

## ENVIRONMENTAL CHANGE IN SHROPSHIRE DURING THE LAST 13,000 YEARS

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### ABSTRACT

The meres, mosses and fens of Shropshire and Cheshire are sites of major scientific importance for contemporary ecological and palaeoecological studies. Detailed studies are available for the later prehistoric phase of the postglacial history of Shropshire. Whilst the modern day appearance of the Shropshire-Cheshire Plain inevitably owes much to modern farming practices, the impact of prehistoric man must not be overlooked. Areas which are farmed today first came under the plough four to five thousand years ago. Two and a half thousand years ago, the impact of Iron Age man was sufficient to cause major soil erosion. Thus, during the first half of the Holocene period, climatic factors were predominant in shaping the environment and determining the composition of the forests. After 3,000 BC, however, Man increasingly became the main agent of change.

The aim of this paper is to provide an insight into the environmental history of North Shropshire since the final phase of the last glaciation. Particular attention is paid to the effects of man on the landscape, and the possible influences of climatic change on land use patterns.

### INTRODUCTION

RECENT PALAEOENVIRONMENTAL RESEARCH by Brown (1983a), Barber and Twigger (1987), Haslam (1988), Twigger (1988) and Hobby (1990) has developed the earlier work of Hardy (1939), Turner (1964, 1965), Slater (1972), Beales and Birks (1973) and Beales (1980). Such work has only been possible because of the diverse wetland habitats of the region, recently brought to prominence by the discovery of Lindow Man, a probable Iron Age inhabitant of north west Britain (Stead, Bourke and Brothwell, 1986). The ecological significance of the Shropshire, Cheshire and southern Lancashire wetlands has long been acknowledged (Sinkler, 1962; Oswald and Herbert, 1965; Reynolds and Sinkler, 1976; Reynolds, 1979) and a major study of the habitats and flora of Shropshire by Sinkler *et al.*, (1985) is now available.

The meres, mosses and fens of Shropshire and Cheshire provide excellent opportunities for study by the modern day ecologist, but it is the ancient deposits preserved within them which provide the raw material for the palaeoecologist and which permit an exploration of the environmental evolution of the region. This paper discusses the results of pollen and plant macrofossil analyses of ancient deposits of peat and lake sediment. Coring equipment can be used to recover samples from successive depths in a sediment profile. Analysis of these samples enables the palaeoecologist to reconstruct past environmental conditions in the area. Samples can be chemically cleaned and concentrated to reveal preserved pollen grains. Each plant type produces its own individual type of pollen grain which can be

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identified with reference to pollen identification keys (Faegri and Iversen, 1975; Moore and Webb, 1978). Washing and sieving of peat samples allows larger plant remains to be examined; identification can again be made with reference to keys (Smith, 1980). Pollen frequency and plant macrofossil data can be plotted on diagrams which show the depth through a given core and the relative frequencies of different plant remains identified at successive depths. Reference to such diagrams (Fig. 3) allows deductions to be made about the type of community surrounding a lake or peat moss, at any particular point in time, or about the vegetation covering a peat surface (Fig. 4). Some examples of pollen grains preserved from sites in Shropshire are shown in Fig. 2. The scientific names of plants mentioned in the text are given in Table 1.

The letters BC (Before Christ) in this paper denote uncalibrated radiocarbon dates. Sometimes an actual radiocarbon date is shown, complete  $\pm$  (plus or minus) one standard deviation, together with laboratory number, in years bp (before present): "Present" is defined as 1950. A radiocarbon date is only a statement of the probability that a sample has a date within a given age range and radiocarbon dates are not necessarily equivalent to actual "calendar" dates (*cf.* Pearson *et. al.*, 1986).

#### PALAEOLITHIC TO NEOLITHIC PERIODS from about 11,000 to about 3,000 BC

The melting ice masses of the Devensian glaciation left behind them a mantle of glacial till, overlain in places by fluvioglacial sands and gravels. These glacial deposits include material eroded from Scotland, the Lake District and the Irish Sea Basin (Shaw, 1972). Triassic sedimentary strata from the Shropshire area are represented in the till, together with fluvioglacial deposits and material derived from Palaeozoic strata in the Welsh Mountains. Poorly-drained gley soils developed on the glacial till whilst, on the sand and gravel ridges, freer draining brown earths evolved as the natural soil type. Peat deposits accumulated in hollows separating the sand and gravel ridges, typically where relatively shallow areas of open water existed in the lateglacial and early postglacial period (*cf.* Cannell and Harries, 1981).

The lateglacial vegetational history of Shropshire has been discussed by Beales (1980) and the evidence was reviewed in the context of Northwest Britain as a whole by Barber & Twigger (1987). The lateglacial Shropshire landscape was predominantly treeless. The diverse habitats, from drier ridge crests to damper hollows, fens and lake-surrounds supported a herb flora which, at this stage, endured a relatively harsh climatic regime. A short-lived climatic amelioration allowed an open birch woodland to develop in Shropshire, but a reversion to cold conditions saw the re-expansion of herb-rich grassland in the final part of the Devensian (Beales, 1980; Barber and Twigger, 1987). This sequence of climatic fluctuation between ca. 11,000 and ca. 8,000 BC appears to have varied in significance and timing throughout the British Isles (Lowe and Gray, 1980; Barber and Twigger, 1987) but the evidence from across much of the northwest indicates a shift to warmer conditions around 10,000 BC, followed by a temporary reversion.

In Shropshire, climatic warming after 8,000 BC permitted the immigration of main forest trees, with birch initially abundant and hazel rapidly developing as a major shrub. Pine, oak and elm combined to produce high forest across the area by ca. 6,000 BC. After this time pine became less important, oak consolidated its status and alder and lime added to the diversity of woodlands (Beales, 1980). The increase in alder abundance (ca. 5,000 BC in Britain) has been linked to the onset of damper, more oceanic climatic

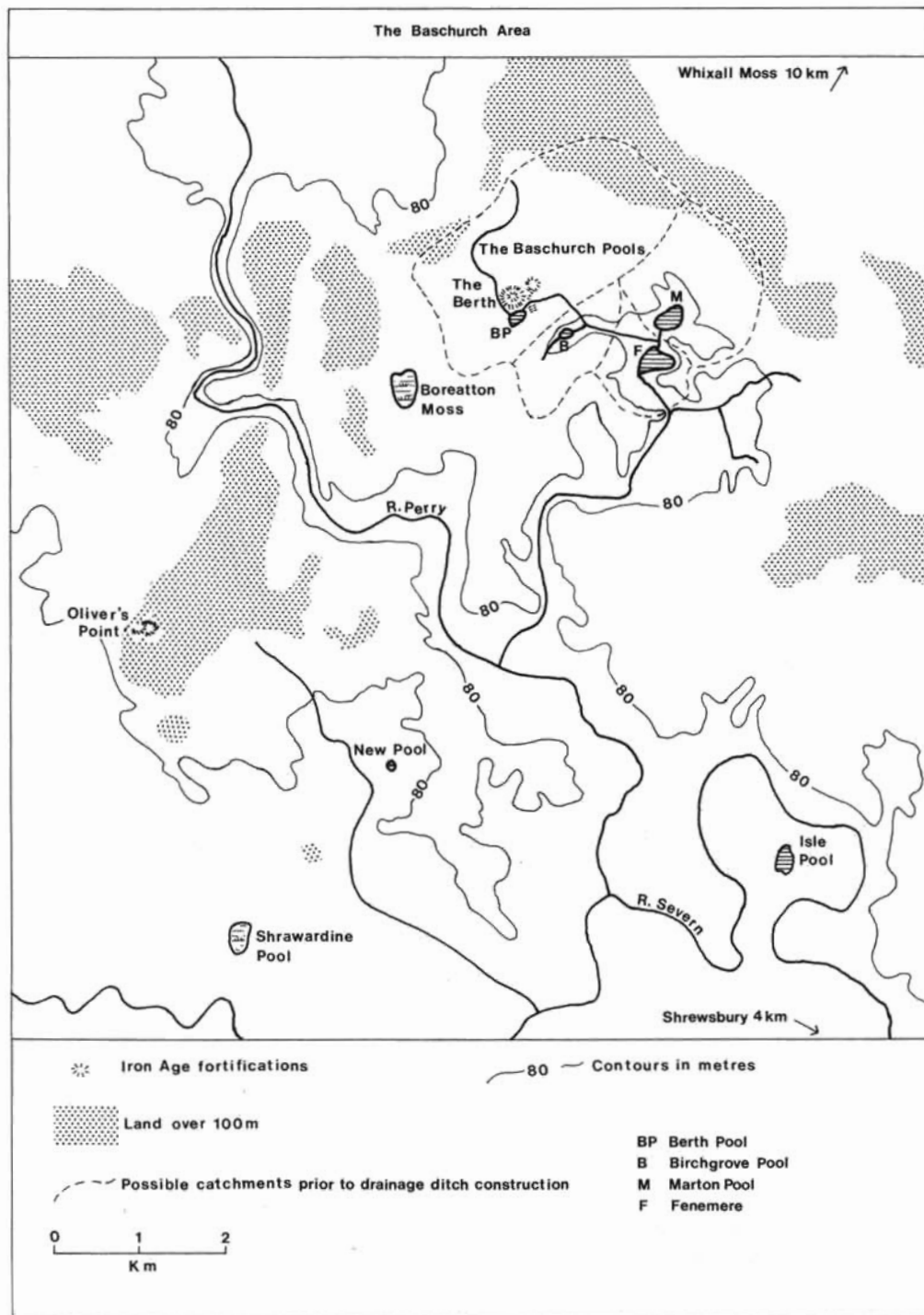


FIG. 1.  
Wetland sites in the vicinity of Baschurch, near Shrewsbury, North Shropshire.

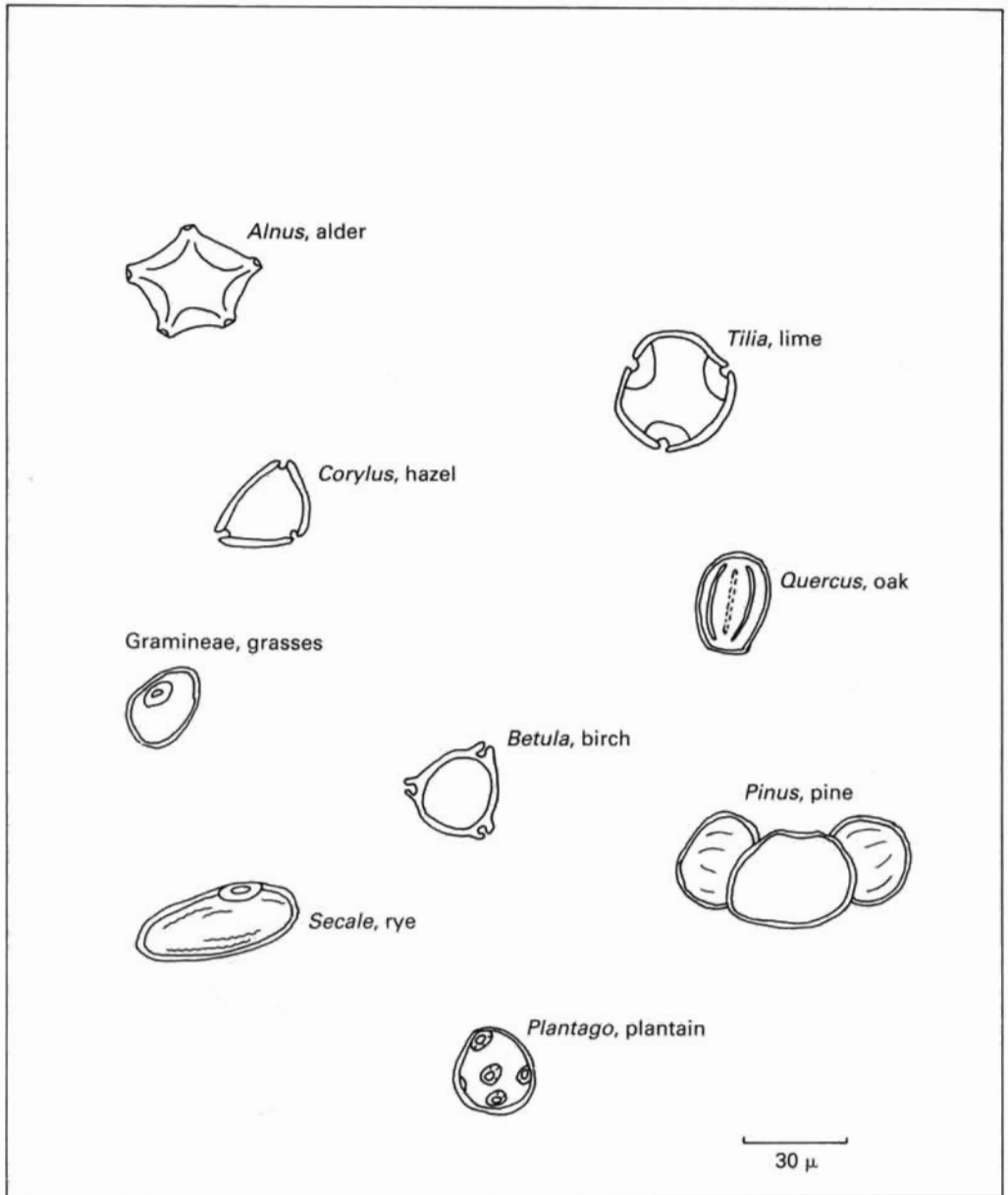


FIG. 2.  
Examples of pollen grains from ancient deposits in Shropshire.

conditions (Godwin, 1975) although recent research (Smith, 1984) has indicated that alder may have acted as an opportunist coloniser in woodlands affected by the activities of Mesolithic Man.

Prior to 3,000 BC, this broadleaved woodland formed a stable ecosystem with relatively little erosion of forest soils (Brown and Barber, 1985). Conventionally, the natural woodlands of Britain are defined as "mixed oak forests" although pollen evidence from the

Table 1.  
The scientific names of plants mentioned in the text

Alder	<i>Alnus glutinosa</i>	Hornbeam	<i>Carpinus betulus</i>
Ash	<i>Fraxinus excelsior</i>	Lime	<i>Tilia</i> sp.
Beech	<i>Fagus sylvatica</i>	Oak	<i>Quercus</i> sp.
Birch	<i>Betula</i> sp.	Scots pine	<i>Pinus sylvestris</i>
Elm	<i>Ulmus</i> sp.	Willow	<i>Salix</i> sp.
Hazel	<i>Corylus avellana</i>	Yew	<i>Taxus baccata</i>
Other plants			
Dandelion	<i>Taraxacum officinalis</i>	Heather	<i>Calluna vulgaris</i>
Dock/Sorrel	<i>Rumex</i> sp.	Plantain	<i>Plantago lanceolata</i>
Bracken	<i>Pteridium aquilinum</i>	Bog moss	<i>Sphagnum</i> sp.

Ferns and mosses do not have pollen, but their spores persist in peat and lake deposits in much the same way as the wind-dispersed pollen of higher plants.

Baschurch area of Shropshire (Twigger, 1988) suggests that lime was abundant, if not dominant, in some localities (*cf.* Grieg, 1982). After ca. 3,000 BC, there is more widespread evidence for Man's alteration of woodland composition and structure. The palaeoecological evidence from this period has been reviewed by Birks (1986) for Northwest Britain. At Crose Mere, Beales (1980) dates a decline in elm pollen to  $5,296 \pm 150$  bp (Q-1235). This feature is associated with an increase in the frequencies of ash pollen. Ash is a light-demanding tree and the pollen evidence suggests that reductions in the elm canopy permitted more light to penetrate to the forest floor; maintenance of these canopy gaps favoured rapid growth of ash saplings.

Pollen evidence for the establishment of cereal growing both before (Edwards and Hiron, 1984), and during (Birks, 1986), the elm decline, together with a diversification of weed pollen in the Neolithic period, points to Man's activities being the cause of the elm decline, although an early epidemic of Dutch elm disease remains a possibility (Moore, 1984). In North Shropshire, Neolithic lowland pollen diagrams indicate a very low level of human exploitation of the woodlands (Beales, 1980; Slater, 1972; Pannett and Morey, 1976; Brown, 1983b, Twigger, 1988) although this cannot rule out the possibility that some larger and longer-lived clearances occurred on drier hill crests (Limbrej, 1987). After 2,000 BC however, and particularly after 1,200 BC (Turner, 1964; Twigger, 1988), human impact on the woodland increased and, in some localities, land cleared during the Bronze Age has remained open to the present day (Twigger, 1988).

[Editors Note: The selection of excavation reports recently published by the Shropshire Archaeological and Historical Society (Carver, 1991) appeared after this paper was accepted for publication. That by Barker, Haldon and Jenks appears particularly relevant to this section].

#### THE EARLIER BRONZE AGE

##### Woodland Clearance and Cereal Cultivation from about 2,000 until about 1,300 BC

Pollen grains preserved in lake sediments and peat deposits in the Baschurch area of North Shropshire (Fig. 1) suggest that, between ca. 2,000 and ca. 1,700 BC, elm and lime trees were removed from the woodlands by Man (Twigger, 1988). This phase of human activity

has radiocarbon dates of  $3,950 \pm 50$  bp (SRR-2834) and  $3,550 \pm 50$  bp (SRR-2833) at New Pool; and  $3,660 \pm 50$  bp (SRR-2831) and  $3,790 \pm 50$  bp (SRR-2832) at Boreatton Moss. At ca. 2,000 BC, at New Pool, increased birch pollen frequencies are associated with a reduction in lime pollen. Corresponding changes in pollen frequencies are detectable at Boreatton Moss prior to 1,840 BC and it is probable that the two events are correlated (Twigger, 1988). At this time, Boreatton Moss grass and herb pollen frequencies increase. After 1,840 BC, Boreatton Moss cereal and herb pollen types increase further and there are marked declines in elm, and particularly lime, pollen at ca. 1,800 BC. There is also evidence, from the pollen and spore record, for flooding of the moss surface at Boreatton (Twigger, 1988). It is possible that at ca. 1,800 BC, the clearance of trees, and other farming activity, on the well drained soils adjacent to the moss led to an increase in overland water flow and soil through-flow as the forest canopy was reduced (*cf.* Lockwood, 1983). Peat, immediately above this earlier Bronze Age lime decline at Boreatton Moss, has a radiocarbon date of  $3,660 \pm 50$  bp. At New Pool a lime decline has a date of  $3,550 \pm 50$  bp.

Thus, by the end of the Bronze Age in Shropshire, ca. 1,300 BC, the postglacial temperate forest had already been altered in several important respects. The abundance of elm and lime in the woodland was much reduced. There could also have been open areas from which all trees had been cleared. Herb communities had established themselves, albeit in relatively small enclaves, and the light-demanding birch and ash were more abundant. Pollen evidence from the Baschurch area suggests that yew increased in abundance as a result of Neolithic and earlier Bronze Age clearances. On the pollen diagram from Fenemere, near Baschurch (Fig. 3), phase B6 is dated, by extrapolation, to the Bronze Age (Twigger, 1988). Whilst tree pollen totals are relatively high, it can be seen that herb types including plantain and docks and sorrels occur. Bracken spores are also present.

At Crose Mere (Beales, 1980), bracken spores occur more frequently in the pollen record from the earlier Bronze Age onwards, pointing to improved light conditions on the woodland floor and, possibly, to higher wind velocities amongst thinned trees.

Archaeological evidence from Shropshire attests to the presence of Man in the County in the early Bronze Age period, ca. 2,000 to ca. 1,300 BC. Prehistoric routeways, thought to have been in use on ridge crests (Chitty, 1956; 1963), may have carried traffic associated with local bronze industries (Thomas, 1972). An early cremation, at the prehistoric cemetery at Bromfield in South Shropshire, has been dated to  $1,556 \pm 178$  BC (BIRM 64, Stanford, 1982). A rectangular floor area at the occupation site on the summit of The Breidden Hill, Powys, has a date of  $1,550 \pm 100$  BC (Musson, 1976) and in 1961 an early Bronze Age stone axe-mould was found near Longden Common, south of Shrewsbury (Thomas, 1972). The latter stages of the Bronze Age in lowland Shropshire were not times of widespread woodland clearance (Beales, 1980; Twigger, 1988) although, on the ridge crests, the landscape could have been more open (*cf.* Limbrey, 1987). At ca. 1,250 BC, however, the impact of man on lowland forests increased.

#### THE LATER BRONZE AGE

##### The Clearing of the Woodlands from around 1,200 until around 800 BC

The radiocarbon dated pollen diagram from Fenemere (Fig. 3) shows that elm, lime, and oak pollen frequencies declined at  $3,190 \pm 60$  bp (SRR-2923). Birch, ash, and willow frequencies increased. Grass pollen frequencies increased and other herb pollen types such as plantains and docks, occur more frequently. Bracken spores also increased in abundance. These changes suggest the creation of small clearings in the woodlands with herb

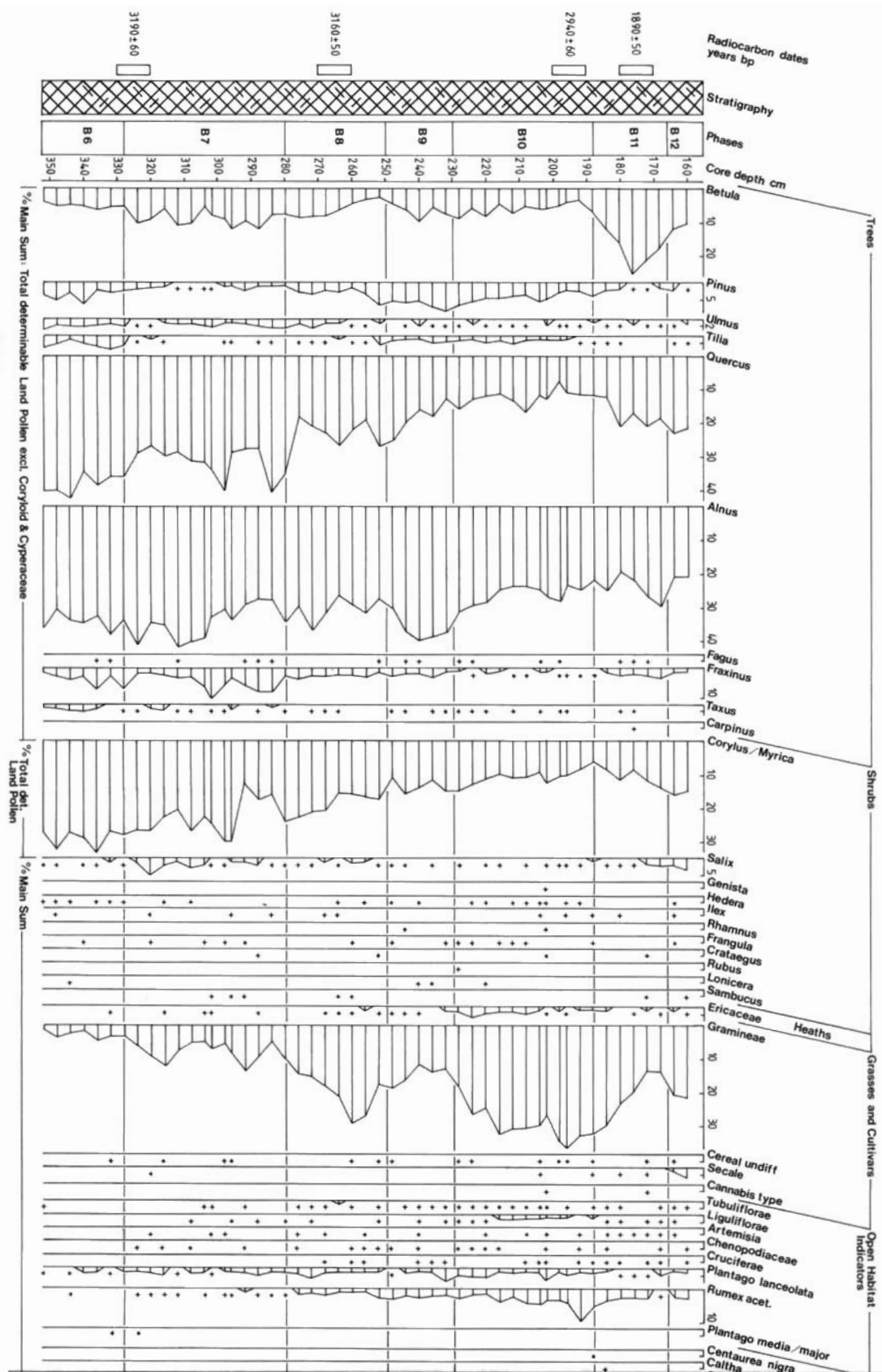
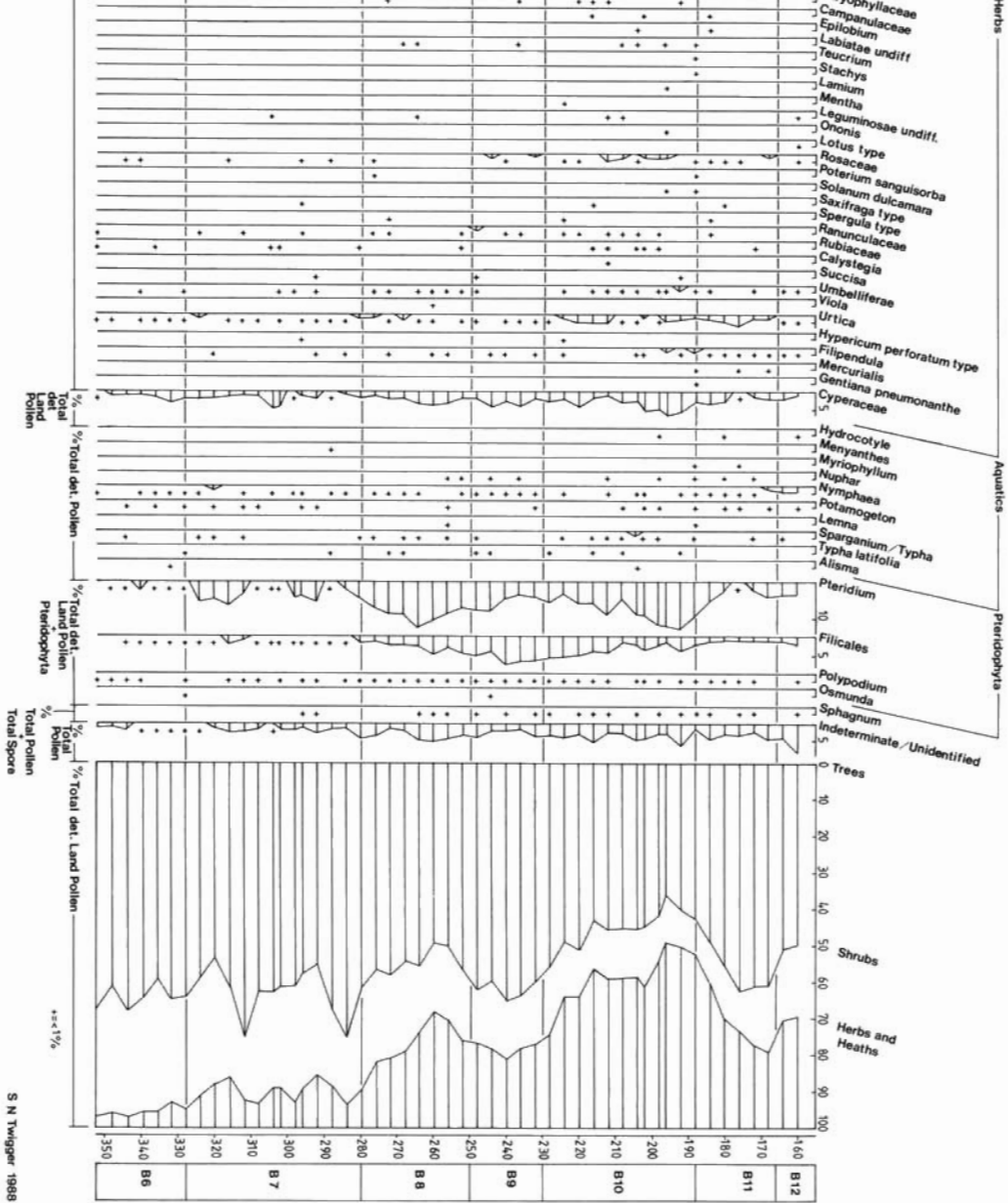


Fig. 3. Percentage pollen frequency diagram from Fenneret, Shropshire.





communities expanding in areas where lime, elm and oak had been cleared (Twigger, 1988; *cf.* Turner, 1964). The start of this phase of vegetation change at Fenemere, B7 (Fig. 3) is thought to parallel, temporally, the onset of zone CMCP8 in the pollen diagram from Crose Mere (Beales, 1980). The decline of lime pollen frequencies at this time at Fenemere and Crose Mere, and associated changes in the frequencies of other pollen types, have biostratigraphic parallels with observed pollen frequency changes at Whixall Moss, Shropshire, where a decline in lime pollen frequencies has a date of  $3,238 \pm 115$  bp (Turner, 1964). The Fenemere and Whixall Moss dates for this lime decline overlap at one standard deviation from the mean and the date for the lime decline at the CMCP7b/CMCP8 boundary at Crose Mere of  $3,714 \pm 129$  bp (Q-1234) (Beales, 1980) is quite probably too old. It seems likely that when woodland clearance activity occurred close to Crose Mere, ca. 1,250 BC, old carbon from organic deposits was washed into the mere (*cf.* Pennington *et al.*, 1976) This carbon would dilute the contemporary carbon in the lake sediments and thus increase the radiocarbon age.

The vegetation changes inferred at Fenemere, at the start of the later Bronze Age, have parallels with those inferred by Turner (1964, 1965) at Bloak Moss, Ayrshire, and Cors Caron (Tregaron Bog) Clywd. Turner identified small, temporary clearances dating to the later Bronze Age at these sites. Short-lived reductions in tree pollen types were accompanied by rises in herb and bracken pollen. Turner suggested that areas, ca. 100 to 200 metres across, were being cleared, farmed and then abandoned after a limited period, probably less than a century. A similar pattern to this is evident at Fenemere in phase B7; small clearances appear to have been created and then abandoned after about 100 years (Twigger, 1988). At Fenemere, twin peaks of grasses and bracken, in particular, are evident in B7. These are separated by peaks in ash and oak pollen. There is an apparent regularity in this clearance-regeneration cycle, both in magnitude and duration of the successive episodes. It is possible that the clearings included both arable and pastoral land since cereal type pollen is present in the record at this time. Once abandoned, the clearings would have been colonised by ash and oak.

Pollen of beech and hornbeam occurs at Fenemere during the later prehistoric period (Fig. 3). There is evidence from elsewhere in Britain and Europe (Godwin, 1975) that these trees expanded their range, beyond their native areas, as a result of Man's interference in the ancient woodlands. Beech and hornbeam are possibly outside their native areas in Shropshire (Sinker *et al.*, 1985) and could have become established in the region as oak, elm and lime were cleared by Man. It is known that the Bronze Age was characterised by increasing territorial organisation amongst human groups (Fowler, 1983; Bradley, 1984) and, whilst the clearance and regeneration cycles in B7 at Fenemere could represent random immigration and emigration by human groups, these movements could have been more ordered (Twigger, 1988).

Archaeological evidence for Man's occupation of Shropshire in the later Bronze Age occurs at Sharpstones Hill, near Shrewsbury, where Bronze Age cremations have radiocarbon dates of  $1,255 \pm 130$  BC and  $1,020 \pm 188$  BC (Coles and Harding, 1979).

#### THE LATER BRONZE AGE—EARLY IRON AGE TRANSITION from about 800 until about 600 BC

The pattern of small scale clearance and regeneration of woodland around Fenemere and the other Baschurch Pools gave way to more widespread woodland clearance at around 800 BC, the B7/B8 boundary at Fenemere (Fig. 3). An extrapolated age depth profile for

the sediments between 160 cm and 350 cm at Fenemere was derived using the dates of  $3,190 \pm 60$  bp and  $1,890 \pm 50$  bp. The two intermediate dates of  $3,160 \pm 50$  bp and  $2,940 \pm 60$  bp have been disregarded since these data may have been affected by the inwashing of old carbon during phases of increased human activity in the lake catchment (Twigger, 1988).

At Fenemere, ca. 800 BC, oak pollen declines, lower ash frequencies are recorded and grass, docks and bracken all increase in frequency. Birch and elm decrease in the latter stages of phase B8 where grass and bracken pollen frequencies are highest. The typical open habitat indicators (plantains, docks and sorrels) occur at more than 1% during B8. Reductions in total tree pollen are more marked at this time at Berth Pool and Birchgrove Pool, which lie close to Fenemere (Fig. 1). It appears likely that more of the woodland was cleared closer to the former two sites (Twigger, 1988; Barber and Twigger, 1987). Bog moss spores are more frequent in the palynological record at Fenemere from the end of phase B8 onwards (Fig. 3), suggesting an overall increase in wetness in the peat deposits surrounding the pools. This could reflect a general climatic deterioration or, alternatively, increased run-off into the peat areas as vegetation was cleared from the surrounding drier soils (*cf.* Lockwood, 1983). Unhumified peat above a recurrence surface at Chat Moss, Lancashire (Birks, 1963–1964), has a radiocarbon date of  $2,645 \pm 100$  bp (Q-683) pointing to a deterioration in climatic conditions (*cf.* Barber, 1981; Haslam, 1988). However, the Baschurch Pools lie in the rainshadow of the Welsh Mountains and a marked reduction in peat humification is not recorded at Whixall Moss, north of Shrewsbury, until  $1,750 \pm 60$  bp [i.e. 200 AD] (SRR-3035; Haslam, 1988). Cereal pollen occurs infrequently at Fenemere and the other Baschurch Pools in phase B8 but grass pollen frequencies, particularly at Berth Pool and Birchgrove Pool, are relatively high. It is likely that a wide variety of grass species, including those occurring in damper habitats, are represented in the composite Gramineae curve but extensive pastoral agriculture appears to have been practised at this time. Cereal pollen is not, however, well dispersed in airstreams (Vuorela, 1973) and its poor representation in phase B8 cannot be a guide to the importance of arable farming to the human groups in the area. The extent of woodland clearance in north Shropshire appears to have varied between ca. 800 and ca. 600 BC (Twigger, 1988). Averaged over a wide area of the lowlands, possibly a third of the tree cover was removed with up to three quarters of the woodland cleared in favoured localities (*cf.* Twigger, 1988), such as the drier, well-drained brown earth soils on the sand and gravel deposits.

The archaeological record from the Shropshire–Welsh Border area at the time of phase B8 at Fenemere, ca. 800 to ca. 600 BC, points to an increase in human activity. Radiocarbon dates from a hillfort at the summit of The Breidden Hill, some 20 km or so to the west of the Baschurch area, place a phase of construction and human occupation in the later Bronze Age. Charcoal samples from the bases of post holes have radiocarbon dates of  $828 \pm 71$  BC and  $800 \pm 41$  BC and an occupation soil at the site has yielded a date of  $868 \pm 64$  BC (Musson, 1976). These dates can be compared to the extrapolated date of ca. 800 BC at the start of the woodland clearance phase, B8, at the Baschurch Pools. The Welsh Marches have a high concentration of hilltop settlement dating to the later Bronze Age (Megaw and Simpson, 1979; Savory, 1976; Stanford, 1982) and it is possible that territorial reorganisation at that time led to an increase in woodland clearance, in the Marches, as new settlements were established (*cf.* Limbrey, 1987).

There appears to have been a reduction in land use intensity after ca. 600 BC in the Baschurch area—Phase B9 in Fig. 3. Grass and bracken frequencies decline; birch, pine, lime and alder frequencies increase but oak continues to decline. Herb pollen diversity is

generally maintained but the indications are that cleared areas were reduced in size. Another possibility is that, for a time, farming activity became concentrated in foci at some distance from the pools. In contrast to the indications of some woodland recolonisation, possibly mainly on damper soils around Fenemere and Marton Pool (Twigger, 1988), herb pollen representation remains high around the adjacent Birchgrove Pool and Berth Pool (Twigger, 1988; Barber and Twigger, 1987). Increases in tree pollen representation are also recorded by Beales (1980) in mid CMCP8 at Crose Mere.

Pollen evidence from the lowlands thus points to a shift in farming activity away from land close to the meres between ca. 600 and ca. 400 BC (Twigger, 1988). Subsequently, renewed woodland clearance took place and wider areas of open land were created.

#### THE LATER IRON AGE, around 400 BC

Clearances after ca. 400 BC, in phase B10, appear to have been more extensive than those of phase B8 at Fenemere. Phase B10 dates to the mid to late Iron Age and archaeological evidence from The Breidden Hill confirms human activity in the area at that time. Roundhouses have radiocarbon dates of  $479 \pm 55$  BC,  $460 \pm 100$  BC,  $375 \pm 63$  BC and  $320 \pm 80$  BC; four-posted buildings at the same site have dates of  $294 \pm 40$  BC,  $240 \pm 80$  BC and  $238 \pm 70$  BC (Musson, 1976). Late Iron Age occupation is postulated at The Berth, a small fortified hillock adjacent to Berth Pool, which lies only 1.5 km to the north west of Fenemere (Fig. 1; Stanford, 1972; Gelling and Stanford, 1965). The population of Britain appears to have been expanding rapidly during the later Iron Age (Fowler, 1983; Taylor, 1984) and widespread woodland clearance occurred throughout Britain at that time (Turner, 1981). The degree of agricultural organisation was capable of producing an agricultural surplus in Britain (Fowler, 1983; Bradley, 1984).

At Fenemere in the later Iron Age, herb and heath pollen increased to around 50% of total land pollen. Extrapolated radiocarbon dates suggest that the maximum clearance expansion occurred at ca. 100 BC (Twigger, 1988). The radiocarbon date of  $2,940 \pm 60$  bp for the herb pollen peak at 190 cm to 200 cm at Fenemere is probably too old and has almost certainly been affected by the inwashing of older carbon into the lake sediments at a time of increased farming activity in the lake catchment. During phase B10 at Fenemere, the quantities of birch, pine, oak, alder and ash pollen all decline, suggesting an overall reduction in the woodland cover in the area, permitting an expansion of herb communities. As before, cereal pollen is poorly represented but this does not rule out the presence of at least some arable farming. Phase B10 at Fenemere has close biostratigraphic parallels with the later stages of pollen zone CMCP8 at Crose Mere (Beales, 1980). At both Crose Mere and Fenemere, grass and bracken pollen/spore frequencies are high. This could be due to bracken expansion within more open woodlands, surrounding areas of grassland, or to bracken colonisation of the grasslands. Tracts of heathland are indicated by the presence of heather pollen in phase B10 at Fenemere. The increase in pine pollen during phases B8 to B10 could be due to establishment of trees in drier, sandy heaths although there is evidence that pine colonised peat surfaces in the area during the Iron Age (Hardy, 1939; Turner, 1964; Haslam, 1988). A variety of herbs, normally associated with arable or pastoral farming (Turner, 1964; Behre, 1981) occurs at Fenemere in B10. In particular, continuous curves for *Plantago lanceolata* and *Rumex* type (docks and sorrels) are recorded. In mid B10, Compositae (section Liguliflorae) pollen, probably dandelion, occurs at more than 1% in several samples. Dandelions commonly occur on grassland subjected to regular cutting and trampling (Sinker *et al.*, 1985). Beyond the margins of the meres, where belts of

alder trees would persist on damper soils, more than half of the woodland in the Baschurch area had probably been cleared by the end of phase B10, ca. 100 BC.

Iron Age deforestation is well documented elsewhere in the Severn Basin (Brown and Barber, 1985) and the overall picture is reviewed in Barber and Twigger (1987). Brown (1983*b*) demonstrated that substantial erosion of soils occurred as a result of Iron Age deforestation and farming (*cf.* Shotton, 1978) and analysis of the magnetic iron oxide content of the sediments at Fenemere and Berth Pool (Twigger, 1988) points to the exposure and erosion of subsoils in the catchments of these lakes during the Iron Age.

Total tree pollen fell to ca. 40% of total land pollen at Fenemere in the Iron Age but at the nearby sites of Berth Pool and Birchgrove Pool tree pollen dropped to less than 20% (Twigger, 1988), pointing to the concentration of human settlement close to the latter two meres.

#### THE END OF THE IRON AGE AND START OF THE ROMAN PERIOD from about 50 BC until about 100 AD

This period is characterised in North Shropshire by woodland regeneration, at least in the lowlands. Recolonisation of cleared land, first by shrub woodland and then by high forest, began around 50 BC. This phase apparently lasted approximately 150 to 200 years, and was succeeded by renewed woodland clearance (Phase B12, Fig. 3).

At Fenemere, above 190 cm in phase B11, birch, oak, ash and alder pollen frequencies increase. Grass, herb and bracken frequencies decline. Total herb and heath pollen declines from ca. 50% to ca. 20% of total land pollen. The areas of land cleared by Iron Age man, in the vicinity of the Baschurch Pools, were thus largely recolonised by trees after ca. 50 BC, with the probable exception of land close to Berth Pool where human occupation appears to have continued (Twigger, 1988). Initially, birch was abundant in this woodland but ultimately oak began to predominate as a high forest developed. The reasons for land abandonment cannot be deduced from the pollen record. Cultural factors were almost certainly the cause, although there is evidence from peat deposits in Shropshire that the climate deteriorated at the end of the Iron Age (Haslam, 1988). A cold and wet climate could have led to repeated crop failure causing economic stress, although it is not possible to assess the importance of arable agriculture to the local economy. Extrapolated dates for the regeneration phase, B11, place it at the end of the Iron Age and in the early Roman period. This was a time of cultural stress and tribal reorganisation in Britain (Bradley, 1984; p. 147).

Beales (1980) identified a woodland regeneration phase, CMCP9, at Crose Mere although radiocarbon dates from that site suggested that the phase occurred in the mid Iron Age. CMCP9 is very similar to B11 in terms of pollen frequency changes and both phases parallel sections I and J of Turner's (1964) pollen diagram from Whixall Moss. Given the proximity of these sites, and their biostratigraphic similarities, it is probable that B11, CMCP9 and I/J all represent the same phase of woodland regeneration (Twigger, 1988). Evidence from pollen diagrams alone might not be sufficient to infer climatic deterioration at a given time but, in North Shropshire, there is further evidence from peat deposits. The preserved remains of past peat surfaces suggest that the climate became cooler and wetter at the end of the Iron Age at the time when woodland regrowth occurred.

#### PEAT MACROFOSSIL EVIDENCE FOR CLIMATIC CHANGE IN NORTH SHROPSHIRE

Hardy (1939) identified a layer of pine stumps buried in the peat at Whixall Moss, one of which was radiocarbon dated to  $2,307 \pm 100$  bp (Turner, 1964). It is possible that rising

water tables in that peat killed the pines, and there is evidence for wetter conditions on Whixall Moss in the late Iron Age and early Roman periods (Haslam, 1988). Beales (1980) suggested that the decline in pine pollen frequencies at  $2,310 \pm 85$  bp (Q-1233) at Crose Mere could correlate to the pine stump layer at Whixall Moss although evidence from the Baschurch Pools points to a date of ca. 50 BC for a regional pine pollen decline and Beales (1980) expressed some reservations about the accuracy of the date of  $2,310 \pm 85$  bp.

At Whixall Moss, detailed examinations of the peat stratigraphy by Haslam (1988) have identified a shift to wetter conditions on the Moss surface at  $2,180 \pm 50$  bp (SRR-3074), additional radiocarbon dates from the pine stumps are needed to clarify the relationship between the pine stump layer and evidence for increasing surface wetness at the site. A slight lowering of pine pollen frequencies occurs ca. 2,100 bp at Fenemere and the continuous curve for pine pollen ends at the radiocarbon dated horizon at  $1,890 \pm 50$  bp (Fig. 3). It is possible that the dying-back of pines on peat surfaces in the area contributed to a regional reduction in pine pollen in the atmosphere although pines could also have grown on open heathlands and, if these were recolonised by broadleaved woodland after ca. 50 BC, regional pine pollen totals would have declined. Pine pollen is recorded infrequently at Crose Mere (Beales, 1980) and Berth Pool (Barber and Twigger, 1987) after the end of the Iron Age, ca. 50 AD. Scots pine was planted extensively in Britain in the 18th Century AD and over much of the country there is evidence that pine, due to clearance by Man, was completely absent for some 2,000 years, prior to this planting. Present-day Scots pine populations in Shropshire probably derive mainly from stocks planted during the last 200 years or so. It is possible, however, that limited populations survived on peat surfaces by re-seeding from more ancient stocks. Ultimately, the question of the survival of pine rests upon the recovery of pine wood, bark or cone remains which can be confidently dated to the period ca. 100 BC to ca. 1750 AD in Shropshire.

Following the shift to wetter conditions on the surface of Whixall Moss at  $2,180 \pm 50$  bp, the degree of humification of the peat dropped (Fig. 4). This marked humification change has radiocarbon dates of  $1,930 \pm 50$  bp [i.e. 20 AD] (SRR 3036) below the humification change and  $1,750 \pm 60$  bp [i.e. 200 AD] above it (Haslam, 1988). Semi-quantitative examination of the fossil bryophyte assemblages (Haslam, 1988) permits the construction of a curve of relative hydrological conditions on the Moss (Fig. 4). Based upon simple weighted averages ordination of the macrofossil species (Shimwell, 1971; Persson, 1981; Dupont, 1986), it shows a pronounced increase in surface wetness at Whixall Moss after  $2,180 \pm 50$  bp (SRR 3074), which resulted in the formation of an unhumified peat matrix at  $1,750 \pm 60$  bp (SRR 3035) (Fig. 4). Comparable shifts in peat humification have been identified elsewhere in Britain and in continental Europe (Godwin, 1975; Aaby, 1976; Barber, 1981; Haslam, 1988). Such shifts are believed to correspond to a general climatic deterioration in north western Europe over the period 4,500 to 500 bp. At Whixall Moss, cyclic wet phase shifts, of ca. 60 to 100 radiocarbon years duration, appear to be superimposed upon the general trend. Van Geel (1978) has observed similar cyclical shifts in peat deposits in the Netherlands.

A pool peat, formed under wetter conditions on the bog surface, was associated with Lindow Man, the bog body from Lindow Moss in north Cheshire. This pool peat has a date of 210 BC (Barber, 1986) indicating a shift towards cooler, wetter climatic conditions in north west Britain in the later Iron Age.

Direct palaeoclimatic evidence from this period is poor. Magny (1982) proposes a southward displacement of the polar air masses and polar front during the Bronze Age, leading to a cooler climate over the whole of Europe. Increased dampness in central Europe is

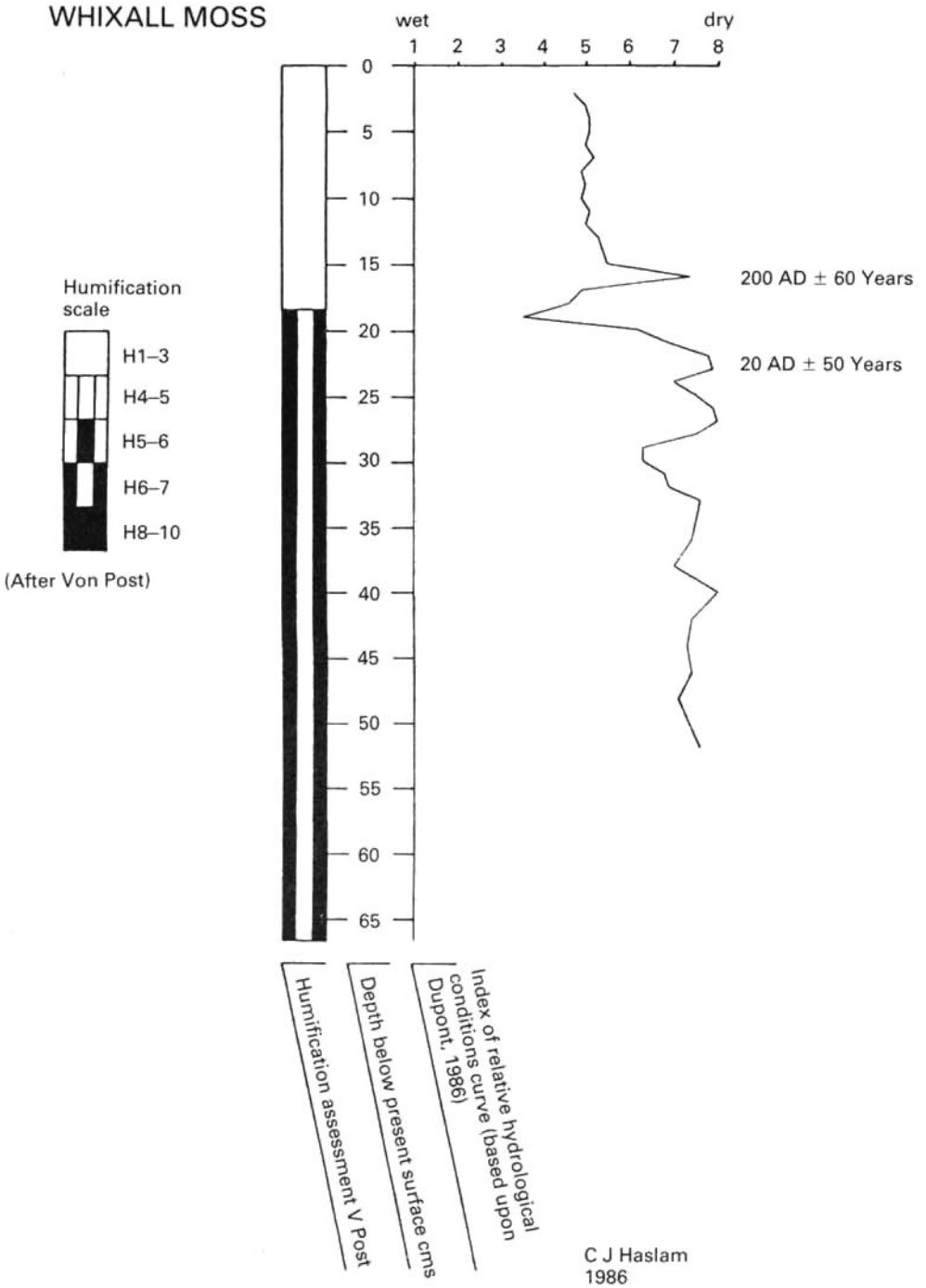


FIG. 4.  
Curve of relative hydrological conditions; Whixall Moss.

attributed to the southward tracking of consequent depressions around the extended polar high pressure area. During the Iron Age, cooling was accentuated but involved the increased influence of colder maritime air and damp polar air in northern Europe. The net result of this was a wetter climate during the Iron Age.

It cannot be known for certain if climatic deterioration, of itself, led to cultural stress and to a change in the pattern of Man's exploitation of the landscape. It is clear that land abandonment and climatic deterioration were broadly coincident in lowland Shropshire during the late Iron Age. If climatic factors were not the sole cause of land abandonment, in certain areas, they might at least have exacerbated cultural stresses.

#### THE POST-ROMAN PERIOD: 5th Century AD to the Present

Pollen evidence from Crose Mere (Beales, 1980), the Baschurch area (Twigger, 1988; Barber and Twigger, 1987) and from the Lancashire-Cheshire Mosses (Beales and Birks, 1976; Birks, 1963-1964; Birks, 1965) indicates an expansion in the area of farmed land during the Second Century AD. Arable agriculture, with hemp and rye cultivation, appears to have assumed transitory importance in Anglo Saxon times (Beales, 1980; Twigger, 1988) but, in Medieval and later periods, pastoral agriculture evolved as the dominant land-use in northern Shropshire (Rowley, 1972). Today the low-lying grasslands of the County are still commonly sown for grazing whilst the drier brown earths, on the fluvio-glacial sand and gravel ridges which stretch across the Shropshire-Cheshire Plain, are characteristically used for arable farming. During the post-Roman period, the sediments in the Shropshire-Cheshire meres became increasingly inorganic (Beales, 1980; Smith, 1985; Twigger, 1988) pointing to the erosion of soil layers into the meres as agricultural intensification affected soil stability (Pannett and Morey, 1976; Fullen and Reed, 1986). In addition, agricultural fertilisers with high nutrient concentrations have been washed into the meres in more recent times, enhancing the process of eutrophication of the waters (Reynolds and Sinker, 1976). The historic period has undeniably seen land-use intensification. It has also seen previously uncultivable land brought into use, as drainage works have proceeded on the wetter soils and peats (Rowley, 1972; Hey, 1974). Soil erosion in the Severn basin during mid Holocene times, when woodland extended over wider areas of Shropshire, has been estimated at around 20 tonnes per square kilometre per year. In more recent times, as agriculture has spread and intensified, erosion rates have increased to around 120 to 140 t.km<sup>-2</sup>a<sup>-1</sup> (Brown and Barber, 1985); unquestionably dramatic evidence of Man's impact on the land.

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