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# Evidence for the vegetation and habitat of the reindeer (*Rangifer tarandus*) in the Loch Lomond stadial of north-west England

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## Abstract:

The *in situ* find of the antler of a reindeer (*Rangifer tarandus*) in Late Devensian lake deposits at Audenshaw, Greater Manchester is reported. Many of the previous records for the animal in Great Britain and Ireland have come from cave deposits, the nature of which has precluded stratified pollen analyses. The antler is dated to  $10970 \pm 60$  yrs BP and the surrounding lake deposits analysed to attempt recreation of the immediate environment of the Zone III Loch Lomond Stadial in northwest England.

## Key words:

Reindeer (*Rangifer tarandus*), Zone III Loch Lomond Stadial, natural habitat, pollen analysis, radiocarbon dates, North-west England

## Introduction

During a watching-brief of enabling works for the construction of the M60 motorway at Lumb Lane Playing Fields, Audenshaw in Manchester (NGR: SJ995976) on 1 February 1996, the antler of a reindeer (*Rangifer tarandus*) was discovered (Plate 1). The site was visited and surveyed by the author on the following day, the results of which are shown as a site location map, cross-section and profile in Figure 1. The location was at the SSW of Ashton Moss and in the upper catchment of Debdale Brook and at an altitude of 93.5m O.D. The upper horizons of the profile comprised topsoil of the playing fields and ground built up from spoil deposited during the construction of Ashton Canal in 1792 and the Manchester, Sheffield & Clee-thorpes Railway in 1841. There was an absence of peat deposits suggesting that any such might have been removed before the canal and railway were constructed. The shallow 0.2m horizon of fine silty/organic lake-mud, in which the antler was lodged, lay directly beneath the spoil and above a layer of glacial till, between 89.21m and 89.00m O.D. In cross-section, the organic lake-mud layer appeared as a small basin, 4.6m in diameter, 0.21m at its deepest, tapering to 0.05m at its extremities. A section was removed from the deposits that bore the impression of the antler at 89.07-89.10m O.D., and taken for storage in the laboratory prior to analysis for pollen and plant macrofossils.



Plate 1: Right antler of juvenile reindeer showing residual cortex around the burr and blue vivianite colouration of exposed medulla.

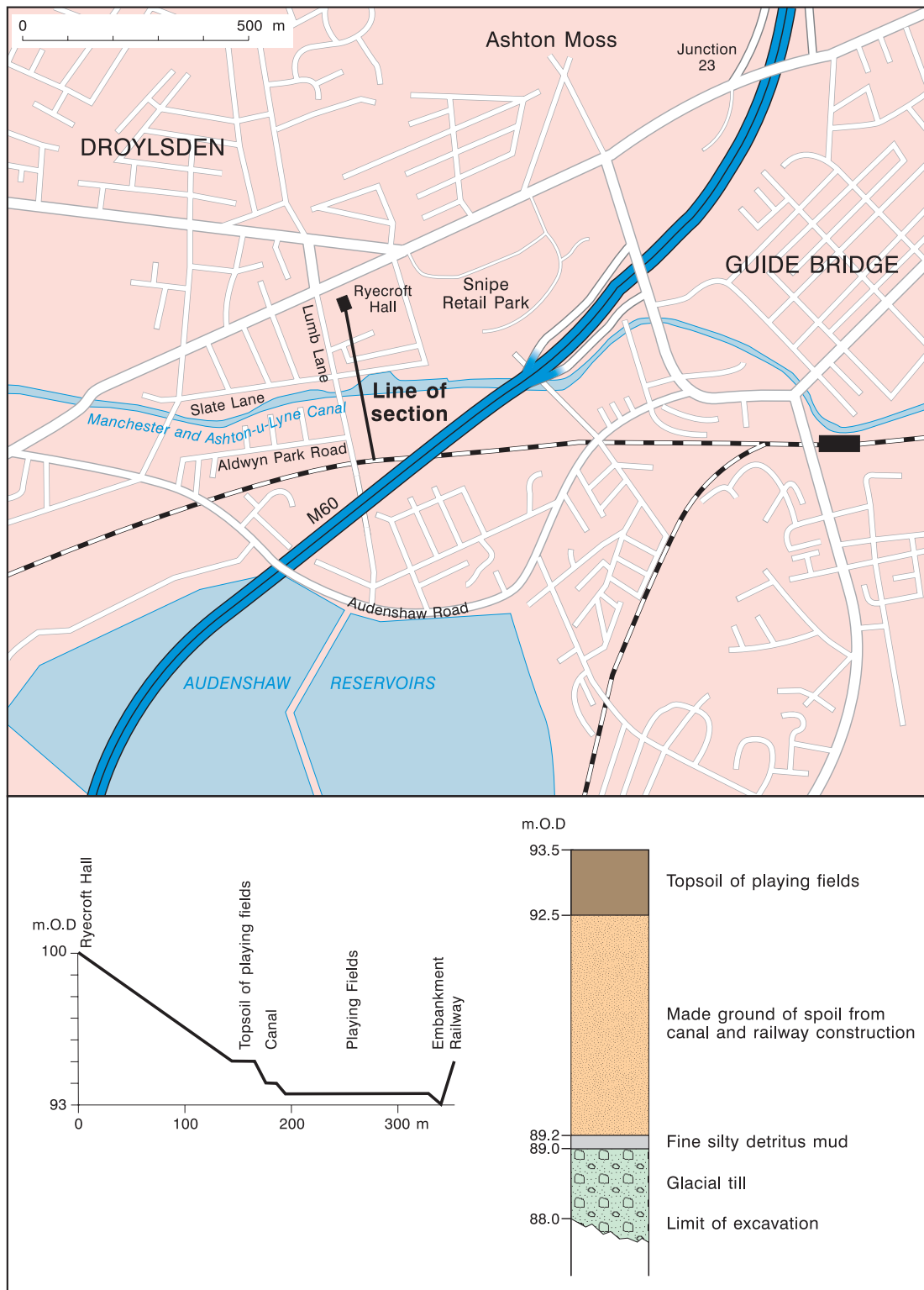


Figure 1: Location map of find site, cross section and stratigraphy

### The date of the antler and its context

The antler was identified as belonging to *Rangifer tarandus* with reference to Reynolds (1933) and confirmation was provided by Dr Derek Yalden of the School of Biological Sciences, University of Manchester. It was the right antler of a juvenile deer, with broken brow and bez tines, and lacking both back and crown tines. It was devoid of all but

15mm of cortex at its base, resulting in the superficial deposition of oxidised blue ferrous phosphate or vivianite over much of the length of its exposed medulla. The mensural details are shown in Table 1 below. At 330mm in length it is much smaller than most records for complete antlers (Whitehead 1964) and was probably shed naturally by a juvenile animal.

Table 1: Antler dimensions

Lengths	(mm)	Circumferences	(mm)
total	420	burr	87
to brow tine	10	shaft between tines	78
to bez tine	90	shaft @ 100mm	70
brow to bez tine	55	shaft @ 300mm	64
brow tine	35	brow tine	53
second tine	110	bez tine	52

AMS radiocarbon dating of a collagen extraction with alkali from the antler yielded a measured  $^{14}\text{C}$  age of  $10930 \pm 60$  BP and a conventional  $^{14}\text{C}$  age of  $10970 \pm 60$  BP (Beta-94413). Following the recommended procedure (cf. Roberts 1998: 19), calibration to calendar years using the conventional age results in a date of 12860 Cal. yr BP. Whether the traditional system of the definition of the Late-Devensian and Holocene chronozones by conventional  $^{14}\text{C}$  dates or calendar year calibrated dates, as advocated by Roberts (1998; 19), the date falls within the early part of the Loch Lomond Stadial (Younger Dryas) Zone III chronozone (13000 – 11500 Cal. yr BP/ 11000 – 10000 conventional  $^{14}\text{C}$  yr BP). The date is set into context with other conventional dates from Great Britain and Ireland in Table 2 which reveals several features that are of interest. Eleven of the seventeen dates fall within the Loch Lomond Stadial, one from the Windermere Interstadial (Zone II) and four from the Pre-Boreal (Zone IV). The last reliable record of an indigenous animal (Yalden 1999), from the Alt na Uamh Caves, Inchnadamph, Scotland is from the Early Boreal (Zone V). Many of the records for Zone III occur south of latitude  $52^{\circ} 30' \text{ N}$ ; the Audenshaw site at  $53^{\circ} 30' \text{ N}$  is the oldest, most northerly record in Britain, though the most northerly Zone III locality is Roddans Port, Co. Down at  $54^{\circ} 30' \text{ N}$ . The final, Zone V record from Inchnadamph is at  $58^{\circ} 10' \text{ N}$ .

An overwhelming majority of the radiocarbon dates come from animals found in cave deposits, to where the animals were taken as prey, and only the Audenshaw and Earl's Barton finds are from what may be described as open country. As the latter was a piece of antler worked as a tool, it was not necessarily deposited in the natural environment of the animal. Reynolds (1933) and Whitehead 1964 consider the animal to have been widespread and frequent in Britain and Ireland during the Pleistocene and report several records for Scotland from the Late Devensian and early Holocene. There are records from peat deposits at East Dereham in Norfolk and in shelly marls beneath peat at Chester and also at Whittington hall, Lancashire. In Ireland, Mitchell (1941a,b, Mitchell and Parkes 1949) published

rudimentary pollen analyses of presumed Zone II 'chalk-mud' deposits associated with both reindeer and giant Irish elk remains from beneath what was considered to be an allochthonous Zone III solifluction layer with poor pollen preservation. The coincidence of the dated Audenshaw antler with Zone III deposits suitable for the derivation of a pollen diagram would appear to be unique in Great Britain and Ireland.

Table 2: Late-Devensian and Holocene radiocarbon dates for the reindeer (*Rangifer tarandus*) in Great Britain and Ireland.

$^{14}\text{C}$ Date (yr bp)	Site location	Author
12 480	Castlepook Cave, Co. Cork	Woodman <i>et al.</i> , (1997)
10 990	Kilgreany Cave, Co. Waterford	Woodman <i>et al.</i> , (1997)
<b>10 970</b>	<b>Audenshaw, Greater Manchester</b>	<b>Shimwell (this paper)</b>
10 910	Chelm's Combe Cave, Somerset	Currant (1991)
10 850	Edenvale Cave, Co. Clare	Woodman <i>et al.</i> , (1997)
10 780	Ossom's Cave, Staffordshire	Scott (1986)
10 700	Kilgreany Cave, Co. Waterford	Woodman <i>et al.</i> , (1997)
10 600	Ossom's Cave, Staffordshire	Scott (1986)
10 450	Gough's Cave, Somerset	Currant (1991)
10 320	Earl's Barton, Northamptonshire	Cook & Jacobi (1994)
10 250	Roddans Port, Co. Down	Woodman <i>et al.</i> , (1997)
10 190	Chelm's Combe Cave, Somerset	Currant (1991)
9 940	Dead Man's Cave, Yorkshire	Clutton-Brock (1991)
9 920	Gough's Cave, Somerset	Currant (1991)
9 850	Dead Man's Cave, Yorkshire	Clutton-Brock (1991)
9 750	Dead Man's Cave, Yorkshire	Clutton-Brock (1991)
8 300	Inchnadamph Caves, Sutherland	Clutton-Brock (1991)

## Pollen analysis

The silty/organic lake-mud was a dark gyttja, or eutrophic lake mud deposit and devoid of plant macrofossils other than leaf fragments of the genus *Racomitrium*, characterised by their sinuose-nodulose cell walls. Pollen preservation was, however, relatively good and Figure 2 presents the results of the analysis, using the standard acetolysis method of Faegri and Iversen (1964), of the eight horizons relative to the depth in m O.D. The summary diagram at the left shows the relative proportion of all pollen taxa grouped into tree, shrub and herbaceous components. *Pinus*, *Betula*, *Alnus* and *Quercus* are considered to comprise the tree component, *Juniperus*, *Salix*, *Betula* cf *nana*, *Empetrum* and Coryloid types the shrub component. *Betula*, as *B. pubescens*, and distinguished from the dwarf birch (*B. nana*), is regarded as a major forest tree component in lowland areas, unlike its categorisation in a 'smaller trees

and shrubs' group by Johnson *et al.*, (1990). Its ability to grow to relatively massive proportions in the later Holocene is evidenced by the  $^{14}\text{C}$  dating of a trunk of >2m girth from nearby Ashton Moss (SJ926992) to  $6220 \pm 70$  BP (Beta-94412), (Robinson and Shimwell (1997). *Salix* is regarded as a shrub because the major contributing species were most probably low-growing taxa of Section *Vetrix* like *S. lapponum*, *S. lanata* and *S. arbuscula*, or similarly dwarf species of the Section *Chamaetia*, such as *S. herbacea*, *S. myrsinites* and *S. reticulata* (Meikle 1984, Stace 1997). The herbaceous group comprises grasses and sedges, a wide range of forbs and both Filicales and *Lycopodium*. The main body of the diagram presents the representation of the major pollen and spore taxa expressed as a percentage of the total pollen and spores (%TP) and arranged in the order trees/shrubs/herbaceous types. The less frequent taxa are arranged in descending order of their presence in the various sample horizons and additional taxa recorded in two or less horizons are noted in the text. Two LPAZs may be recognised.

*LPAZ LL1 89.00-89.12m O.D.*

Tree pollen types account for between 7 % and 10% of the %TP and shrub pollens 5-11%. *Pinus* and *Betula* occur in all horizons, with maxima of 3% and 7% at 89.09m and 89.12m respectively. Single grains of *Alnus* and *Quercus* are recorded in the two upper horizons. *Juniperus* (3-7%), *Salix* (1-5%) and *Empetrum* (3%) are the main shrub components in shrub percentages ranging between 7% and 11%. Herbaceous pollen types predominate with %TP values varying from 78-87%, of which Cyperaceae (46-55%) and Poaceae (15-24%) are dominant; values for Filicales range from 4-10%. Of the additional twenty-one herbaceous taxa, only *Artemisia* and *Rumex acetosella* appear in all horizons, *Thalictrum* (2%) occurs in the lower four, and *Filipendula* (3%) in the upper four horizons. The specific diversity of the five horizons is markedly higher in the two lower horizons, becoming reduced by half in the upper three. Details are as follows: 89.00m: 13 (eight in diagram, plus *Caltha*, *Equisetum*, *Potentilla*, *Typha* and *Valeriana*); 89.03m: 16 (fourteen plus *Potentilla* and *Typha*); 89.06m: eight (seven plus *Armeria*); 89.09m: seven; 89.12m: seven (five plus *Armeria* and *Plantago maritima*).

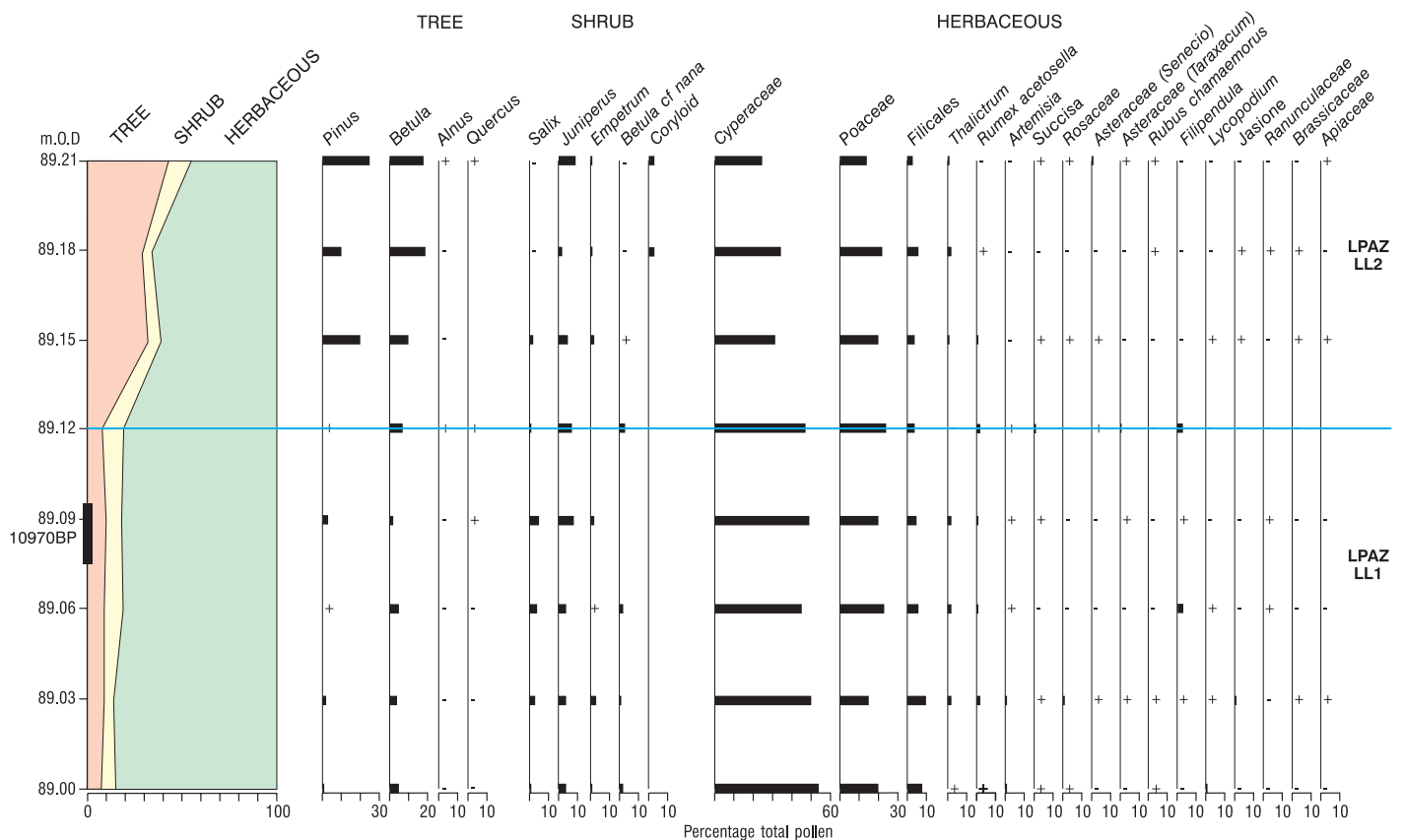


Figure 2: Percentage pollen diagram from Lumb Lane, Audenshaw (SJ995976).



LPAZ LL2 89.12-89.21m O.D.

The percentage representation of tree pollen increases from 8% in the upper horizon of LPAZ LL1 to 32% in the lowest horizon of LPAZ LL2, and then to 43% in the uppermost horizon. *Pinus* (10-25%) and *Betula* (10-19%) are the major contributing types. *Juniperus* (2-9%) remains the dominant shrub, *Empetrum* is constant at 1-2%, *Salix* and *Betula cf nana* disappear and Coryloid type appears at 3% in the upper two horizons. Values for herbaceous pollen fall to between 66% and 45%, Cyperaceae (25-32%) and Poaceae (14-22%) being the major types. Filicales and *Thalictrum* remain constant, but *Filipendula* is absent. Herbaceous specific diversity increases to 11 types in both 89.15m and 89.18 (eight plus *Epilobium*, *Galium* and *Caryophyllaceae*), and 10 in 89.21m (nine plus *Urtica*).

## Discussion

The basic characteristics of the Late Devensian/early Holocene vegetation of Great Britain and Ireland have been succinctly summarised in such texts as Godwin (1975) and Roberts (1998). Similarly, a regional understanding of the climate, vegetation and landscape of this transitional period in north-west England has been developed through the research of Manley (1959), Godwin (1960), Birks (1965), Hibbert *et al.*, (1971), Tipping (1987) and Johnson *et al.*, (1990), *inter alia*. The truncated pollen diagram presented in Figure 2 clearly demonstrates this transition from the Loch Lomond Stadial (Younger Dryas) Zone III (LPAZ LL1) to the Pre-Boreal Zone IV (LPAZ LL2) defined by a marked rise in arboreal pollen from 8% at a altitude/depth of 89.12m

O.D. to 32% at 89.15m, and a concomitant decrease in herbaceous pollen. The depth of deposit from the present day surface at Audenshaw taken to represent Zone III (c. 150mm), is similar to those recorded for other regional lowland sites; Godwin (1960), for example, has a depth of c.150mm at Moss Lake, Liverpool, and Birks (1965) records 200mm at both Bagmere, Cheshire and Chat Moss, Greater Manchester. The pollen record lacks evidence of the presence of floating aquatic species and the presence of emergents such as *Typha* and *Equisetum* and helophytes like *Caltha* and *Filipendula*, suggest deposition in a eutrophic mire habitat. This feature apart, the pollen record does little more than confirm the findings of previous research, but the radiocarbon dating of the antler of reindeer found *in situ* at 89.09m O.D., is of particular interest in the fact that it appears to be the first definite record of a find in association with the type of vegetation actually grazed by the animal. Assuming antler and pollen deposition to be synchronous and vertically stable, several extrapolations may be made on the nature of the immediate environment.

First, the highest %TP values for *Salix*, *Juniperus* and *Cyperaceae* were recorded at the antler horizon of 89.09m O.D., suggesting the predominance of a low shrub heath typical of tundra margins and probably most closely akin to the *Salix lapponum-Filipendula ulmaria* communities of Norway (Nordhagen 1943), and the *Juniperetum nanae* (McVean and Ratcliffe 1962), the *Juniperus nana* nodum of Scotland (Birks 1973), described by Rodwell (1991) as the *Calluna vulgaris-Juniperus communis ssp. nana* heath. However, the general absence of Ericaceae pollen in the

Table 3: Probable specific complement of Zone III vegetation.

<b>Dwarf shrubs:</b> <i>Betula nana</i> , <i>Empetrum nigrum ssp. nigrum</i> , <i>Juniperus communis ssp. nana</i> , <i>Salix herbacea</i> , <i>S. lanata</i> .
<b>Grasses &amp; sedges:</b> Cyperaceae: <i>Trichophorum cespitosum ssp. germanicum</i> , <i>Eriophorum angustifolium</i> , <i>Kobresia myosuroides</i> , <i>Carex spp.</i> , most probably <i>C. bigelowii</i> , <i>C. capillaris</i> , <i>C. microglochis</i> , <i>C. nigra</i> , <i>C. norvegica</i> .
Poaceae: <i>Agrostis stolonifera</i> , <i>Deschampsia alpina</i> , <i>Festuca vivipara</i> , <i>Hierochloe odorata</i> , <i>Phleum alpinum</i> , <i>Poa glauca</i> , <i>P. alpina</i> .
<b>Herbs:</b> <i>Armeria maritima</i> , <i>Artemisia norvegica</i> , <i>Caltha palustris</i> , <i>Epilobium alsinifolium/E. anagallidifolium</i> , <i>Equisetum arvense/E. pratense/E. variegatum</i> , <i>Filipendula ulmaria</i> , <i>Plantago maritima</i> , <i>Potentilla anserina/P. crantzii</i> , <i>Rubus chamaemorus</i> , <i>Rumex acetosella</i> , <i>Succisa pratensis</i> , <i>Thalictrum alpinum</i> , <i>Typha angustifolia</i> , <i>Urtica dioica</i> , <i>Valeriana officinalis/V. dioica</i> .
Ranunculaceae: <i>Ranunculus acris/R. repens</i> .
Rosaceae: <i>Alchemilla alpina</i> , <i>Dryas octopetala</i> , <i>Geum rivale</i> , <i>Sibbaldia procumbens</i> .
Rubiaceae: <i>Galium boreale/G. verum</i> .
Brassicaceae: <i>Draba incana/D. norvegica</i> .
Caryophyllaceae: <i>Cerastium fontanum</i> , <i>Minuartia stricta</i> , <i>Lychnis alpina</i> , <i>Sagina nodosa/S. saginoides</i> , <i>Silene acaulis</i> .
Asteraceae (Senecio type): <i>Erigeron borealis</i> , <i>Tussilago farfara</i> , <i>Leontodon autumnalis</i> .
Asteraceae (??type): <i>Omalotheca supina/O. norvegica</i> .
Umbelliferae: <i>Angelica sylvestris</i> .
Filicales: <i>Blechnum spicant</i> , <i>Polystichum lonchitis</i> .
Lycopodium: <i>Huperzia selago</i> .

deposits is a distinguishing feature from these present day plant communities, although this may be a function of the fact that the site is lowland, rather than montane. Unfortunately, macrofossil preservation was poor, but it seems probable that the ubiquitous tundra bryophyte *Racomitrium lanuginosum* was present. Second, the diversity of herbaceous pollen taxa falls from sixteen at 89.03m to eight at 89.06m, then to seven for the two subsequent horizons of LPAZ LL1, before recovering to eleven in the lower horizons of LPAZ LL2. The marked reduction in taxa from 89.03m to 89.06m and its continuation in the subsequent horizons probably represents a closure of the vegetation by the vigorous growth of *Salix* and *Juniperus* scrub. Such a subtle vegetation change in response to climatic amelioration may have been one of the causative factors for the suggested northward migration of the reindeer during the Loch Lomond Stadial and Pre-Boreal chronozone (Yalden 1999).

The probable specific complement of the flora of the Late Devensian stage represented in LPAZ LL1 is shown in Table 3, data being derived by reference to Rodwell (1991), Stace (1997), Kristinsson (1998) and the author's personal field experience and observations in Scotland, Shetland and Iceland. Although many species listed are of montane or alpine distribution in Great Britain and Ireland, all the species were recorded in lowland habitats between 63° and 65° N in Iceland, at or below the 80-95m O.D. altitude of the Audenshaw site. Where pollen taxa cannot be identified to the species level, several possible alternatives of appropriate geographical and ecosociological distribution are given. Thus, for example, the species of *Equisetum* that might conceivably have been present are threefold; there are four most likely species for the Rosaceae type, six for the Caryophyllaceae type, and so on. There is a general lack of evidence to suggest whether the rise in specific

diversity in LPAZ LL2 was due to recolonisation of the same species from the lower horizons of LPAZ LL1 or whether related species of a different ecosociological amplitude invaded. The only new pollen taxa in the upper LPAZ are *Galium*, *Urtica* and the Coryloid type, either *Corylus avellana* or *Myrica gale*. The increase in the percentage representation of *Pinus* and *Betula* pollen, the relative constancy of *Juniperus* and the presumed appearance of *Corylus* in the upper horizons of the profile are all features that are typically characteristic of the Pre-Boreal (Zone IV) chronozone.

## Conclusions

Three main points may be highlighted by way of a summation of the research investigation and its wider significance in the context an understanding of Late Devensian environments.

1. The Audenshaw site for the reindeer is the third oldest Late Devensian record and furthest north Zone III Loch Lomond Stadial site in mainland Britain.
2. The strong indication that the antler was shed naturally and the fact that it was found in situ where the animal was presumably grazing enable a meaningful analysis and interpretation of the vegetation of the Loch Lomond Stadial. This situation is rare in the sense that contrasts most reindeer find sites have been from caves in which the analysis of associated deposits does not provide a reliable representation of past vegetation and landscape.
3. Although the nature of the pollen and spore content of the deposits is generally typical of previously published analyses of Zone III and IV vegetation, a detailed interpretation of the possible species represented in the broader pollen taxa has seldom been attempted.

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