricted to less than 5ha. Obviously the question of a tree cover is a very important one when pollen diagrams from peat mosses are examined (cf Jacobson and Bradshaw 1981, 89). Boreatton Moss is located in a hollow in the surrounding land with slopes leading down from level ground to the edge of the moss. This topographic factor could have resulted in an increased tendency for regional pollen to overshoot the site and for local tree and shrub pollen in particular to be abundantly produced by taxa growing on the slopes.

8.2.4.2 Berth Pool, Birchgrove Pool and Boreatton Moss

The intensity of clearance activity around Boreatton, Berth and Birchgrove appears to have been broadly comparable in the late Iron Age although a wider fringing tree belt could have existed around Boreatton. The dominant pollen source areas of these three sites appear to have been smaller than those at Marton and Fenemere. The representation of Pinus at Boreatton is closely similar to that seen at the two smaller pools. Turner (1965) defined extensive clearance as occurring where grass pollen frequencies reached 100% of total tree pollen and in an almost completely cleared contemporary landscape around Bloak Moss the grass pollen amounted to at least 200% of total tree pollen. Grass pollen as a percentage of total tree pollen at the B8-B10 Gramineae peaks reaches 187% at the centre of Boreatton and 310% at Birchgrove Pool, compared to 81% at Fenemere. It seems probable that the brown earth soil belt in which Boreatton is situated (Figure 5) was almost wholly denuded of woodland in the late Iron Age whereas lower-lying ground closer to Marton and Fenemere was widely, but not completely cleared of woodland. The pollen record has previously been examined in adjacent lake and moss deposits. Vuorela (1977) and Donner et al (1978, 277) found that indications of clearance activity appeared at approximately the same time in adjacent peat and lake sediment profiles and Vuorela (1977, 214) noted that, at least in relation to total N.A.P pollen types indicative of culture appeared in similar proportions in lake and moss profiles although local changes in land use practise were clearly discernible in the peat profile, rather than the lake sediment profile. The conventional cultural indicators are all represented at Boreatton Moss. Cruciferae tends to occur more regularly at the pools whereas Tubuliflorae exhibits relatively high frequencies at the moss but Plantago lanceolata tends to be well represented at both lake and moss sites. The contrasts between Berth Pool, Birchgrove Pool and Boreatton Moss in phase B5 suggest that farming activity in the early Bronze Age was concentrated around Boreatton Moss. Whilst this activity can be traced at Berth and Birchgrove, the contrasts suggest that the pollen spectra at Boreatton are mainly extra-local in character, and the site is predominantly representative of an area of c.1 to 2km^2.

8.2.5 New Pool and the Baschurch area

The diagram from New Pool mostly covers phases B3 to B6, although phase designation is problematic and the site itself is outside the Baschurch area. Two events in the New Pool spectra can be correlated with reasonable confidence to events in the Baschurch area; the B3 beaker clearances and the B5 Tilia decline

8.2.5.1 Phase B3 c.2000-2100bc

There is considerable inter-site variability in the registration of this clearance activity at New Pool, Boreatton Moss and Berth Pool. Herb pollen types are more abundant at Boreatton Moss although similar arboreal pollen fluctuations are in evidence at all three sites. Ulmus and Tilia reductions are apparent and post-B3 Quercus expansions can be seen. New Pool appears to have had important localised sources of Betula pollen but subsequent reductions in Betula, however, suggest that these sources were not necessarily confined to the surface of the site. Given the low frequencies of

Pinus at Boreatton in B8-B10, when Pinus appears to have been part of the regional pollen rain, it is probably the case that the Pinus pollen in B3 at that site is from local sources and this is also thought to be the case at New Pool. New Pool, as demarcated on the map today (Figure 4) is approximately the same size as Birchgrove Pool although it lies at the eastern end of a narrow strip of peat deposits. This peat strip is only c.50m wide immediately to the north of the New Pool basin and is surrounded by Baschurch and Newport series brown earths (Figure 5). This peat would have been surrounded by woodland and could well have been encroached by birch, alder and willow at its margins and it is thus unlikely that it received a significant proportion of regional pollen and the Pinus pollen at New Pool is therefore probably of local origin. Human impact was thus spatially variable at the late Neolithic/early Bronze Age transition, some lower-lying woodland was exploited but the indications are that the more widely cleared areas, and probably the settlement sites, were located on higher ground (Limbrey 1987). The site of Boreatton Farm, 200m to the north west of the moss and 100m a.s.l. could well have been a favoured settlement site since the early Neolithic period. Again, it is only the examination of several sites in different localities which allows reasonable confident inferences about settlement pattern to be made.

8.2.5.2 Phase B5: An early Bronze Age Tilia decline

This feature can be identified at New Pool and Boreatton Moss, where it has been radiocarbon dated, and at Berth Pool and Birchgrove Pool. Again, clearance activity appears to be concentrated close to Boreatton Moss, where a continuous cereal pollen curve occurs and where Tilia is temporarily eliminated from the pollen record. Secale occurs at both Boreatton and Berth and whilst cereal pollen is absent at New Pool, herb pollen representation improved at that site at the Tilia decline. Human impact at Boreatton appears to have affected the hydrology of the moss, an indication of the potential environmental impact of human settlement, even in the early Bronze Age. Locally, herb pollen totals are slightly higher at Berth Pool, in comparison to Birchgrove Pool and Plantago lanceolata representation is higher at New Pool, in comparison to Berth or Birchgrove. The tendency for Gramineae to peak at the Tilia decline horizon can be clearly seen at Boreatton, and is detectable at Berth and Birchgrove but not at New Pool. Obviously there are very marked contrasts in grass and herb pollen frequencies in the early Bronze Age at Boreatton Moss and New Pool. The pollen source area at New Pool is probably very restricted and evidently includes woodland which was not cleared and it could well be the case that a settlement site existed in close proximity to Boreatton Moss. Conceivably, the activities of one particular human group are in evidence at Boreatton, Berth and Birchgrove although the spectra from New Pool attest to the fact that man was active in many localities in the Shropshire lowlands in the early Bronze Age.

8.2.6 Inter-site variability: general conclusions

Where chronological overlaps between cores occur, the same sequence of vegetation changes can be traced at all six sites although B11 cannot realistically be termed a regeneration phase at Berth Pool. Spatial variations in the intensity of human impact are in evidence and there are also clear indications that the dominant pollen source areas at each site vary in extent; no one site is adequately representative of the chronology and pattern of vegetation clearance across the few square kilometres around Baschurch. The broad outlines of environmental change in prehistoric Britain have now been established (Simmons and Tooley 1981) and the results presented here, together with other studies, for example, Turner and Hodgson (1981) and Bennett (1986), show that significant localised variations do occur in pollen spectra. Studies specifically designed to assess the implications of localised pollen profile variability are lacking (Edwards 1983, 588) and potentially, such studies constitute a productive line of research. In the future, a trend away from single site-single profile studies towards carefully designed multi-profile studies is necessary if detailed inferences are to be made about the variable environmental impact of human groups.

8.3 Numerical Zonation

The positioning of objectively defined zone splits (Birks and Gordon 1985) has been used in this project to indicate the relative importance, in terms of changes in pollen content, of the phase boundaries. The order in which the zone splits were made is shown on the pollen diagrams. The earliest splits mark the levels where the most substantial changes in pollen content occur, the objective of numerical zonation being the creation of a series of pollen zones which are, in numerical terms internally homogenous and, in terms of their pollen content, distinct from zones immediately above and below (Birks and Gordon 1985). At the Baschurch Pools and Boreatton Moss the B8 tree decline constitutes one of the most important ZONATION boundaries. The onset of B11 is similarly important at Boreatton, Birchgrove, Fenemere and Marton Pool but evidently not important at Berth Pool. In terms of the position of numerical zone splits, the B6/B7 *Tilia* decline horizon is an important one at the Baschurch Pools; the B9/B10 boundary is numerically defined at Fenemere but not at Marton Pool. The B5 *Tilia* decline is selected as an important zone boundary at Boreatton Moss, but is of minor importance at Berth Pool; the B7 clearance and regeneration episodes are picked out by ZONATION splits at the Baschurch Pools but not at Boreatton. At New Pool pollen content changes associated with the B5 *Tilia* decline are important and, as at Boreatton, the B3 clearance activity is picked out by ZONATION splits. Solely in terms of changes in pollen content, important zone boundaries can thus be identified which are common to some sites but absent at others, an indication of the spatial variability in pollen deposition over a relatively restricted area. Although numerical zonation has not been used here as the basis of phase designation (*cf* Birks and Gordon 1985), the use to which it has been put, namely as a test of the significance of the pre-designated phase boundaries, suggests that it can be constructively used in an assessment of pollen profile variability. Obviously, an acceptable chronology must be established for the pollen profiles under study, then it will be possible to see to what extent a given pattern of ZONATION splits can be replicated from profile to profile.

8.4 Pollen source area and environmental archaeology

Theoretical and empirical studies, representative of a wide variety of sites have given a clear insight into the nature of pollen transfer and deposition (Andersen 1974a, 1974b; Berglund 1973, Bonny 1976, 1978, 1980; Bonny and Allen 1984; Caseldine 1981; Cundill 1986; M.B. Davis 1968, 1973; Davis and Brubaker 1973; M.B. Davis et al 1971; R.B. Davis et al 1969; Jacobson and Bradshaw 1981; Bradshaw and Webb 1985; Tauber 1965, 1967a, 1967b, 1977; Turner 1975; Prentice 1985). Pollen profile replicability has recently been examined by M.B. Davis et al (1984), Tolonen (1984) and Edwards and Thompson (1984) and the question of pollen profile variability and replicability has recently been reviewed by Edwards (1983). For pollen profiles to be of value in environmental archaeology a full understanding of all the factors associated with the origins of those profiles is necessary. Critical questions must be asked in respect of a given pollen profile: is it representative of the site from which it is derived?; what is the extent of the area from which most of the pollen has been derived? (Tauber 1965, 10). The results of this study confirm that for moss sites, multiple profiles are indispensable (cf Turner 1975, Edwards 1982) and that virtually identical pollen profiles can be obtained from different locations in the deep water zone of a small lake. Also, similar profiles can be obtained from separate, but adjacent basins which are more than 6ha in extent. Site size is critically important when a consideration is made of the extent to which a pollen profile from that site is representative of human activity directly associated with a nearby archaeological site. Turner (1979) suggests that if several sites in a region exhibit the same vegetational changes, and the sites vary in morphology and their proximity to archaeological sites, then those vegetational changes can be seen as typical of the whole region. The results from the Baschurch area suggest that, when seeking palynological evidence for human activity associated with a particular archaeological site, the pollen site should preferably be small, no more than 150-200m in diameter and not more than 1-200m from the archaeological site in question. If the pollen site is any larger than this, it will be representative of a much wider area, and could show clearance phenomena at a time when the archaeological site is unoccupied. If the pollen site is in the size range where localised vegetational changes predominate in the pollen spectra, but is more than 2-300m from the archaeological site, it could show land abandonment when the archaeological site is in fact occupied. Pollen sites could provide misleading information about the degree of clearance associated with a given phase of human activity when those sites are marginal to the foci of activity (Edwards, 1979, 257). The Herefordshire/Shropshire area has one of the densest concentrations of hillforts in Britain (Fowler 1983, 61) and many of these sites were occupied in the Iron Age (Stanford 1972a, 1972b, 1980). The Berth shows that lowland as well as ridge-crest sites were occupied in the Iron Age and the pollen evidence presented here shows that the Shropshire lowlands were extensively cleared during the Iron Age. The similarities and contrasts observed between the sites examined in this study have, to a certain extent, confirmed the validity of the model relating basin size to pollen source area given by Jacobson and Bradshaw (1981), but certain important cautions should be borne in mind when estimating the area which has the most significant bearing upon the pollen spectra.

Two clear points emerge from this study:

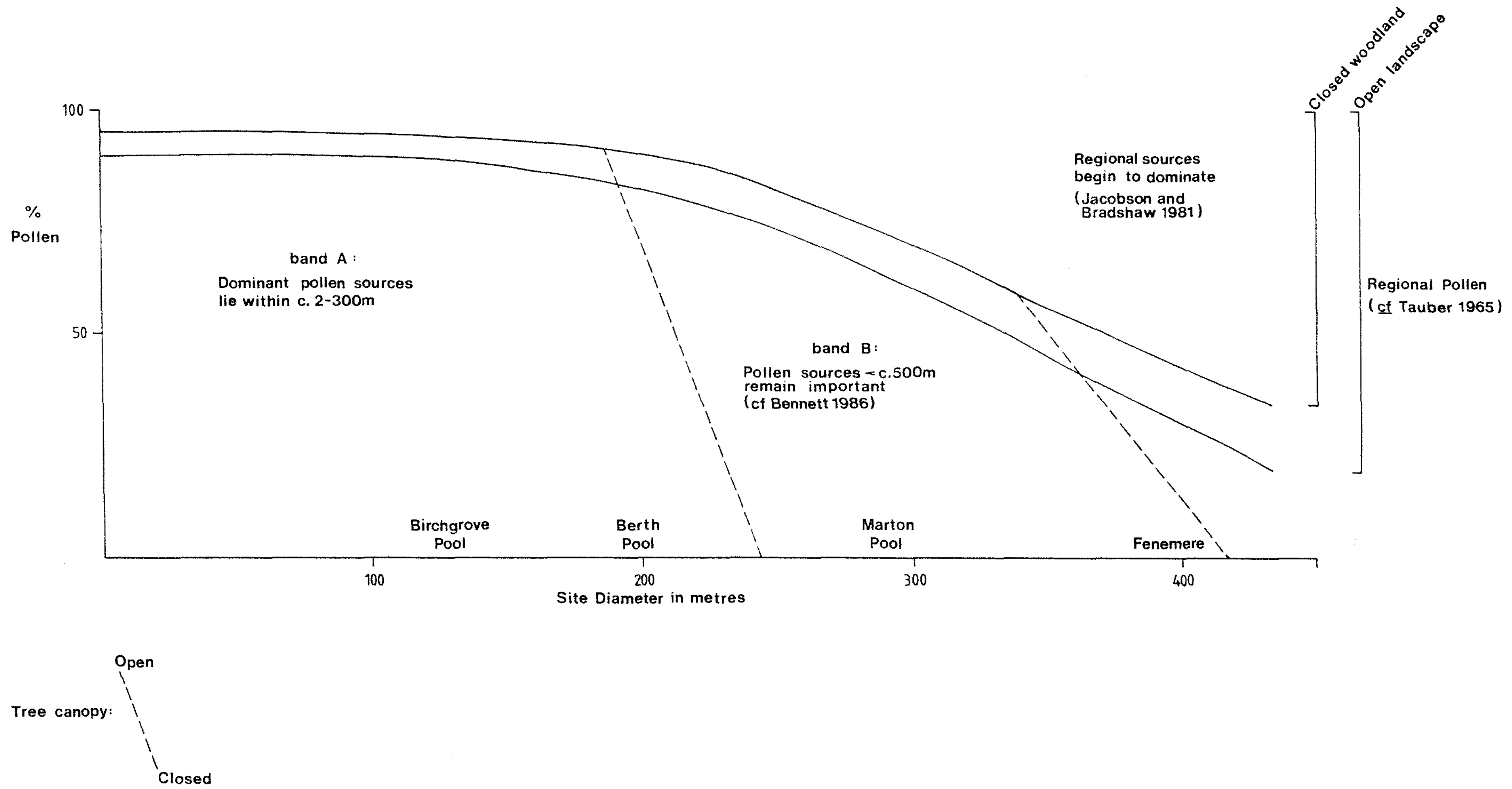
(i) The dominant pollen source areas of sites the size of Berth Pool, which is c.150m x 200m in extent, should not be over-estimated. The model given by Jacobson and Bradshaw (1981) suggests that with a site diameter of c.200m, a closed basin will receive a high proportion of its pollen from plants growing up to "several hundred metres" from the basin, and about 20% of its pollen from further afield. Contrasts between Berth Pool and the other sites suggest that with a site diameter of c.200m, pollen from plants growing within 200m-300m of the edge of the basin will have the most significant influence on the interpretation of pollen spectra from that site. The average pollen source area could theoretically increase if the pollen assemblage changed (Prentice 1985, 78) and thus estimates of the size of the pollen source area at a site should be made for specific phases in the vegetational history of that site. When a generalised estimate of pollen source area is sought, however, definitions of local, extra-local and regional pollen sources should as far as possible be standardised. Prentice (1985, 81) suggests that extra-local pollen is derived from within 20m to 2km of the basin edge. Given this estimate of the extent of the extra-local pollen source, a cleared area $5km^2$ to $10km^2$ in extent could be postulated around Berth Pool in phase B11, given that Berth Pool is too large to be dominated by local pollen and too small to exhibit a regional pollen spectra. In reality, contrasts between Berth, Boreatton Moss and the three other pools suggest that the cleared area around Berth Pool was no more than c.$1km^2$ in extent during B11. At Berth Pool it is thought that cleared land adjacent in places to the lake shore provided a strong localised pollen source (cf Oldfield 1970). Localised pollen sources at sites the size of Berth Pool, c.3ha, could potentially be more influential than the model produced by Jacobson and Bradshaw (1981) would suggest. Berglund (1973, 122) estimated the effective pollen source area radius at a lake with a radius of 50m to be less than 500m. On the basis of the results presented in this study it is suggested that where the radius of an enclosed basin is c.100m or less, the radius of the dominant pollen source area will be approximately 3 to 4 times the radius of the site. This would allow areas close to Birchgrove Pool to be outside the dominant pollen source area of Berth Pool.

(ii) The area of the region represented in the pollen spectra of a large site should not be over-estimated. Although Marton Pool, at c.7ha in extent is large enough to receive pollen from the regional pollen rain the spectra at the site at the B9/B10 transition clearly contrast with the spectra from the B9/B10 transition at the adjacent Fenemere (Chapter 5). Bennett (1986, 617) suggested that the pollen source area of The Mere, Stow Bedon, could be restricted to c.$2km^2$. Berglund (1973, 122) estimated the pollen source area radius for a lake basin of 5ha in extent as being 1000m, giving an area of some $3km^2$. Stow Bedon Mere is 6ha in area and Marton 6.8ha. Sites this size do not therefore appear to be predominantly representative of a wide area; pollen from several kilometres or more from the basin can be expected but the importance of extra-local sources should not be underestimated.

At Fenemere, pollen sources on dry ground in close proximity to the site could be relatively influential, although this is not certain. Figure 36 is based on the main findings of this study and of previously published studies and summarises the contribution of

Fig 36 Site Size and Pollen Source Area

Figure based on Baschurch Pools only



359

this project to the debate concerning pollen source area and basin size.

Intra-site pollen frequency contrasts at Boreatton Moss suggest that the importance of different pollen source areas, albeit relatively localised sources, varies across the surface of a moss (cf Turner 1975) although Boreatton is not apparently a raised moss (cf Sinker 1962) and is not an optimum site for a multiple-core study. Contrasts in pollen frequency and diversity are however evident when the core from the centre of Boreatton is compared to one taken c.20m from the edge (cf Edwards 1982). Multiple coring, particularly of the most marginal peats appears to be an important pre-requisite in the reconstruction of vegetational patterns around peat mosses.

This project has confirmed that multiple profile analysis, where site availability is fully exploited, is a productive strategy in palaeoecology and can lead to the more confident interpretation of palaeoecological data.

Appendix 1

Radiocarbon dating

New Pool series

New Pool 1 SRR-2834

Mildly humified, mainly herbaceous peat from levels with pollen evidence for early human interference in the woodland.

Depth of radiocarbon sample	87-95cm
Correlated depth in main pollen core	73-78cm
Date 3950±50bp :	^{13}C = -27.2°/oo

New Pool 2 SRR-2833

Mildly humified, mainly herbaceous peat from levels with pollen evidence for small scale woodland clearance, characterised by a decline in *Tilia*, lime pollen.

Depth of radiocarbon sample	70-75cm
Correlated depth in main pollen core	66-69cm
Date 3550±50bp :	^{13}C = -27.8°/oo

Boreatton Moss series

Boreatton 1 SRR-2831

Moderately humified peat with abundant *Sphagnum* remains situated immediately above a humification change at a horizon with pollen evidence for woodland clearance by main, characterised by the end of a continuous curve for *Tilia*, lime pollen.

Depth of radiocarbon sample	182-192cm
Correlated depth in main pollen core	162-172cm
Date 3660±50bp :	^{13}C = -25.6°/oo

Boreatton 2 SRR-2832

More highly humified peat below the humification change referred to above, levels have pollen evidence for the creation of clearings in the woodland and for crop growing.

Depth of radiocarbon sample 195-205cm

Correlated depth in main pollen core 175-185cm

Date 3790±50bp : ^{13}C= -27.8°/oo

Fenemere series

Fenemere 1 SRR-2920

Organic detritus mud from a horizon in the lake sediment with pollen evidence for woodland regeneration in the region around the site.

Depth of radiocarbon sample 170-180cm

Correlated depth in main pollen core 180-180cm

Date 1890±50bp ^{13}C= -30.9°/oo

Fenemere 2 SRR-2921

Organic detritus mud from a horizon in the sediment with pollen evidence for extensive woodland clearance in the region around the site.

Depth of radiocarbon sample 190-200cm

Correlated depth in main pollen core 190-200cm

Date 2940±60bp : ^{13}C= -29.3°/oo

Fenemere 3 SRR-2922

Organic detritus mud from a horizon in the sediment with pollen evidence for an enhanced degree of woodland clearance in the region around the site.

Depth of radiocarbon sample 250-260cm

Correlated depth in main pollen core 260-270cm

Date 3160±50bp : ^{13}C= -29.9°/oo

Fenemere 4 SRR-2923

Organic detritus mud from a horizon in the sediment with pollen evidence for a moderate increase in the intensity of woodland clearance, characterised by declines in Ulmus, elm, and Tilia, lime pollen.

Depth of radiocarbon sample	305-315cm
Correlated depth in main pollen core	320-330cm
Date 3190±60bp	13_C= -30.7°/₀₀

General comments

Radiocarbon dates were applied for at a relatively early stage in the project, before the eight pollen diagrams had been fully prepared. Initially, there was some uncertainty regarding the horizons of biostratigraphic correlation between the meres and the two mosses, the dates helped to resolve this uncertainty and showed that Tilia declines occurred in both the earlier and later Bronze Age. The horizons at 320cm to 330cm at Fenemere (main pollen core) can be correlated, on biostratigraphic grounds, to radiocarbon dated horizons at Crose Mere (Beales 1980) and Whixall Moss (Turner 1964a). Some of the dates obtained by Beales were questioned (Beales 1980) and thought possibly to be too old. The date obtained by Turner (1964a) for a Tilia decline at Whixall Moss was based on a 1cm thick slice of ombrotrophic peat and overlaps, at one standard deviation, the Tilia decline date from Fenemere. SRR-2923 is not questioned but SRR-2921 and SRR-2922 are questioned. These dates are thought to have undergone reversal as a result of the inwashing of old carbon during clearance phases (cf Pennington et al 1976, Beales 1980). SRR-2920 has been accepted as valid; the degree of disturbance in the region around the mere indicated at 170cm to 180cm is not dissimilar to that indicated at 320cm to 330cm. The implications of SRR-2920 are considered more fully in Chapter 6.

BIBLIOGRAPHY

AABY, B. 1979 Characterisation of peat and lake deposits. in Berglund, B.E. (ed) Palaeo-hydrological changes in the temperate zone in the last 15000 years. I.G.C.P. Subproject B, Lake and Mire environments, project guide Vol II. University of Lund. 77.

ALLEN, S.E. (ed.) 1974 Chemical Analysis of Ecological Materials Blackwell, Oxford.

ANDERSEN, S. Th. 1970 The relative pollen productivity and pollen representation of North European trees, and correction factors for tree pollen spectra. Danmarks Geologiske Undersøgelse Series II, 96.

ANDERSEN, S. Th. 1973 The differential pollen productivity of trees and its significance for the interpretation of a pollen diagram from a forested region. in Birks, H.J.B. and West, R.G. (eds) Quaternary Plant Ecology Oxford. 109-115.

ANDERSEN, S. Th. 1974a Wind conditions and Pollen Deposition in a Mixed Deciduous Forest
1. Wind conditions and pollen dispersal.
Grana, 14,57-63

ANDERSEN, S. Th 1974b Wind Conditions and Pollen Deposition in a Mixed Deciduous Forest.
II Seasonal and Annual Pollen Deposition.
Grana 14, 64-77

BARBER, K.E. 1976 History of Vegetation.
in Chapman, S.V. (ed)
Methods in Plant Ecology
Blackwell, Oxford. 5-84.

BARBER, K.E. 1981 Peat Stratigraphy and Climatic Change.
A.A. Balkema, Rotterdam.

BARBER, K.E. 1984 A large-capacity Russian-pattern sediment sampler.
Quaternary Newsletter 44, 28-31.

BARBER, K.E. 1985 Peat Stratigraphy and Climatic Change: Some speculations.
in Tooley, M.J. and Sheail, G.M. (eds)
The Climatic Scene London.
175-185

BARBER, K.E. and TWIGGER, S.N. 1987 Late Quaternary Palaeoecology of the Severn Basin.
in Gregory, K.J., Lewin, J., Thornes, J.B., (eds.)
Palaeohydrology in practice: a river basin analysis.
Wiley, Chichester.

BEALES, P.W. 1980 The late Devensian and Flandrian Vegetational History of Crose Mere, Shropshire.
New Phytologist 85, 133-161.

BEALES, P.W. and BIRKS, H.J.B. 1973 Palaeolimnological studies in North Shropshire and Cheshire <u>Shropshire Conservation Trust Bulletin</u> 28, 12-15.

BEHRE, K.E. 1981 The Interpretation of Anthropogenic indicators in Pollen Diagrams. <u>Pollen et Spores</u> 23, 225-245.

BEHRE, K.E. (ed) 1987 <u>Anthropogenic Indicators in Pollen Diagrams</u>. A.A. Balkema, Rotterdam.

BENNETT, K.D. 1984 The Post-glacial history of <u>Pinus sylvestris</u> in the British Isles. <u>Quaternary Science Reviews</u> 3, 133-155.

BENNETT, K.D. 1986 Competitive interactions among forest tree populations in Norfolk, England, during the last 10000 years. <u>New Phytologist</u> 103, 603-620.

BERGLUND, B.E. 1973 Pollen dispersal and deposition in an area of south-eastern Sweden - some preliminary results. in Birks, H.J.B. and West, R.G. (eds). <u>Quaternary Plant Ecology</u> Oxford. 117-129.

BERGLUND, B.E. (ed) 1986 <u>Handbook of Holocene Palaeo-ecology and Palaeohydrology</u> Wiley, Chichester.

BIRKS, H.J.B. 1963-4 Chat Moss, Lancashire. Memoirs and Proceedings of the Manchester Literary and Philosophical Society 106, 22-45.

BIRKS, H.J.B. 1965 Pollen analytical investigations at Holcroft Moss, Lancashire and Lindow Moss, Cheshire. Journal of Ecology 53, 299-314.

BIRKS, H.J.B. 1973 Modern pollen rain studies in some artic and alpine environments. in Birks, H.J.B. and West, R.G. (eds). Quaternary Plant Ecology. Oxford, 143-168.

BIRKS, H.J.B. 1986a Numerical zonation, comparison and correlation of Quaternary pollen - stratigraphical data. in Berglund, B.E. (ed). Handbook of Holocene Palaeoecology and Palaeohydrology. Wiley, Chichester. Chapter 37.

BIRKS, H.J.B. 1986b Late-Quaternary biotic changes in terrestrial and lacustrine environments, with particular reference to north-west Europe. in Berglund, B.E. (ed). Handbook of Holocene Palaeoecology and Palaeohydrology. Wiley, Chichester, 3-66.

BIRKS, H.J.B. and BERGLUND, B.E. 1979 Holocene pollen stratigraphy of southern Sweden: a reappraisal using numerical methods. Boreas 8, 257-279

BIRKS, H.J.B. and BIRKS, H.H. 1980 Quaternary Palaeoecology. Edward Arnold, London.

BIRKS, H.J.B. and GORDON, A.D. 1985 Numerical methods in Quaternary Pollen Analysis. Academic Press, London.

BJORCK, S, DEARING, J.A. and JONSSON, A. 1982 Magnetic susceptibility of Late Weichselian deposits in south-eastern Sweden. Boreas 11, 99-111

BONNY, A.P. 1976 Recruitment of pollen to the seston and sediment of some Lake District Lakes. Journal of Ecology 64, 859-887.

BONNY, A.P. 1978 The effect of pollen recruitment processes on pollen distribution over the sediment surface of a small lake in Cumbria. Journal of Ecology 66, 385-416.

BONNY, A.P. 1980 Seasonal and annual variation over 5 years in contemporary airborne pollen trapped at a Cumbrian lake. Journal of Ecology 69, 45-70.

BONNY, A.P. and ALLEN, P.V. 1984 Pollen recruitment to the sediments of an enclosed lake in Shropshire, England. in Haworth, E.Y. and Lund, J.W.G. (eds).

Lake Sediments and Environmental History.
Leicester University Press, 231-259.

BOWEN, H.C. 1978 'Celtic' fields and 'ranch' boundaries in Wessex. in Limbrey, S. and Evans, J.G. (eds). *The Effect of Man on the Landscape: the Lowland Zone.* C.B.A. Research Report 21. London. 115-123.

BRADLEY, R. 1978 *The Prehistoric Settlement of Britain.* Routledge and Kegan Paul. London.

BRADLEY, R. 1984 *The social foundations of prehistoric Britain.* Longman, London

BRADSHAW, R.H.W. 1981a Modern pollen representation factors for woods in S.E. England. *Journal of Ecology* 69, 45-70

BRADSHAW, R.H.W. 1981b Quantitative reconstruction of local woodland vegetation using pollen analysis from a small basin in Norfolk, England. *Journal of Ecology* 69, 941-955.

BRADSHAW. R.H.W. and THOMPSON, R. 1985 The use of magnetic measurements to investigate the mineralogy of Icelandic lake sediments and to study catchment processes. *Boreas* 14, 203-215.

BRADSHAW, R.H.W. and WEBB, T. 1985 Relationships between contemporary pollen and vegetation data from Wisconsin and Michigan, U.S.A. Ecology 66 (3),721-737.

BROOKE, D. and THOMAS, K.W. 1968 The distribution of pollen grains in microscope slides. Part I. The non-randomness of the distribution. Pollen et Spores 9, 621-630.

BROWN, A.G. 1982 Human impact on the former floodplain woodlands of the Severn. in Bell, M. and Limbrey, S. (eds). Archaeological Aspects of Woodland Ecology. B.A.R. Int. Ser. 146. 93-103.

BROWN, A.G. 1983a Late Quaternary Palaeohydrology, Palaeoecology and Floodplain Development of the Lower River Severn. Unpublished Ph.D. Thesis University of Southampton.

BROWN, A.G. 1983b Floodplain deposits and accelerated sedimentation in the lower Severn basin. in Gregory, K.J. (ed). Background to Palaeohydrology. Wiley, Chichester. 375-397.

BROWN, A.G. and BARBER, K.E. 1985 Late Holocene Palaeoecology and Sedimentary History of a small Lowland catchment in Central

England.
Quaternary Research 24, 87-102.

BUCKLAND, P.C. and EDWARDS, K.J. 1984 The longevity of pastoral episodes of clearance activity in pollen diagrams: the role of post occupation grazing. Journal of Biogeography 11, 243-249.

BURGESS, C.B. 1980 The Bronze Age in Wales. in Taylor, J.A. (ed). Culture and Environment in Prehistoric Wales. B.A.R. Brit. Ser. 76, 243-286.

BURNHAM, C.P. and MACKNEY, D. 1964. Soils of Shropshire. Field Studies 2. 1, 83-109.

CABORN, J.M. 1957 Shelterbelts and Microclimate. Forestry Commission Bulletin No. 19. Edinburgh : H.M.S.O.

CAMERON, R.A.D. and PANNETT, D.J. 1980 Hedgerow Shrubs and Landscape History: Some Shropshire examples. Field Studies 5. 2.177-194.

CANNELL, B. and HARRIES, W.J.R. 1981 The sand and gravel resources of the country around Wem, Shropshire. Mineral Assessment Report 86, Institute of Geological Sciences, N.E.R.C.,London.

CASELDINE, C.J. 1981 Surface pollen studies across Bankhead Moss, Fife, Scotland. Journal of Biogeography, 8, 7-25.

CASPARIE, W.A. 1972 Bog development in south eastern Drenthe (The Netherlands). Vegetatio 25, 1-271.

CHAMBERS, F.M. 1982 Environmental history of Cefn Gwernffrwd, Near Rhandirmwyn, Mid Wales. New Phytologist 92, 607-615.

CHAMBERS, F. and JONES, M.K. 1984 Antiquity of Rye in Britain. Antiquity 58, 219-224.

CHITTY, L.F. 1933 Bronze looped palstave from Whixall Moss, North Shropshire. Shropshire Archaeological Transactions 157, 73-75.

CHITTY, L.F. 1956 An Introduction to Shropshire Archaeology. Archaeological Journal 113, 178-185

CHITTY, L.F. 1963 The Clun-Clee Ridgeway: a prehistoric trackway across South Shropshire. in Foster, I. and Alcock, L. (eds). Culture and Environment. London. 171-192.

CHITTY, L.F. 1968 A bronze looped palstave from New House Farm, Wolverley, near Wem, Shropshire. Transactions of the Shropshire Archaeological and Natural History Society 58, 101.

COLES, J.M. and HARDING, A.F. 1979 The Bronze Age in Europe. Methuen, London.

COARD, M.A. et al 1983 Palaeoliminological studies of annually-laminated sediments in Loe Pool, Cornwall, U.K. Hydrobiologia 103, 185-191.

CRABTREE, K. 1975 A review of methodological advances in pollen analysis. in Peel, R., Chisholm, M. and Haggett, P. (eds). Processes in Physical and Human Geography. Bristol Essays, London.

CROMPTON, E. and OSMOND, D.A. 1954 The soils of the Wem District of Shropshire. Memoirs of the Soil Survey of Great Britain 138.

CUNDILL, P.R. 1986 A new design of pollen trap for modern pollen studies. Journal of Biogeography 13, 83-98

CUNLIFFE, B.W. 1978 Iron Age Communities in Britain (second edition). London.

CUSHING, E.J. 1967 Late Wisconsin Pollen Stratigraphy and the Glacial sequence in Minnesota. in Cushing, E.J. and Wright, H.E. (eds). Quaternary Palaeoecology Yale. 59-88.

DANIELS, R.E. 1978 Floristic analyses of British mires and mire communities. *Journal of Ecology* 66, 773-802.

DAVIS, M.B. 1963 On the theory of pollen analysis. *American Journal of Science* 261, 897-912.

DAVIS, M.B. 1968 Pollen grains in lake sediments: Redeposition caused by seasonal water circulation. *Science*, New York, 162, 796-799.

DAVIS, M.B. 1973 Redeposition of Pollen grains in Lake Sediment. *Limnology and Oceanography* 18, 45-52.

DAVIS, M.B., BRUBAKER, L.B., and BEISWENGER, J.M. 1971 Pollen grains in lake sediments: Pollen percentages in surface sediments from southern Michigan. *Quaternary Research* 1, 450-467.

DAVIS, M.B. and BRUBAKER, L.B. 1973 Differential sedimentation of pollen grains in Lakes. *Limnology and Oceanography* 18, 635-646.

DAVIS, M.B. BRUBAKER, L.B. and WEBB, T. 1973 Calibration of absolute pollen influx. in Birks, H.J.B. and West, R.G. (eds). *Quaternary Plant Ecology*. Oxford. 9-25.

DAVIS, M.B. and DEEVY, E.S. 1964 Pollen accumulation rates: estimates from late-glacial sediment of Roger's Lake. Science 145, 1293-1295.

DAVIS, M.B., MOELLER, R.E. and FORD, J. 1984 Sediment focussing and pollen influx. in Haworth, E.Y. and Lund, J.W.G. (eds). Lake Sediments and Environmental History. Leicester University Press. Chapter 10.

DAVIS, R.B. BREWSTER, L.A. and SUTHERLAND, J. 1969 Variation in pollen spectra within lakes (1). Pollen et Spores 11, 557-571.

DEARING, J.A. 1983 Changing patterns of sediment accumulation in a small lake in Scania, southern Sweden. Hydrobiologia, 103, 59-64.

DEARING, J.A., ELNER, J.K. and HAPPEY-WOOD, C.M. 1981 Recent Sediment Flux and Erosional Processes in a Welsh Upland Lake - Catchment Based on Magnetic Susceptibility Measurements. Quaternary Research 16, 356-372.

DEARING, J.A. and FLOWER, R.J. 1982 The magnetic susceptibility of sedimenting material trapped in Lough Neagh, Northern Ireland and its erosional significance. *Limnology and Oceanography* 27(5), 969-975.

DEARING, J.A., FOSTER, I.D.L. and SIMPSON, A.D. 1982 Timescales of denundation: the Lake-drainage basin approach. in *Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield.* (Proceedings of the Exeter Symposium, July 1982). I.A.H.S. Publ. no. 137.

DELCOURT, P.A., DELCOURT, H.R. and DAVIDSON, J.L. 1983 Mapping and calibration of modern pollen-vegetation relationship in the south eastern United States. *Review of Palaeobotany and Palynology*, 39, 1/2, 1-45.

DONALDSON, A.M. and TURNER, J. 1977 A pollen diagram from Hallowell Moss, near Durham City, U.K. *Journal of Biogeography* 4, 25-33.

DONNER, J.J., ALHONEN, P., ERONEN, M., JUNGNER, H. and VUORELA, I. 1978 Biostratigraphy and radiocarbon dating of the Holocene lake sediments of Tyotjarvi and the peats in the adjoining bog Varrasuo west of Lahti in southern Finland. Annales Botanici Fennici 15, 258-280.

EDWARDS, K.J. 1979 Palynological and Temporal Inference in the Context of Prehistory, with Special Reference to the Evidence from Lake and Peat Deposits. Journal of Archaeological Science 6, 255-270.

EDWARDS, K.J. 1981 The Separation of Corylus and Myrica pollen in Modern and Fossil samples. Pollen et Spores 23, 2, 205-218.

EDWARDS, K.J. 1982 Man, Space and the Woodland Edge - Speculations on the Detection and Interpretation of Human Impact on Pollen Profiles. in Bell, M. and Limbrey, S. (eds). Archaeological Aspects of Woodland Ecology. B.A.R. Int. Ser. 146, 5-22.

EDWARDS, K.J. 1983 Quaternary Palynology: Multiple profile studies and pollen variability. Progress in Physical Geography 7, 4, 587-609.

EDWARDS, K.J. and ROWNTREE, K.M. 1980 Radiocarbon and palaeoenvironmental evidence for changing rates of erosion at a Flandrian stage site in Scotland.

in Cullingford, R.A., Davidson, D.A. and Lewin, J. (eds). Timescales in Geomorphology. John Wiley & Sons Ltd, 207-223.

EDWARDS, K.J. and THOMPSON, R. 1984 Magnetic, palynological and radiocarbon correlation and dating comparisons in long cores from a northern Irish lake. Catena, 11, 83-89.

EVANS, A.T. and MOORE, P.D. 1985 Surface pollen studies of Calluna vulgaris and their relevance to the interpretation of bog and moorland pollen diagrams. Circaea 3, 3, Winter 1985, 173-178.

FAEGRI, K. 1966 Some problems of Representativity in Pollen Analysis. Palaeobotanist 15, 135-140.

FAEGRI, K. and IVERSEN, J. 1975 Textbook of pollen analysis. 3rd Edition, Blackwell, Oxford.

FOSTER, I.D.L., DEARING, J.A. and APPLEBY, P.G. 1986 Historicl trends in catchment sediment yields: a case study in reconstruction from lake-sediment records in Warwickshire, U.K. Hydrological Sciences Journal 31, 3, 9/1986.

FOWLER, P.J. 1983 The Farming of Prehistoric Britain. Cambridge University Press.

FRENCH, C.N. and MOORE, P.D. 1986 Deforestation, Cannabis cultivation and schwingmoor formation at Cors Llyn (Llyn Mire), central Wales. New Phytologist 102(3), 469-481.

FULLEN, M.A. and REED, A.H. 1986 Rainfall, Runoff and Erosion on bare arable soils in east Shropshire, England. Earth Surface Processes and Landforms 11, 413-425.

GARBETT, G.G. 1981 The Elm Decline: the Depletion of a Resource. New Phytologist 88, 573-585.

GELLING, P.S. 1962 The Berth, near Baschurch. West Midlands Archaeological News Sheet 5 (1962), 4.

GELLING, P.S. 1964 The Berth, near Baschurch, Shropshire. West Midlands Archaeological News Sheet 7 (1964), 5.

GELLING, P.S. and STANFORD, S.C. 1965 Dark Age pottery or Iron Age ovens? Transactions and Proceedings of the Birmingham Archaeological Society, 82, 77.

GODWIN, H. 1940 Pollen analysis and forest History of England and Wales. New Phytologist 39, 320-400.

GODWIN, H. 1967 Pollen analytical evidence for the cultivation of Cannabis in England. Review of Palaeobotany and Palynology 4, 71.

GODWIN, H. 1975 History of the British Flora. Second Edition. Cambridge University Press.

GODWIN, H. and WILLIS, E.H. 1960 Cambridge University Natural Radiocarbon Measurements II. American Journal of Science Radiocarbon Supplement 2, 62-72.

GORDON, A.D. and BIRKS, H.J.B. 1972 Numerical methods in Quaternary palaeoecology: I Zonation of pollen diagrams. New Phytologist 71, 961-979.

GORDON, A.D. and BIRKS, H.J.B. 1974 Numerical methods in Quaternary Palaeoecology: II Comparison of pollen diagrams. New Phytologist 73, 221-249.

GREATREX, P.A. 1983 Interpretation of macrofossil assemblages from surface sampling of macroscopic plant remains in mire communities. Journal of Ecology 71, 773-791.

GREIG, J.R.A. 1982 Past and Present lime woods of Europe. in Bell, M. and Limbrey, S. (eds). Archaeological Aspects of Woodland Ecology. B.A.R. Int. Ser. 146. 23-55.

GROENMAN-VAN WAATERINGE, W. 1978 The impact of Neolithic man on the landscape in the Netherlands. in Limbrey, S. and Evans, J.G. (eds). The Effect of Man on the Landscape: The Lowland Zone. C.B.A. Research Report 21, London. 135-146.

HALL, S.A. 1981 Deteriorated pollen grains and the interpretation of Quaternary pollen diagrams. Review of Palaeobotany and Palynology 32, 193-206.

HARDY, E.M. 1939 Studies of the Post-glacial history of British vegetation V The Shropshire and Flint Maelor mosses. New Phytologist 38, 364-396.

HARRISON, R.J. 1980 The Beaker Folk. Thames & Hudson, London.

HAVINGA, A.J. 1967 Palynology and Pollen preservation. Review of Palaeobotany and Palynology 2, 81-98.

HAVINGA, A.J. 1984 A 20-year experimental investigation into the differential corrosion susceptibility of pollen and spores in various soil types. Pollen et Spores 26, 3-4, 541-558.

HELBAEK, H. 1964 The Isca grain, a Roman Plant introduction in Britain. New Phytologist 63, 158-164.

HEY, D.G. 1974 An English Rural Community. Myddle under the Tudors and Stuarts. Leicester University Press.

HICKS, S.P. 1971 Pollen-analytical evidence for the effect of prehistoric agriculture on the vegetation of north Derbyshire. New Phytologist 71, 647-668.

HILTON, J. and LISHMAN, J.P. 1984 The effect of redox changes on the magnetic susceptibility of sediments from a seasonally anoxic lake. Limnology and Oceanography 30(4) 907-909.

HIRONS, K.R. and EDWARDS, K.J. 1986 Events at and around the First and Second Ulmus declines: Palaeoecological Investigations in Co. Tyrone, Northern Ireland. New Phytologist 104, 131-153.

HIRONS, K.R. and THOMPSON, R. 1986 Palaeoenvironmental application of magnetic measurements from inter-drumlin hollow lake sediments near Dungannon, Co. Tyrone, Northern Ireland. Boreas 15;2. 117-135.

HUNTLEY, B. and BIRKS, H.J.B. 1983 An Atlas of past and present pollen maps for Europe: 0 - 13000 years ago. Cambridge University Press.

IVERSEN, J. 1941 Landnam i Danmarks Stenalder. Danmarks Geologiske Undersøgelse Ser. II, 66, 20-68.

IVERSEN, J. 1949 The influence of prehistoric man on vegetation. Danmarks Geologiske Undersøgelse Series 4, 3(6), 1-25.

JACOBSON, G.L. Jr and BRADSHAW, R.H.W. 1981 The selection of sites for palaeovegetational studies. Quaternary Research 16, 80-96.

JANSSEN, C.R. 1966 Recent pollen spectra from the deciduous and coniferous-deciduous forests of north eastern Minnesota: A study in pollen dispersal. Ecology 47, 804-825.

JANSSEN, C.R. 1973 Local and Regional pollen deposition. in Birks, H.J.B. and West. R.G. (eds). Quaternary Plant Ecology Oxford.

JOHNSON, R.H. 1971 The Last Glaciation in north west England: a general survey. Amateur Geologist 5, 18-37.

JONES, R., BENSON-EVANS, K. and CHAMBERS, F.M. 1985 Human influence upon sedimentation in Llangorse Lake, Wales. Earth Surface Processes and Landforms. 10, 227-235.

KRZYWINSKI, K. 1977 Different Pollen Deposition Mechanism in Forest: a simple model. *Grana* 16, 199-202.

LEHMAN, J.T. 1975 Reconstructing the rate of accumulation of lake sediment. The effect of sediment focussing. *Quaternary Research* 5, 541-550.

LIMBREY, S. 1987 Farmers and Farmland: Aspects of Prehistoric Land-Use in the Severn Basin. in Gregory, K.J., Lewin, J. and Thornes, J.B. (eds). *Palaeohydrology in Practice: A river basin analysis*. Wiley, Chichester.

LLOYD-JONES, J. 1984 *Society and Settlement in Wales and the Marches 500BC to AD 1100*. B.A.R. Brit. Ser. 121 (i and ii).

LOCKWOOD, J.G. 1983 Modelling climatic change. in Gregory, K.J. (ed). *Background to Palaeohydrology*. Wiley, Chichester. 25-50.

LOWE, J.J. and WALKER, M.J.C. 1986 Flandrian Environmental History of the Isle of Mull, Scotland. II Pollen analytical data from sites in Western and Northern Mull. *New Phytologist* 103, 417-436.

MACKERETH, F.J.H. 1969 A short core sampler for subaqueous deposits. *Limnology and Oceanography* 14, 145-151.

MACKNEY, D., and BURNHAM, C.P. 1964 The Soils of the West Midlands. Soil Survey of Great Britain: England and Wales, Bulletin No.2.

MAGUIRE, D.J. 1983 The identification of agricultural activity using pollen analysis. in Jones, M. (ed). Integrating the Subsistence Economy. B.A.R. Int. Ser. 181, 5-18.

MAGUIRE, D., RALPH, N. and FLEMING, A. 1983 Early land-use on Dartmoor - Palaeobotanical and pedological investigations on Holne Moore. in Jones, M. (ed). Integrating the Subsistence Economy. B.A.R. Int. Ser. 181, 57-107.

MARTIN, H.M. 1968 Conditions affecting the distribution of Mercurialis perennis L in certain Cambridgeshire woodlands. Journal of Ecology 56, 777-793.

MEGAW, J.V.S. and SIMPSON, D.D.A. 1979 Introduction to British Pre-History. Leicester University Press.

MOLYNEUX, L.A. 1971 A complete result magnetometer for measuring the remanent magnetisation in rocks. Geophysical Journal of the Royal Astronomical Society 32, 429-434.

MOORE, P.D. (ed) 1984a European Mires. Academic Press.

MOORE, P.D. 1984b Hampstead Heath clue to historical decline of elms. Nature 312, 103.

MOORE, P.D. and CHATER, E.H. 1969 The changing vegetation of west central Wales in the light of human history. Journal of Ecology 57, 361-379.

MOORE, P.D. and WEBB, J.A. 1978 An Illustrated Guide to Pollen Analysis. Hodder and Stoughton, London.

MORRIS, E.L. 1980 Petrological Report for the Iron Age Ceramics from The Berth, Shropshire (SJ429237). Unpublished report, Department of Archaeology, University of Southampton.

MULLINS, C.E. 1977 Magnetic susceptibility of the soil and its significance in soil science - A review. Journal of Soil Science 28, 223-246.

MUSSON, C.R. 1976 Excavations at the Breiddin 1969-1973. in Harding, D.W. (ed). Hillforts: Later Prehistoric Earthworks in Britain and Ireland. London. 293-302.

OLDFIELD, F. 1963 Pollen analysis and man's role in the ecological history of the south-east Lake District. Geografiska Annaler 45(1), 23-40.

OLDFIELD, F. 1970 Some aspects of scale and complexity in pollen - Analytically based palaeoecology. Pollen et Spores 12, 163-172.

OLDFIELD, F. 1981 Peats and Lake Sediments: Formation, stratigraphy, description and nomenclature. in Goudie, A. (ed). Geomorphological Techniques. London. 306-326.

OLDFIELD, F., BARNOSKY, C., LEOPOLD, E.B. and SMITH, J.P. 1983 Mineral magnetic studies of lake sediments. Hydrobiologia 103, 37-44.

OLDFIELD, F., DEARING, J.A., THOMPSON, R. and GARRET-JONES, S. 1978 Some magnetic properties of lake sediments and their possible links with erosion rates. Polskie Archiwum Hydrobiologii 25, 321-331.

OLDFIELD, R., RUMMERY, T.A., THOMPSON, R. and WALLING, D.E. 1979 Identification of suspended sediment sources by means of magnetic measurements: Some preliminary results. Water Resources Research 15, 2, 211-218.

OLDFIELD, F., KRAWIECKI, A.,

MAHER, B., TAYLOR, J.J. and TWIGGER, S.N. 1985a The Role of Mineral Magnetic Measurements in Archaeology. in Fieller, N.R.J., Gilbertson, D.D., Ralph, N.G.A. Palaeoenvironmental Investigations: Research Design, Methods and Data Analysis. B.A.R. Int. Ser. 258. 29-43.

OLDFIELD, F., WORSLEY, A.T. and APPLEBY, P.G. 1985b Evidence from Lake sediments for recent erosion rates in the highlands of Papua New Guinea. in Douglas, I. and Spencer, T. (eds). Environmental Change and Tropical Geomorphology. Chapter 9, 185-196.

OSWALD, P. and HERBERT, A. (eds) 1965 Proceedings of a Meres and Mires Conference at Attingham Park, Shrewsbury. N.E.R.C.: The Nature Conservancy.

PANNETT, D.J. and MOREY, C. 1976 The origin of the old river bed at Shrewsbury. Bulletin of the Shropshire Conservation Trust 35, 7-12.

PARSONS, R.W., GORDON, A.D. and PRENTICE, I.C. 1983 Statistical uncertainty in forest composition estimates obtained from fossil pollen spectra via the R-value model.

Review of Palaeobotany and Palynology 40, 177-189.

PEACOCK, D.P.S. 1968 A petrological study of certain Iron Age pottery from Western England. Proceedings of the Prehistoric Society 34, 414-427.

PEARSON, G.W., PILCHER, J.R., BAILLIE, M.G.L., CORBETT, D.M. and QUA, F. 1986 High-Precision ^{14}C Measurement of Irish Oaks to show the Natural ^{14}C Variations from AD 1840 to 5210 BC. Radiocarbon 28, 2B, 911-934.

PECK, R.M. 1973 Pollen budget studies in a small Yorkshire catchment. in Birks, H.J.B. and West, R.G. (eds). Quaternary Plant Ecology. Oxford. 43-60.

PENNINGTON, W. 1969 The History of British Vegetation. English Universities Press, London.

PENNINGTON, W. 1970 Vegetation history in the north-west of England: A regional synthesis. in Walker, D. and West, R.G. (eds). Studies in the Vegetational History of the British Isles. Cambridge University Press. 41-79.

PENNINGTON, W. 1973 Absolute pollen frequencies in the sediments of lakes of different Morphometry. in Birks, H.J.B. and West, R.G. (eds). Quaternary Plant Ecology. Oxford. 79-104.

PENNINGTON, W. 1979 The origins of pollen in lake sediments: An enclosed lake compared with one receiving inflow streams. New Phytologist 83, 189-213.

PENNINGTON, W., CAMBRAY, R.S., EAKINS, J.D. and HARKNESS, D.D. 1976 Radionuclide dating of the recent sediments of Blelham Tarn. Freshwater Biology 6, 317-331.

PETERKEN, G.F. and GAME, M. 1981 Historical factors affecting the distribution of Mercurialis perennis in central Lincolnshire. Journal of Ecology 69, 781-796.

PIGOTT, C.D. and HUNTLEY, J.P. 1980 Factors controlling the distribution of Tilia cordata at the Northern limits of its Geographical range: II. History in north-west England. New Phytologist 84, 145-164.

PILCHER, J.R. and SMITH, A.G. 1979 Palaeoecological investigations at Ballynagilly, a Neolithic and Bronze Age settlement in Co. Tyrone, Northern Ireland. Philosophical Transactions of the Royal Society of London (B) 286, 1013, 345-369.

POLUNIN, O. and WALTERS, M. 1985 A guide to the Vegetation of Britain and Europe. Oxford University Press.

PRENTICE, I.C. 1978 Modern pollen spectra from lake sediments in Finland and Finnmark, north Norway. Boreas 7, 131-153.

PRENTICE, I.C. 1983a Pollen mapping of regional vegetation patterns in south and central Sweden. Journal of Biogeography 10, 441-454.

PRENTICE,I.C. 1983b Postglacial climatic change: Vegetation dynamics and the pollen record. Progress in Physical Geography. Vol. 7, No. 2, June 1983, 273-286.

PRENTICE, I.C. 1985 Pollen Representation, Source Area, and Basin Size: Towards a Unified Theory of Pollen Analysis. Quaternary Research 23, No. 1, 76-86.

PRICE, M.D.R. and MOORE, P.D. 1984 Pollen dispersion in the Hills of Wales: A 'pollen-shed' hypothesis. Pollen et Spores 26, 1, 127-136.

RANDALL, R.E., ANDREW, R. and WEST, R.G. 1986 Pollen Catchment in Relation to Local Vegetation: Ceann Ear, Monach Isles N.N.R., Outer Hebrides New Phytologist 104, 271-310.

REYNOLDS, C.S. 1979 The Limnology of the Eutrophic Meres of the Shropshire-Cheshire Plain. _Field Studies_ 5(1), 93-173.

REYNOLDS, C.S. and SINKER, C.A. 1976 The Meres: Britain's Eutrophic Lakes. _New Scientist_ 71, 1007, 10-12.

RICHMOND, I.A. 1963 The Cornovii. in Foster, I.L. and Alcock, L. (eds). _Culture and Environment_. London. 251-262.

ROWELL, T.K. and TURNER, J. 1985 Litho-, humic- and pollen-stratigraphy at Quick Moss, Northumberland. _Journal of Ecology_ 73, 1, 11-25.

ROWLEY, R.T. 1972 _The Shropshire Landscape_. Hodder & Stoughton, London.

SAVORY, H.N. 1976 Welsh Hillforts: A Reappraisal of Recent Research. in Harding, D.W. (ed). _Hillforts: Later Prehistoric Earthworks in Britain and Ireland_. London. 237-290.

SHAW, J. 1972 The Irish Sea Glaciation of North Shropshire - Some environmental reconstructions. _Field Studies_ 3, 603-631.

SHOTTON, F.W. 1978 Archaeological inferences from the study of alluvium in the lower Severn-Avon Valleys.

in Limbrey, S. and Evans, I.G. (eds).
Man's Effect on the Landscape: The Lowland Zone.
C.B.A. Research Report 21, London. 27-32.

SIMMONS, I.G. and TOOLEY, M.J. 1981 The Environment in British Prehistory.
Duckworth, London.

SIMS, R.E. 1973 The Anthropogenic factor in East Anglian vegetational history: An approach using A.P.F. techniques. in Birks, H.J.B. and West,R.G. (eds).
Quaternary Plant Ecology.
Oxford. 223-236.

SINKER, C.A. 1962 The North Shropshire Meres and Mosses. A background for Ecologists.
Fields Studies 1(4), 101-138.

SINKER, C.A., PACKHAM, J.R., TRUEMAN, I.C., OSWALD, P.H., PERRING, F.H. and PRESTWOOD, W.V. 1985 Ecological Flora of the Shropshire Region.
Shropshire Trust for Nature Conservation, Shrewsbury.

SLATER, F.M. 1972 A history of the Vegetation of Wem Moss, Shropshire.
Proceedings of the Birmingham Natural History Society 22, 92-118.

SMITH, A.J.E. 1980 The Moss Flora of Britain and Ireland.
C.U.P. Cambridge.

SMITH, J.P. 1985 Mineral Magnetic Studies on Two Shropshire-Cheshire Meres.
Unpublished Ph.D. Thesis, University of Liverpool.

SMITH, R.A. 1907 Timekeepers of the Ancient Britons.
Proceedings of the Society of Antiquaries 21, 319-334.

STANFORD, S.C. 1972a The Function and Population of Hill-forts in the Central Marches.
in Lynch, F. and Burgess, C.(eds).
Prehistoric Man in Wales and the West. Bath. 307-317.

STANFORD, S.C. 1972b Welsh Border Hillforts.
in Thomas, A.C. (ed).
The Iron Age in the Irish Sea Province.
C.B.A. Research Report 9, 25-36.

STANFORD, S.C. 1980 The Archaeology of the Welsh Marches.
Collins, London.

STANFORD, S.C. 1982 Bromfield, Shropshire - Neolithic, Beaker and Bronze Age Sites, 1966-79.
Proceedings of the Prehistoric Society 48, 279-320.

STURLUDOTTIR, S.A. and TURNER, J. 1985 The Elm Decline at Pawlaw Mire: An Anthropogenic Interpretation.
New Phytologist 99, 323-329.

SUTTON, O.G. 1947 The problem of diffusion in the lower atmosphere. Quaterly Journal of the Royal Meteorological Society 73, 257-276.

SUTTON, O.G. 1953 Micrometeorology. McGraw-Hill, New York.

SWITSUR, V.R. and WEST, R.G. 1975 University of Cambridge Natural Radiocarbon Measurements XIV Radiocarbon 17, 3, 301-312.

TALLIS, J.H. 1973 The terrestrialisation of Lake basins in North Cheshire, with special reference to the development of a "Schwingmoor" structure. Journal of Ecology 61, 537-567.

TALLIS, J.H. and BIRKS, H.J.B. 1965 The past and present distribution of Scheuchzeria palustris in Europe. Journal of Ecology 53, 287.

TALLIS, J.H. and MAGUIRE, J. 1972 Central Rossendale; the evolution of an upland vegetation. I. The clearance of woodland. Journal of Ecology 60, 721-737.

TAUBER, H. 1965 Differential pollen dispersion and the interpretation of pollen diagrams. Danmarks Geologiske Undersøgelse Series 2, 89, 1-69.

TAUBER, H. 1967a Differential Pollen Dispersion and Filtration. in Cushing, E.J. and Wright, H.E.

(eds).
Quaternary Palaeoecology.
Yale University Press. 131-141.

TAUBER, H. 1967b Investigations of the mode of pollen transfer in forested areas. Review of Palaeobotany and Palynology 3 (1967) 277-286.

TAUBER, H. 1977 Investigations of aerial pollen transport in a forested area. Dansk Botanisk Arkiv 32(1), 1-121.

TAYLOR, C. 1984 Village and Farmstead. George Philip, London.

TAYLOR, J.A. 1980 Environmental changes in Wales during the Holocene period. in Taylor, J.A. (ed). Culture and Environment in Prehistoric Wales. B.A.R. Brit. Ser. 76, 101-130.

TEN HOVE, H.A. 1968 The Ulmus fall at the Transition Atlanticum - Subboreal in pollen diagrams. Palaeogeography, Palaeoclimatology, Palaeoecology 5, 359-369.

THOMAS, N. 1972 An Early Bronze Age Stone Axe - Mould from the Walleybourne below Longden Common, Shropshire. in Lynch, F. and Burgess, C. (eds) Prehistoric Man in Wales and the West. Bath. 161-165.

THOMPSON, R., BATTARBEE, R.W., O'SULLIVAN, P.E. and OLDFIELD, F. 1975 Magnetic Susceptibility of Lake

Sediments. *Limnology and Oceanography* 20, 687-698.

THOMPSON, R. and MORTON, D.J. 1979 Magnetic susceptibility and particle size distribution in recent sediments of the Loch Lomond Drainage basin, Scotland. *Journal of Sedimentary Petrology*. 49, 3, 801.

THOMPSON, R. and OLDFIELD, F. 1986 *Environmental Magnetism*. Allen & Unwin.

TINSLEY, H.M. 1976 Cultural influences on Pennine vegetation with particular reference to North Yorkshire. *Transactions of the Institute of British Geographers*. New Series 1, 310-322.

TINSLEY, H.M. (with GRIGSON, C.) 1981 The Bronze Age. in Simmons, I.G. and Tooley, M.J. (eds). *The Environment in British Prehistory*. Duckworth, London, 210-249.

TINSLEY, H.M. and SMITH, R.T. 1974 Surface pollen studies across a woodland/heath transition and their application to the interpretation of pollen diagrams. *New Phytologist* 73, 547-565.

TOGHILL, P. and CHELL, K. 1984 Shropshire Geology - Stratigraphic and Tectonic History.

Field Studies 6, 59-101.

TOLONEN, M. 1984 Differences in pollen and macrophytic remains in sediments from various depths in a small kettle-hole lake in southern Finland.
Boreas 13, 403-412.

TROELS-SMITH, J. 1955 Characterisation of unconsolidated sediments.
Danmarks Geologiske Undersøgelse 4, 3, 1-73.

TROELS-SMITH, J. 1960 Ivy, Mistletoe and Elm: Climatic Indicators - Fodder Plants.
Danmarks Geologiske Undersøgelse Ser. 4, 4(4) 1-32.

TURNER, J. 1962 The Tilia decline, an anthropogenic interpretation.
New Phytologist 61, 328-341.

TURNER, J. 1964a The anthropogenic factor in vegetational history. I. Tregaron and Whixall Mosses.
New Phytologist 63, 73.

TURNER, J. 1964b Surface pollen sample analysis from Ayrshire, Scotland.
Pollen et Spores 6, 583-592.

TURNER, J. 1965 A contribution to the history of forest clearance.
Proceedings of the Royal Society (B) 161, 343-354.

TURNER, J. 1970 Post-Neolithic disturbance of British Vegetation.

in Walker, D. and West, R.G. (eds). Studies in the Vegetational History of the British Isles. Cambridge University Press. 97-116.

TURNER, J. 1975 The evidence of Land use by Prehistoric Farming Communities: The use of three-dimensional pollen diagrams. in Evans, J.G. Limbrey, S. and Cleere, H. (eds). The Effect of Man on the Landscape: the Highland Zone. C.B.A. Research Report 11, 86-95.

TURNER, J. 1979 The environment of north east England during Roman times as shown by Pollen Analysis. Journal of Archaeological Science 6, 285-290.

TURNER, J. and HODGSON, J. 1979 Studies in the Vegetational History of the Northern Pennines. I. Variations in the Composition of the Early Flandrian Forests. Journal of Ecology 67, 629-646.

TURNER, J. and HODGSON, J. 1981 Studies in the Vegetational history of the Northern Pennines. II. An atypical pollen diagram from Pow Hill, Co. Durham. Journal of Ecology 69, 171-188.

TWIGGER, S.N. 1983 Environmental Change in Lowland Cheshire. Unpublished Research Report, University of Liverpool, Department of Geography.

TYLER, A. 1981 The Berth, Baschurch. _Archaeological Journal_ 138, 16-17.

VUORELA, I. 1973 Relative pollen rain around cultivated fields. _Acta botanica fennica_ 102, 2-27.

VUORELA, I. 1977 Pollen Grains Indicating Culture in Peat, Mud and Till. _Grana_ 16, 211-214.

WALKER, D. 1966 The Late Quaternary history of the Cumberland Lowland. _Philosophical Transactions of the Royal Society of London (B)_ 251, 1-210.

WALKER, D. 1970 Direction and rate in some British Post-Glacial hydroseres. in Walker, D. and West, R.G. (eds). _Studies in the Vegetational History of the British Isles_. Cambridge University Press. 117-139.

WALKER, M.F. and TAYLOR, J.A. 1976 Post-Neolithic Vegetation Changes in the Western Rhinogau, Gwynedd, north-west Wales. _Transactions of the Institute of British Geographers_. New Series 1 323-345.

WARDLE, P. 1959 The regeneration of _Fraxinus excelsior_ in woods with a field layer of _Mercurialis perennis_. _Journal of Ecology_ 47, 483-497.

WATTS, W.A. 1961 Post-Atlantic forests in Ireland. Proceedings of the Linnean Society of London 172, 33-38.

WALKER, M.J.C. and LOWE, J.J. 1985 Flandrian environmental history of the Isle of Mull, Scotland. I. Pollen-stratigraphic evidence and radiocarbon dates from Glen More, South-Central Mull. New Phytologist 99, 587-610.

WEBB, T. 1974 Corresponding patterns of pollen and vegetation in Lower Michigan: A comparison of quantitative data. Ecology 55, 17-28.

WEBB, T., LASESKI, R.A. and BERNABO, J.C. 1978 Sensing Vegetational Patterns with Pollan Data. Ecology 59, 1151-1163.

WEBSTER, G. 1975 The Cornovii. Duckworth, London.

WEST, R.G. 1973 Introduction. in Birks, H.J.B. and West, R.G. (eds). Quaternary Plant Ecology Oxford.

WILLIAMS, C.T. 1985 Mesolithic Exploitation Patterns in the Central Pennines: A Palynological Study of Soyland Moor. B.A.R. Brit. Ser. 139, 1-179.

WILLS, L.J. 1950 The Palaeogeography of the Midlands University Press, Liverpool, 2nd Edition.

WIMBLE, G.T. 1986 The palaeoecology of the Lowland coastal raised mires of south Cumbria.
Unpublished Ph.D. Thesis, University of Wales (Cardiff).

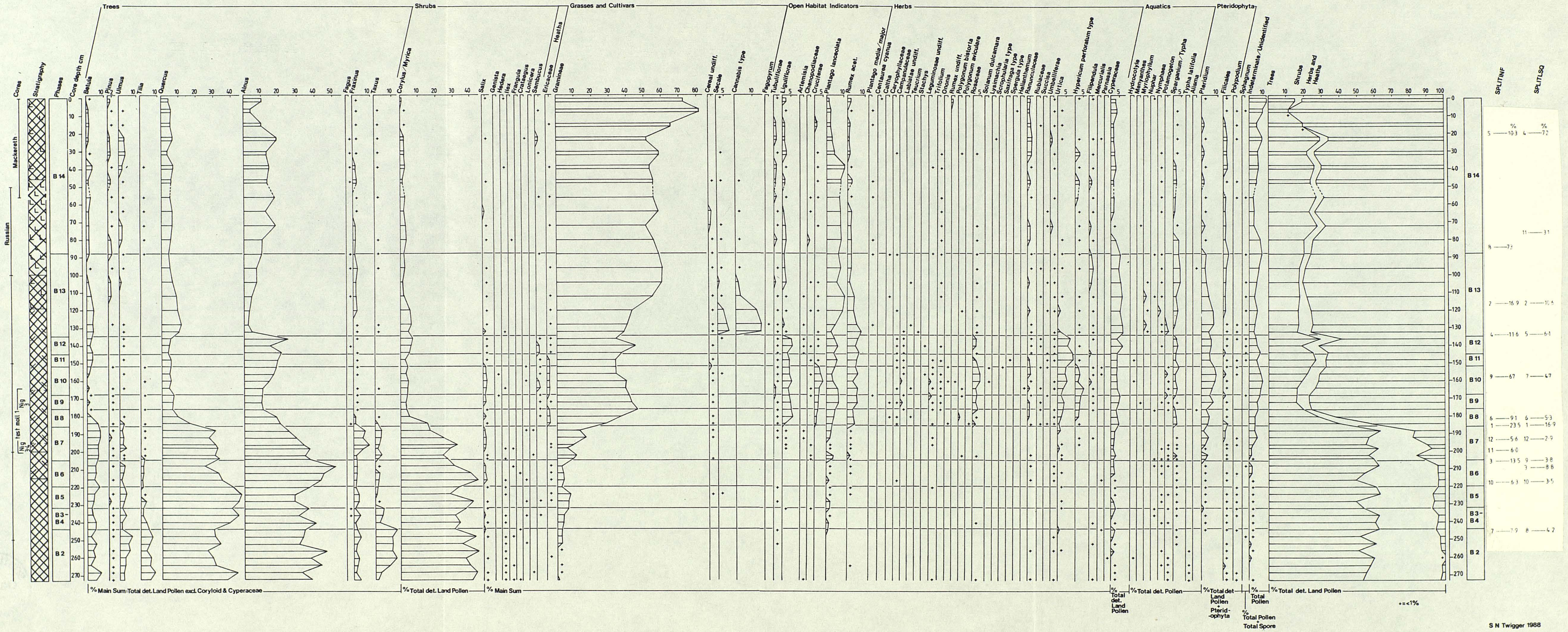
WATON, P.V. 1982 A palynological study of the impact of man on the landscape of central southern England with special reference to the chalk-lands.
Unpublished Ph.D. Thesis, University of Southampton.

WORSLEY, P. 1970 The Cheshire-Shropshire Lowlands. in Lewis, C.A. (ed). The glaciations of Wales and adjoining regions. Longmans, London. 83-106.

WRIGHT, H.E. and PATTEN, H.L. 1963 The Pollen Sum. Pollen et Spores 5, 2, 445-450.

1. Berth Pool II

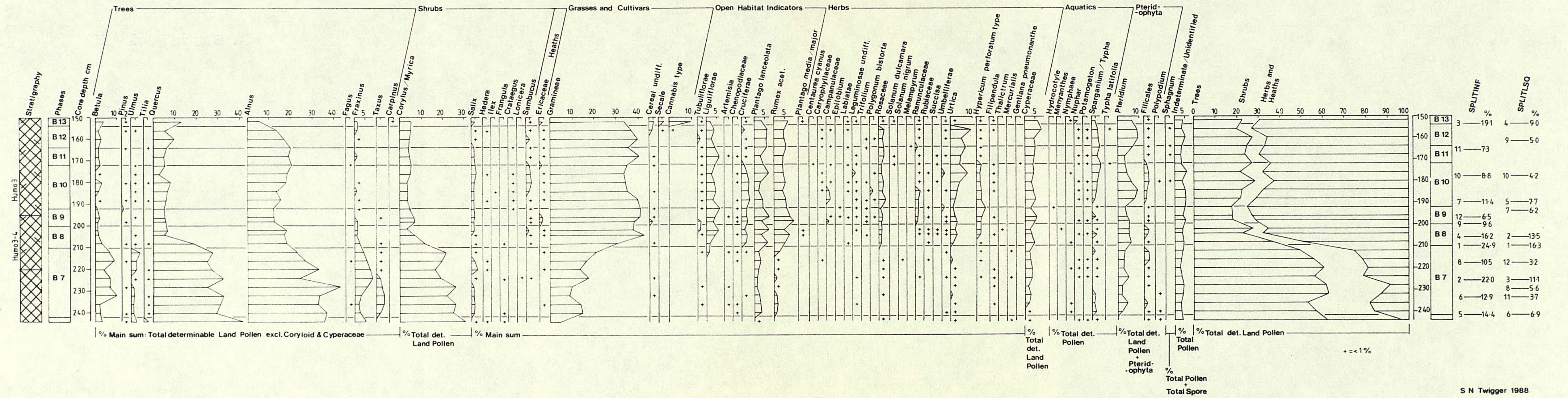
BERTH POOL II



S N Twigger 1988

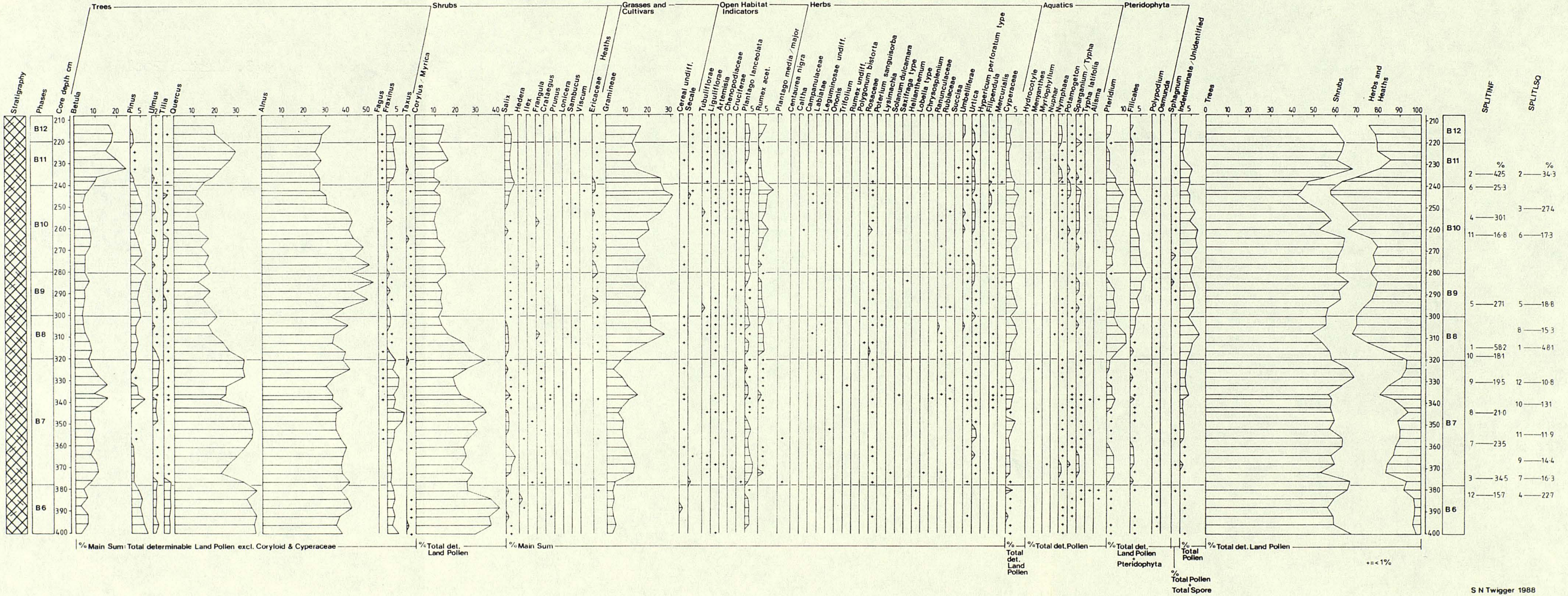
2. Berth Pool III

BERTH POOL III



3. Marton Pool

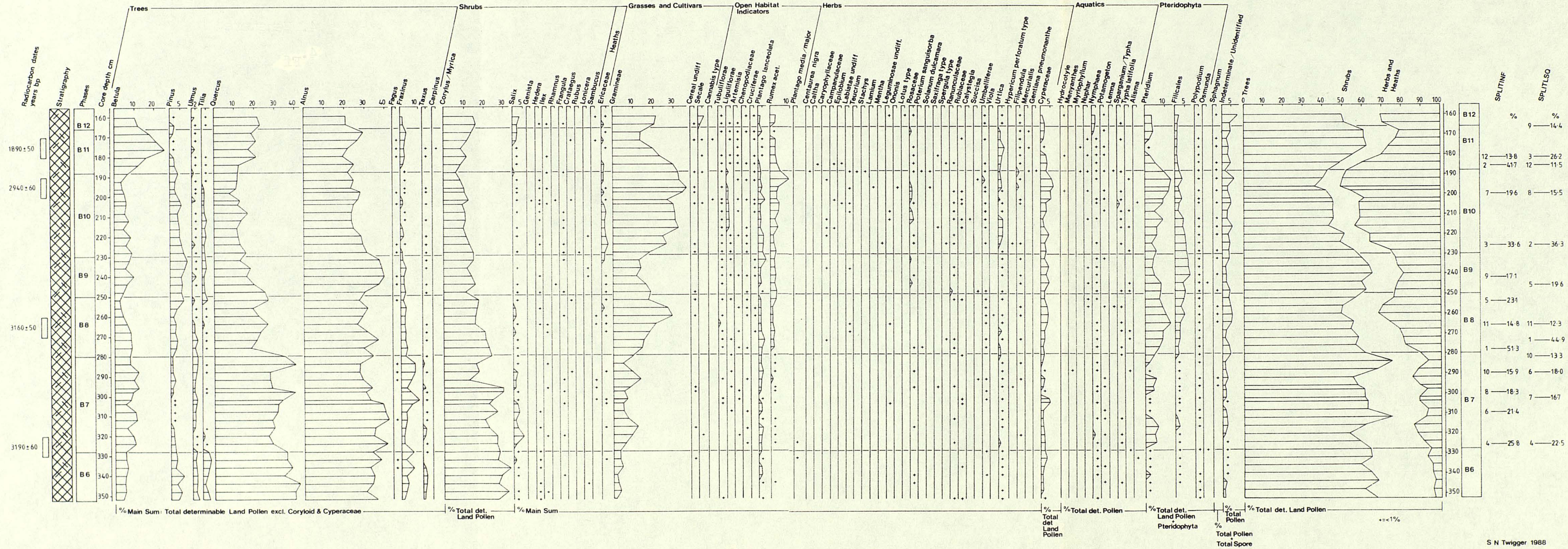
MARTON POOL



S N Twigger 1988

4. Fenemere

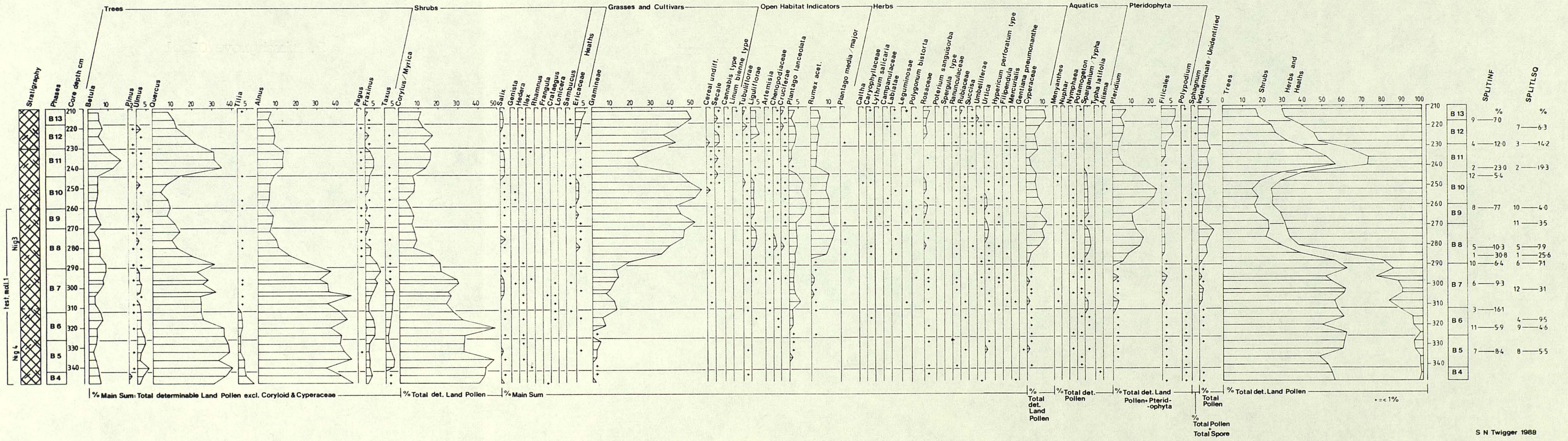
FENEMERE



S N Twigger 1988

5. Birchgrove Pool

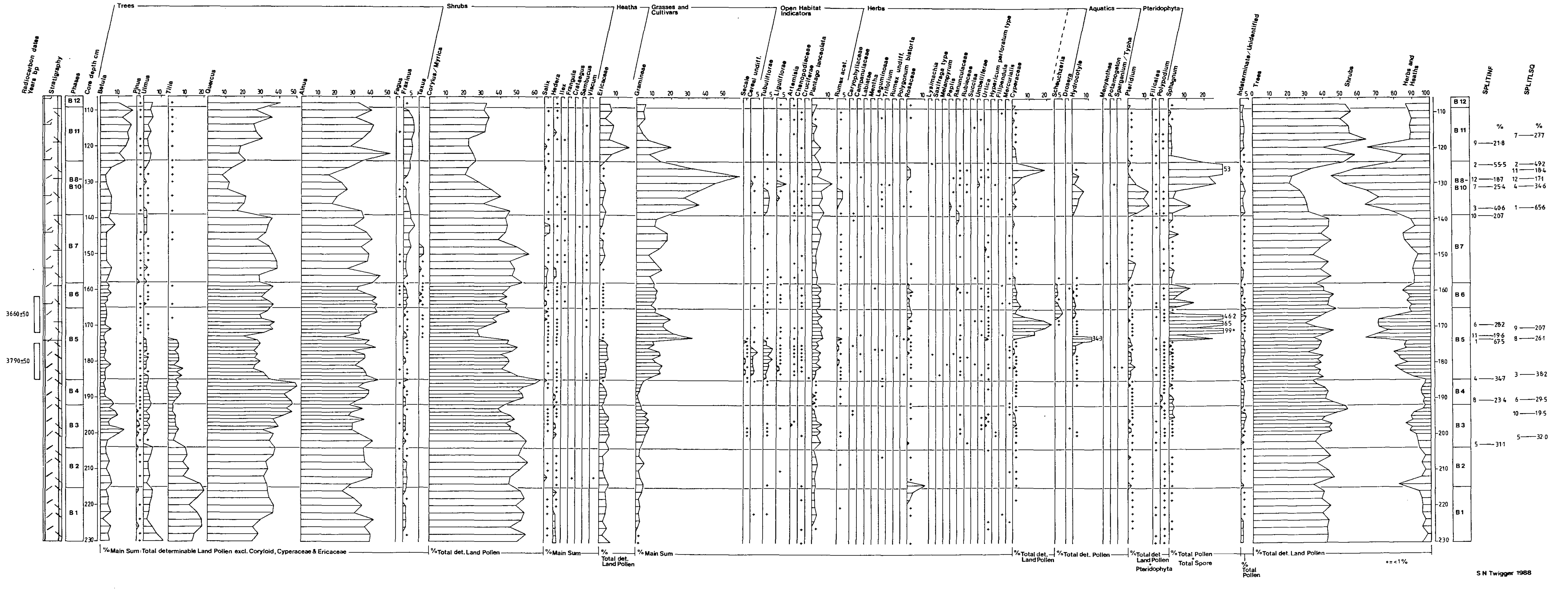
BIRCHGROVE POOL



S N Twigger 1988

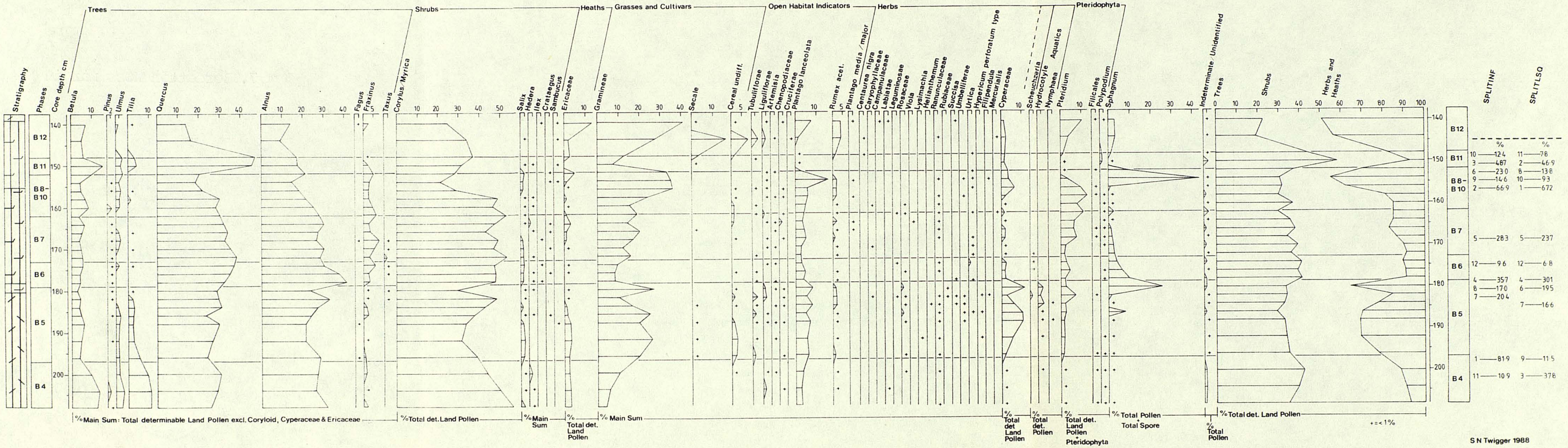
6. Boreatton Moss centre

BOREATTON MOSS centre



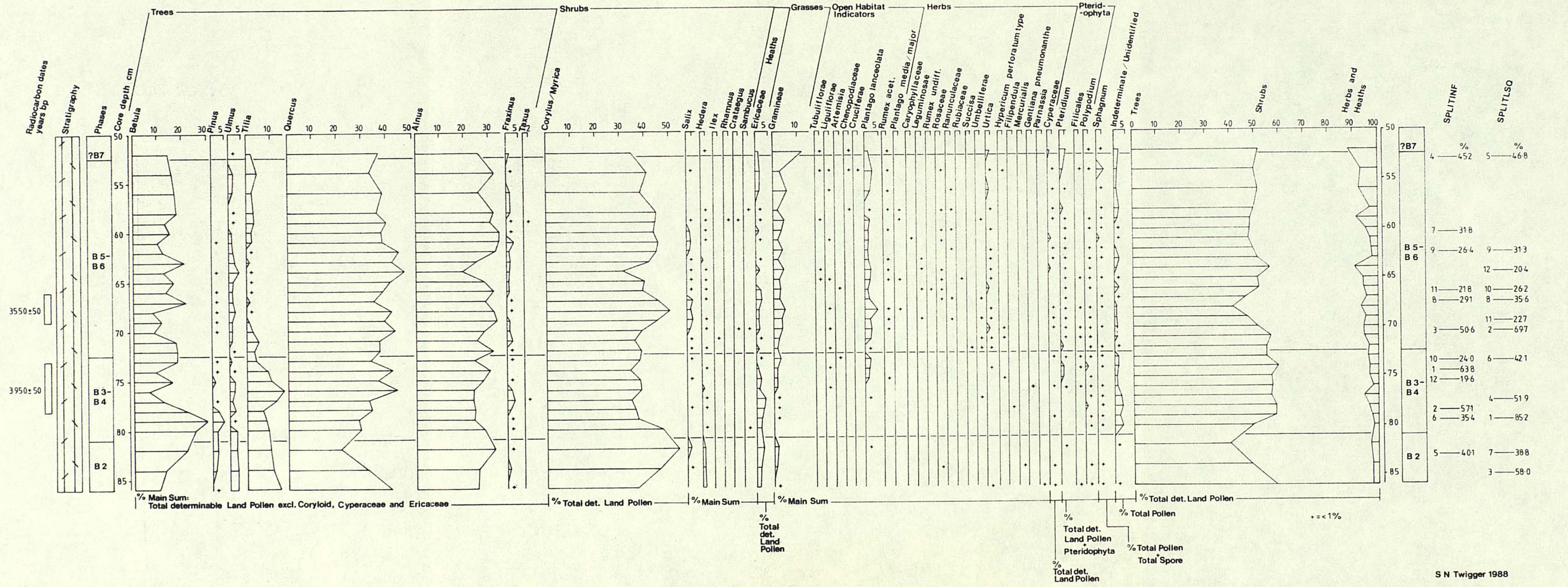
7. Boreatton Moss margin

BOREATTON MOSS margin



8.New Pool

NEW POOL


Radiocarbon dates years bp
Stratigraphy
Phases
Core depth cm
Trees
Shrubs
Heaths
Grasses
Open Habitat Indicators
Herbs
Pteridophyta
Betula
Pinus
Ulmus
Tilia
Quercus
Alnus
Fraxinus
Taxus
Corylus/Myrica
Salix
Hedera
Ilex
Rhamnus
Crataegus
Sambucus
Ericaceae
Gramineae
Tubuliflorae
Liguliflorae
Artemisia
Chenopodiaceae
Cruciferae
Plantago lanceolata
Rumex acet.
Plantago media/major
Caryophyllaceae
Leguminosae
Rumex undiff.
Rosaceae
Ranunculaceae
Rubiaceae
Succisa
Umbelliferae
Urtica
Hypericum perforatum type
Filipendula
Mercurialis
Gentiana pneumonanthe
Parnassia
Cyperaceae
Pteridium
Filicales
Polypodium
Sphagnum
Indeterminate/Unidentified
Trees
Shrubs
Herbs and Heaths
SPLITINF
SPLITLSQ
3550±50
3950±50
?B7
B5-B6
B3-B4
B2
% Main Sum: Total determinable Land Pollen excl. Coryloid, Cyperaceae and Ericaceae
% Total det. Land Pollen
% Main Sum
% Total det. Land Pollen
% Main Sum
% Total det. Land Pollen + Pteridophyta
% Total det. Land Pollen
% Total Pollen
% Total Pollen + Total Spore
% Total det. Land Pollen
+ = < 1%
4 — 45·2
5 — 46·8
7 — 31·8
9 — 26·4
9 — 31·3
12 — 20·4
11 — 21·8
10 — 26·2
8 — 29·1
8 — 35·6
11 — 22·7
3 — 50·6
2 — 69·7
10 — 24·0
6 — 42·1
1 — 63·8
12 — 19·6
4 — 51·9
2 — 57·1
6 — 35·4
1 — 85·2
5 — 40·1
7 — 38·8
3 — 58·0
S N Twigger 1988