Ancient Monuments Laboratory
Report 18/91

PALYNOLOGICAL ANALYSIS OF LISMORE FIELDS, BUXTON, DERBYSHIRE

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Summary

Three peat cores and one buried soil profile were subjected to pollen analysis. The three peat cores overlapped temporally and were correlated by radiocarbon dating and a computer program, SLOTSEQ. The peat cores gave a record of vegetation history of the site from Mesolithic to possibly Medieval times. No chronology was obtained for the soil profile and it was suggested that it revealed fairly recent events. Although no artefacts later than Neolithic were found during excavation, pollen analysis revealed that Lismore Fields had been continuously exploited by man since the Mesolithic period. By about 6000 bp, Neolithic settlers were engaged in a mixed economy and were responsible for progressive clearance of the woodland. The site has possibly the earliest record for cereal cultivation so far found in the British Isles. Early Bronze Age peoples had a very dramatic effect on the local vegetation and continued exploitation appears to have resulted in soil impoverishment and partial abandonment in the Late Bronze Age. The area was occupied again early in the Iron Age and pastoralists were responsible for extensive woodland clearance. The Roman invasion resulted in wholesale deforestation in the region, cereal growing was enhanced, and extensive weedy pastures maintained. There was tentative evidence of relaxation of land management in the Dark Ages.

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INTRODUCTION

Buxton lies in the Peak District National Park in the southern part of the Pennine Chain. The town lies in an area of Carboniferous deposits, situated on the boundary between the limestone plateau and an outcrop of shales and thin limestones surrounding the plateau. These shales and thin limestones are, themselves, surrounded by outcrops of grits and shales of the Millstone Grit Series, and coal measures (Trueman 1971).

Before the construction of a modern housing estate, the site of Lismore Fields was an area of open, damp grassland. It is situated at an altitude of approximately 300 metres on an interfluve between two streams at the head of the River Wye which is composed of solifluction deposits derived from the Corbar and Kinderscout Grits (Canti 1987). The southerly edge of this interfluve plateau slopes steeply towards the southern arm of the Wye, and levels off into a narrow river terrace which runs above part of the northern bank of the stream. Soligenous silty peat deposits of varying depth were found on the river terrace and were sampled for pollen analysis.

The modern vegetation on those parts of the site untouched by the building contractors consists of flush meadow communities on the open areas, and dense trees and typical waterside vegetation alongside the stream, including large stands of *Filipendula ulmaria* (meadowsweet), *Iris pseudacorus* (yellow iris), *Epilobium hirsutum* (great willow herb), and *Cirsium palustre* (marsh thistle). The dominant tree species overshadowing the river terrace today is *Acer pseudoplatanus* (sycamore).

Archaeological excavation was carried out between 1984 and 1987 and this revealed substantial evidence of Mesolithic and Neolithic settlement of the Site with finds of Grimston/Lyles-Hill type pottery, and radiocarbon dates for the Neolithic buildings averaging at about 4950 bp (Garton pers. comm.). There was no indication of exploitation of the area by later peoples, although it must be said that the total excavation area covered only about 0.75% of the plateau (Garton pers. comm.).

Two cores were obtained for pollen analysis by R.S. Scaife and, subsequently, two more were obtained by P.E.J. Wiltshire to supplement those taken by Scaife. A buried soil was also found adjacent to the 1984-85 excavation area, approximately 70 metres from the peat deposits, and this was also subjected to pollen analysis.

Analysis of the peat cores revealed that the sedimentological history was a complex one and correlation of the various peat cores was problematical. This report, therefore, falls into two main sections: the first deals with the process of core correlation, and the second analyses the vegetation history of the site.

Since the main pollen sites were approximately 70 metres from the edge of the archaeological excavation, the peat must be considered to be virtually 'on-site' material. This adds to the importance of Lismore Fields since it is exceedingly rare to find sediments which might yield a long history of vegetation change so close to what is an area of proven, substantial Mesolithic and Neolithic settlement.

The vegetation history of most parts of Britain has been elucidated from cores of sediments taken from lakes or upland peats and, by their very nature, tend to give a regional picture of vegetation change. The peat deposits at Lismore Fields were formed in the relatively enclosed area offered by the river terrace and were, therefore, more likely to have recorded events only in the surrounding few hundred metres (Jacobson & Bradshaw 1981). The peat appears to have accumulated in a woodland edge site, at the transition of the heavily wooded river valley and the open, grassy plateau - a site ideally located to reflect environmental change surrounding the settlement area without too much interference from regional pollen input, and thus of paramount importance to prehistoric archaeology.

METHODS

Sampling

Peat cores (Buxton 1, 2, 4 & 5) were obtained with a Russian peat corer, wrapped in polythene and stored at 3°C. The buried soil was obtained as a monolith and sampled in the laboratory. It is important to note that Buxton 1 was situated approximately 3.5 metres from Buxton 2 and 1.3 metres from Buxton 4. Buxton 4 was about 5 metres from Buxton 2 while the soil profile of Buxton 3 was obtained from the edge of the 1984-85 excavation area, about 70 metres from the peat deposits.

Peat Stratigraphy of Buxton 4

The stratigraphy was assessed in the field and the symbols used in the pollen diagram (Figure 10) are shown below:-

Stratigraphic Symbols in Figure 10

	**Waxy brown, relatively humified peat**
	**Pale brown, relatively unhumified peat**
	**Grey, silty peat with clay**
	**Wood fragments. Close spacing = higher frequency**
	**Rootlets**

Organic Content of Peat

The organic content of the peat in core Buxton 4 was analysed by standard methods involving loss on ignition in a muffle furnace at 550°C (Aaby 1979).

Computer Analysis

The pollen data from cores Buxton 1, 2 and 3 were subjected to detrended correspondence analysis, using DECORANA [program CEP-40 - Cornell Ecology Program series (Hill 1979; Hill & Gauch 1980)]. Data were not transformed and there was no down-weighting of rare species. The data from cores Buxton 1 and 4 were correlated using SLOTSEQ (Gordon 1980c). Only those taxa which attained (in at least one core) a score of 5% or more of total pollen and spores were included in the analysis.

Radiocarbon Dating

Accelerator dates were obtained on samples of peat by the Radiocarbon Accelerator Unit at Oxford University. Dates quoted in this report are uncalibrated radiocarbon years before present (bp).

Charcoal

No attempt was made to count charcoal particles, but a subjective assessment was made of the amounts in each sample. Unfortunately, it was decided that the method of assessment was not accurate enough for inclusion of quantitative results in the report.

Pollen Analysis

In peat cores Buxton 1, 2 and 4 samples were taken at 2.0 cm or 4.0 cm intervals and were subjected to standard acetolysis and hydrofluoric acid treatments (Dimbleby 1985). In the case of the buried soil, contiguous 1.0 cm samples were analysed down the profile. The pollen preparations of Buxton 1, 2 and 3 were suspended in glycerol jelly after staining with safranine, while those of Buxton 4 were mounted in silicone oil without staining.

An attempt was also made to make absolute counts of pollen in Buxton 4, using exotic markers (Stockmarr 1971), but the pollen concentration in the peat was unexpectedly high and the numbers of exotic spores added to the preparation proved to be inadequate for reliable counts. Thus, no attempt was made to construct an absolute pollen diagram.

Pollen slides were examined under phase-contrast microscopy at x 400 magnification and at x 1000 magnification where necessary. The numbers of pollen and spore taxa counted ranged between 350 and 850 with an average of about 450 grains in each sample.

The terminology and palynomorph taxonomy of Moore and Webb (1978) was adopted. Gramineae grains of >40µ were referred to as 'cereals' in the text of this report. It must be stressed that the grains also possessed other characteristics of cereal pollen (see Edwards 1989).

Pollen Diagram

Palynomorphs were expressed as a percentage of the total count, excluding *Alnus* (Jansenn 1959). *Alnus* was expressed as a percentage of total pollen and spores.

Zonation of the diagrams was problematical in view of the complex nature of the sedimentary history of the site. However, the variety of analyses carried out on the peat itself, and on the pollen data, aided the subjective and conventional zonation of the diagrams, based on local pollen assemblage zones (Faegri & Iversen 1975).

Buxton 2 was divided into five zones: B2(1), B2(2), B2(3), B2(4) and B2(5). Buxton 1 was divided into three zones: B1(0), B1(1) and B1(2). The zone at the base of the diagram B1(0) was ignored since its taphonomy was so suspect. Zone B1(1) was also largely disregarded in view of the probability of excessive compaction or loss of peat through erosion or some other agency. Buxton 4 was divided into four zones: B4(0), B4(1,) B4(2), and B4(3). Again the lowermost zone was ignored because of problems in the sedimentology.

The diagram of the soil profile (Buxton 3) was not zoned.

RESULTS

Stratigraphy

Unfortunately, no stratigraphic details were available for Buxton 1 and 2, while Buxton 3 appeared to be a relatively homogeneous soil profile. However, a record was made of the stratigraphy of Buxton 4 as follows:

Depth (cm)	Description
0 - 16	Dark brown, well humified, compacted, homgeneous peat.
16 - 17	Peat as above with black banding (probably charcoal).
17 - 30	Pale brown, relatively unhumified peat with rootlets.
30 - 50	Waxy, brown relatively humified peat.
50 - 65.5	Waxy, brown peat as above with substantial wood fragments.
65.5 - 94	Greyish/brown, well humified peat with rootlets and occasional wood fragments. Some black banding (possibly charcoal).
94 - 100	Grey silty peat with clay.

Pollen was analysed only from 25 cm to 95 cm but since computer analysis showed that Buxton 4 was broadly equivalent to the lower part of Buxton 1, it may be assumed that the stratigraphy above 25 cm of Buxton 4 may be similar to that of the upper deposits of Buxton 1.

Pollen Analysis

The full results of pollen analysis are given in Figures 9-12. Discussion of the results accompanies the figures.

Zone B4(1) of Buxton 4 was considered to be equivalent to Zone B2(5) of Buxton 2, so there was considerable overlap between the two cores. Zone B1(2) of Buxton 1 was considered to be a continuation of the upper part of Buxton 4 with no overlap.

Computer Analysis, Organic Content & Radiocarbon Dating

The results of these analyses, which allowed correlation of peat cores Buxton 1, 2 and 4, and the buried soil profile Buxton 3, are given in Figures 1-8. Discussion of the results accompanies the figures.

Charcoal

Abundant microscopic charcoal was found in every sample in all the cores, including the soil profile.

Spherules

Black spherules were found in certain of the pollen samples in Buxton 1, 2 and 4. Their occurrence in each core is indicated in Figure 7. The nature of the spherules is discussed in relation to Figure 7.

CORRELATION OF POLLEN CORES

Correlation of Buxton 1, 2 and 4

Buxton 2 core was the deepest obtained from the site (140 cm) and it was decided to analyse this fully to give as complete picture as possible from a single sequence of peat deposit. Unfortunately, the peat in the top 25 cm of the core had dried and crumbled in storage so it was considered prudent to set the first sample at 30 cm depth. Buxton 1 core had a depth of 112 cm so it was decided to analyse the top of this sequence until a point of overlap with Buxton 2 was located. It was hoped that a complete sequence of events would thus be obtained.

Pollen analysis showed that the relationship between the two cores was complex and it was impossible to determine subjectively the point of overlap between them. The situation was complicated further by the fact that radiocarbon dates were not available for Buxton 1. Three dates (uncalibrated bp) obtained for Buxton 2 (at 126, 76 and 48 cm depths) were 6630 $\pm$ 80, 4460 $\pm$ 100 and 3540 $\pm$ 70 respectively. This showed that the age of the peat ranged from Mesolithic to the Bronze Age.

It was assumed that, since the top of Buxton 1 was at the surface, and the top sample of Buxton 2 was at 30 cm, a considerable amount of history was contained in the uppermost part of Buxton 1. It was very important, therefore, to be able to correlate the two cores. Furthermore, as will be shown in the next section of this report, indicators of woodland clearance and two pollen grains characteristic of cereal pollen, were found at the base of Buxton 2 (at an interpolated date of 7250 bp). Although there have been reports of cereal pollen being found in pre-Elm Decline deposits of early Neolithic/late Mesolithic age in at least twenty-two sites(Edwards & Hirons 1984; Edwards 1989), none of them approach the early date of the grains found at Lismore Fields. The possibility of early cereals, the lack of radiocarbon dates for Buxton 1, and the enigmatic relationship between the two cores led to the decision to obtain further peat cores from Lismore Fields.

The following describes aspects of the multivariate analysis which contributed to the decision to resample the site.

The complexity of the relationship between the two cores was revealed by DECORANA analysis. Figure 1 (pollen taxon eigenvectors) and Figure 2 (sample eigenvectors) show the results for combined core analysis of Buxton 1 and 2 , with the first axis being plotted against the second. Figure 1 shows that Axis 1 appears to have differentiated between those taxa found in wooded and in open habitats, while Axis 2 was difficult to interpret but may have differentiated between species growing in moist or relatively dry habitats. Figure 2 shows the similarity of one sample with another. In other words, the spatial relationship between each sample plot indicates their degree of ecological similarity - the closer the plots, the more similar the pollen spectra represented by them. Thus, Figure 2 also gives an indication of the similarity between the plant communities throughout the history of Buxton 1 and 2 respectively.

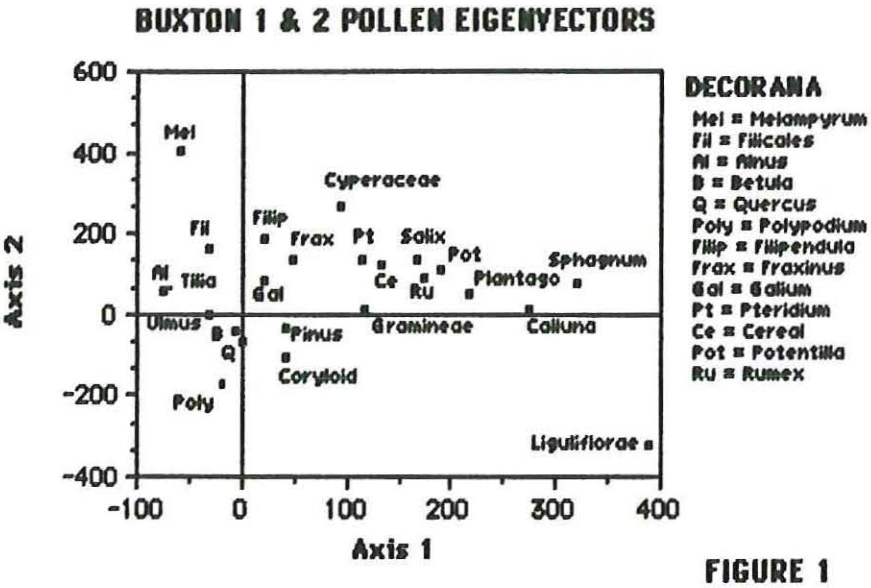


FIGURE 1

Coupled with radiocarbon dates (see later), Figure 2 indicated that the succession at Buxton 2 was one of a series of quite major woodland clearances with subsequent regeneration episodes, but that the trees were progressively and extensively cleared from about 4000 bp. At Buxton 1, there seems to have been no such series of clearance and regeneration episodes – the woodland seems to have been cleared very dramatically.

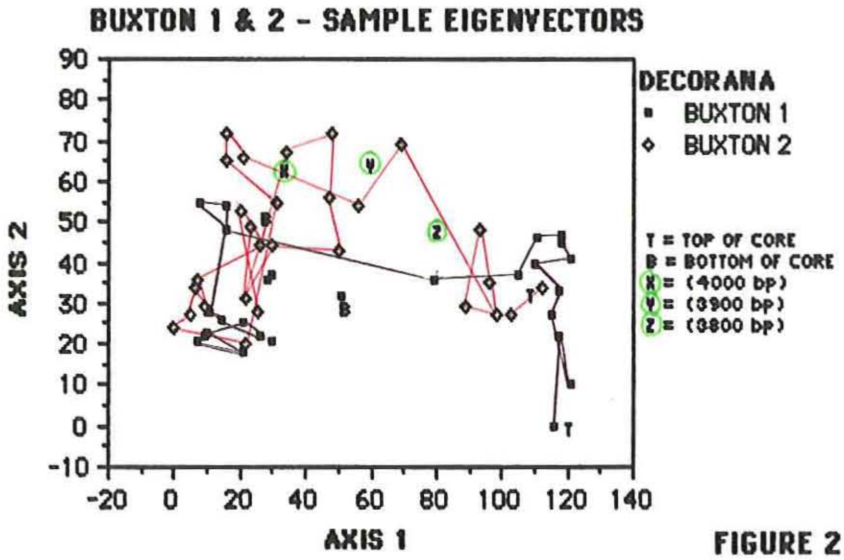


FIGURE 2

DECORANA showed that the bases of both cores were very similar ecologically, although vegetation in Buxton 1 appeared to have been more stable, in spite of Buxton 2 being obtained from only a few metres away. However, there seemed to be much more information contained within Buxton 2 and this suggested that a hiatus had occurred in the sediments of Buxton 1. But in the absence of radiocarbon dates, it was impossible to understand the relationship between the two sequences. Two more cores (Buxton 4 and 5) were subsequently taken from the site in the hope of obtaining a deep, duplicate core from the area of Buxton 2. The new cores were taken approximately 20 cm apart and were thus assumed to be equivalent to one another. It was hoped that a very detailed analysis of their basal sediments would reveal details of Mesolithic activity at Lismore Fields.

While sampling, it was difficult to assess the absolute depths of the new cores since a great deal of overburden had been deposited by the Developer. However, the basal sediments in the core samples had very high levels of silt and it was assumed that the pre-peat deposits had been obtained.

Pollen analysis and radiocarbon dating were carried out on Buxton 4, and the organic content was estimated on Buxton 5. Figure 3 shows the relationship between the ratio of trees/shrub to herbs/dwarf shrubs and organic content of the peat.

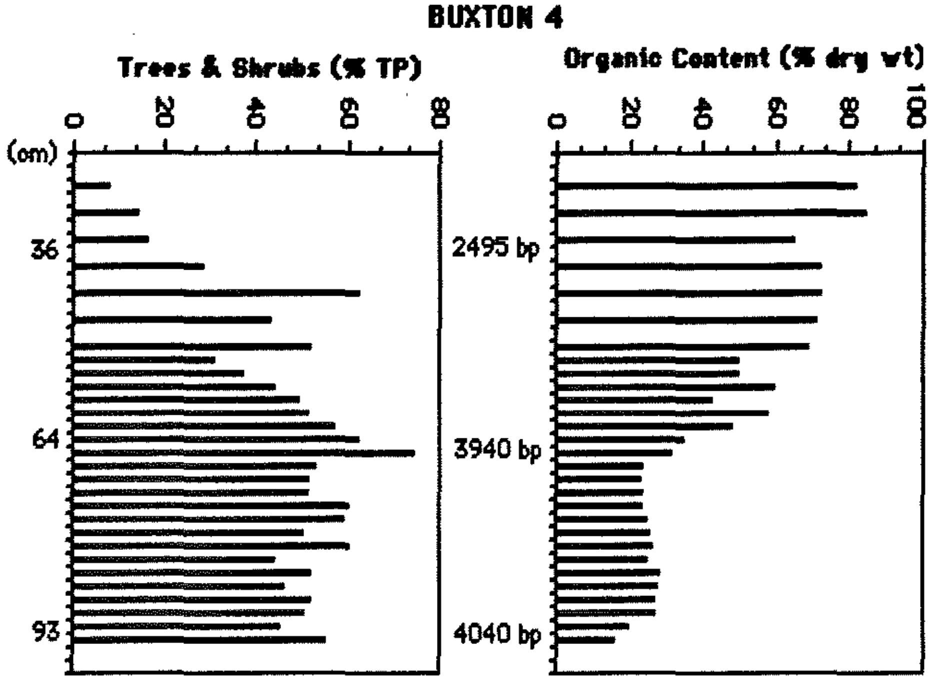


FIGURE 3

It can be seen that peat accumulation was enhanced at 3940 ± 60 bp (at a depth of 64 cm) and that this was correlated with changes in the tree/shrub:herb/dwarf shrub ratio. It can also be seen that the radiocarbon date at the depth of 93 cm, just above the base, was 4040 ± 70 bp. These dates may be considered to be statistically indistinguishable so that at least 29 cm of sediment accumulated exceedingly rapidly. Thus, the material might have been deposited at one time, and at the very most, over a period of 121 years. This meant that from 64 cm to the base of the core, the sediments were probably laid down as a result of erosion of up-slope material which slumped into the sampling site. It also meant that it was not possible to check the validity of the presumed Mesolithic cereal-type pollen found in Buxton 2.

It was difficult to relate the pollen record of the new core precisely to the two previously analysed and, while correlation with Buxton 2 could be achieved by means of the radiocarbon dates, it was necessary to use SLOTSEQ analysis to correlate Buxton 4 with Buxton 1. Figure 4 shows the results of sequence slotting of Buxton 1 with Buxton 4. Here the samples of Buxton 1 and 4 have been slotted in the order dictated by the SLOTSEQ results and then plotted against depth at which each sample occurred in its respective core of sediments. Figure 5 shows Buxton 1 slotted into Buxton 4 and thus shows very clearly how the two cores were related to one another.

It must be noted that there was a low Psi value (1.15) for the slotting of Buxton 1 and 4 and this indicated a good fit of the two sequences.

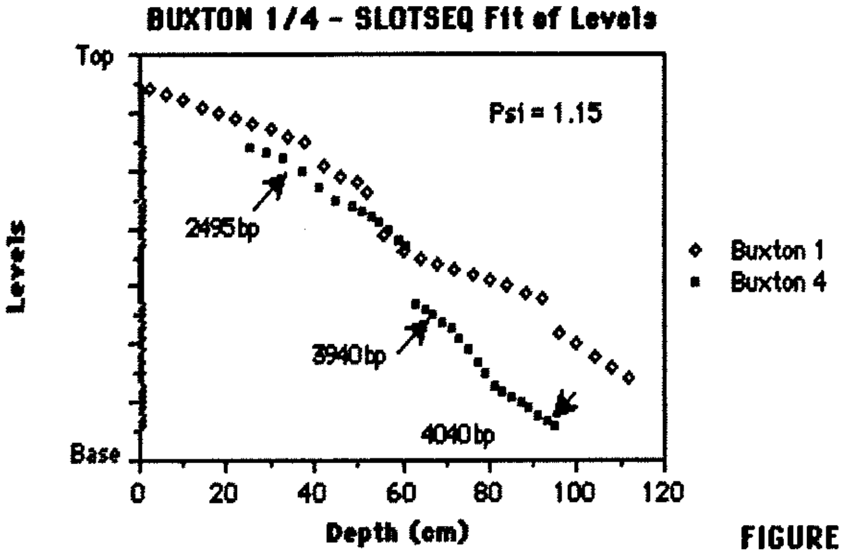
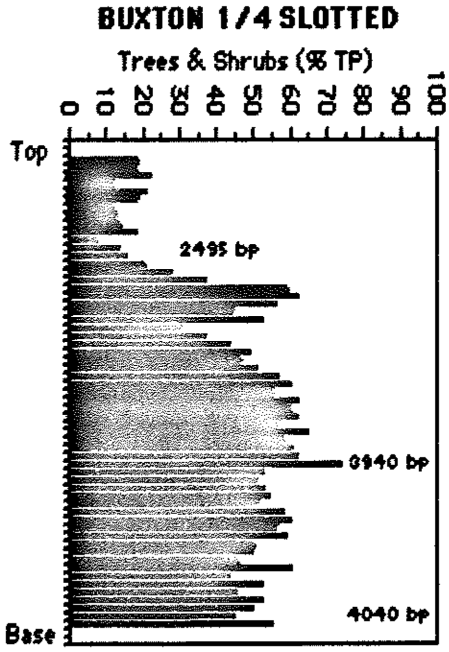


FIGURE 4



Solid black areas indicate position of Buxton 1 samples

FIGURE 5

The slotting of Buxton 1 and 4 shows that the method allowed considerably greater resolution in the pollen record than would have been achieved by either core alone. Furthermore, correlation of Buxton 1 with Buxton 2 via Buxton 4 was possible.

Although only three radiocarbon dates for each of Buxton 4 and Buxton 2 were available, Figure 6 shows that they were more-or-less linear. It was decided, therefore, that interpolation was possible and all the dates in this report which are quoted in brackets are interpolated from the six radiocarbon dates.

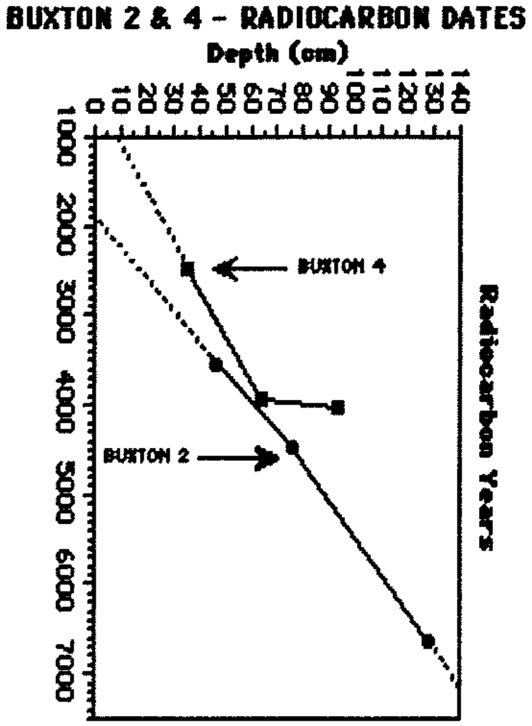


FIGURE 6

Figure 7 shows the results of the correlation of the three cores. It is quite clear that in Buxton 1, samples from 64-112 cm were correlated with most of the samples in Buxton 4 which were thought to be at least partly colluvial in origin. This would account for the apparent stability in the pollen record which was revealed by DECORANA. The stability was illusory; these samples were probably of slumped sediments which arrived into the site very quickly so that the pollen record was relatively homogeneous, as in the case of the basal samples of Buxton 4. The origin of the material is unsure, but the silts probably did not travel very far down the slope of the terrace from the plateau above since the palynomorphs they contained were generally in good condition.

Figure 7 indicates quite clearly that the depositional history of the area from which Buxton 1 and Buxton 4 were obtained was very complex indeed; but there was no clear evidence that the sediments of Buxton 2 had had any significant colluvial input. This would suggest that colluviation was very localised, and it is possible that the colluvium in Buxton 1 and 4 represented a single event of slumping of minerogenic material into the peat. Presumably, peat deposits lay beneath the these silts but could not be obtained because of the limitations of field sampling. It also important to note the finding of black spherules within the deposits of all the cores. In Figure 7 their occurrence is marked on each sample in which they were found. The nature of these spherules is debatable and they are the subject of current research, but it is thought that they are microbially-derived metallic sulphides which are formed under anaerobic conditions (Love 1957); they are certainly associated with conditions of excessive water-logging and standing water. They were present in considerable numbers throughout the basal deposits of Buxton 1 and 4 (the presumed colluvium)and, indeed, were present in virtually every sample of Buxton 4. They were found only sporadically and in small numbers in Buxton 2.

CORRELATION OF BUXTON 1, 4 & 2 CORES

Trees & Shrubs (% TP)

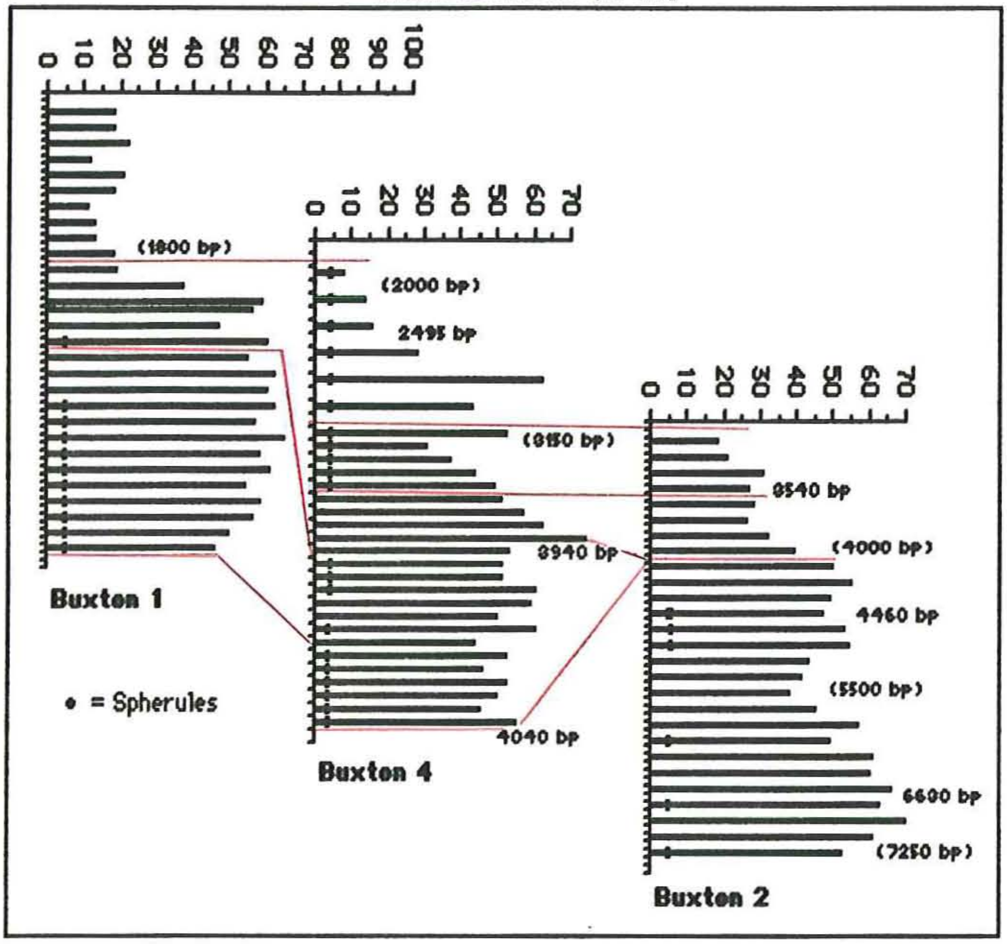


FIGURE 7

The age of Buxton 2 deposits ranges from (7250 bp) at the bottom, to (3050 bp) at the top of the core, and these estimations are based on interpolation from the three radiocarbon dates. Buxton 4 spans from about 3990 bp (taking an average for the two basal radiocarbon dates) to (1990 bp), while Buxton 1 also has a basal date of about (3990 bp), with a date of about (1800 bp) for the sample 38 cm depth. These dates for the Buxton 1 were based entirely on correlation with Buxton 4, as demonstrated by SLOTSEQ, and there is no date for top of the core. However, the modern flora of the site was not represented in the pollen spectra in the uppermost peat; this means that there must either have been a termination of accumulation, or truncation of the profile some time in the past. As will be discussed later, it is probable that the top of Buxton 1 represents Medieval times.

It is very interesting that the colluvium at Buxton 4 (and presumably Buxton 1) is dated at about (4000 bp) and that this coincides with the date of the commencement of a marked and sustained woodland clearance at Buxton 2. This will be discussed in detail later in the report. It is also important to note that, the 28 cm of peat above the presumed colluviation event in Buxton 1, dated tentatively from about (4000 bp) to about (1900 bp), was correlated with 38 cm of peat in Buxton 4. Furthermore, the resolution and information content of the Buxton 4 peat was much greater. This could mean that the Buxton 1 peat had been subjected to greater impaction than that of Buxton 4 so that standard pollen sampling of the impacted peat resulted in reduced resolution, or that peat may have actually been lost from the sequence by erosion or some other agency. The original idea of a hiatus in peat accumulation in Buxton 1, which had been suggested by DECORANA, might thus hold true.

Correlation of Buxton 1 & 2 with Buxton 3

The pollen data obtained from the buried soil profile (Buxton 3) was combined with Buxton 1 and 2 in DECORANA analysis and the results are shown in figure 8

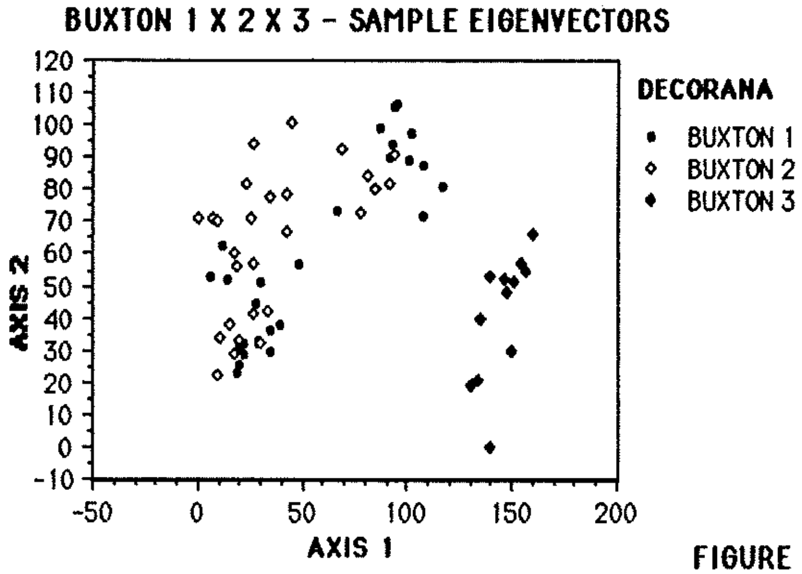


FIGURE 8

The plot of pollen eigenvectors is not shown since it was very similar to that shown in Figure 1. Figure 8 shows that the pollen assemblages of Buxton 3 were very different from those in Buxton 1 and 2. This variance may, in part, be due to the difference between the respective substrates and to taphonomic processes. However, reference to the pollen diagram (Figure 12) makes it quite clear that the plant communities which contributed pollen to Buxton 3 were growing mainly in open conditions.

Unfortunately, it was not possible to obtain radiocarbon dates for the soil so that the temporal relationship of Buxton 3 with the other cores could not be determined. It is possible that the soil pollen was a record of the relatively recent vegetation of the plateau since the top of Buxton 1 indicates open conditions but, on the other hand, the plateau might have been cleared of trees for a very long time in which case it would be impossible to determine the age of the soil from the pollen evidence alone.

POLLEN ANALYSIS

Introduction

As was shown by the correlation of Buxton 1, 2 and 4, portions of Buxton 1 and Buxton 4 could be disregarded because of taphonomic problems which had been highlighted by the various analyses already described. The six radiocarbon dates demonstrated the areas of overlap between Buxton 2 and Buxton 4, and the areas of overlap between Buxton 4 and Buxton 1 have been shown by interpolation.

The Buxton 2 diagram spans the period from about (7250 bp) to (3050 bp). In other words, the latter part of chronozone Flandrian I (c. 8000-7000 bp), all of Flandrian II (c. 7000-5000 bp) and the lower part of Flandrian III (West 1970; Simmons & Tooley 1981). The pollen zone boundaries on the Buxton 2 diagram are drawn for convenience of description and do not coincide strictly with the Flandrian chronozones.

Both Buxton 1 and 4 cover only parts of Flandrian III. Diagram Buxton 4 overlaps Buxton 2 for the period of about 4000 bp to (3050 bp). This overlap will, therefore, be dealt with briefly since there are considerable similarities in the pollen record in the two sites for the period; but differences will also be discussed and interpreted. The period from about (3050 bp) to (1900 bp) is covered by Buxton 4, and from (1900 bp) to possibly Medieval times by Buxton 1

The summary tree/shrub pollen diagrams (Figure 7, also Figures 9-11), and the presence of wood in the peat of Buxton 4, show that the area surrounding the river terrace, from which the peat cores were obtained, supported woodland for much of its history; but consistently high values for non-tree/shrub pollen indicate that at various times, and to greater or lesser extent, the plateau itself had open ground.

There have been various attempts by palynologists to quantify woodland cover and composition, and to assess the areal extent of cleared ground, in terms of pollen input into sediments, (Davis 1963; Tauber 1965; Smith & Taylor 1969; Turner 1970; Andersen 1973; Tinsley & Smith 1974) but precise quantification has been difficult to achieve. Many of the difficulties inherent in interpretation of pollen data, and the range of approaches adopted by palynologists in elucidating vegetation changes, have been reviewed by Caseldine, and his work has provided valuable information on the pattern of pollen dispersal and accumulation in a small wooded raised bog (Caseldine 1981).

The work of Jonassen (1950) and Heim (1962) would suggest that if the proportion of tree pollen in a diagram falls below 50%, the landscape is fairly open and for closed woodland, tree pollen can vary between 64-92%. On the other hand, Smith & Taylor (1969) have shown that percentages of 20% indicate wooded conditions in the vicinity of the site, with 5% being indicative for open moorland vegetation. Work of the author (Wiltshire unpublished), carried out in the same region of Wales as that of Smith & Taylor, refutes their findings; she has shown that a background of 25% tree pollen prevails in the uplands of central Wales where some valley slopes are wooded but plateaux for many hundreds of hectares are completely bare of trees. Turner (1965) suggested that if Gramineae (grass)pollen accounted for about half of the total pollen input, then half of the pollen catchment would be grassland. In Buxton 1, 2 and 4, grass pollen often exceeded 50% of total pollen even where tree pollen was at its highest level in the diagram. It must be remembered, however, that grass pollen is very easily dispersed and, although it is a good indicator of open conditions, it may sometimes be over-represented. But it must be noted that wherever meadowsweet is abundant around a site, it acts as an effective filter of the pollen of all extra-local and regional species, including grasses (Vuorela 1973), so it would be incautious to attach too much importance to fluctuating grass values when a tall herb vegetation is well represented.

What has become very obvious to palynologists is that every site is unique, and that the findings from one area may only be applied to another in the broadest terms.

The pollen sampling sites at Lismore Fields were situated just over the lip of the plateau, above a steep slope down to the bank of the River Wye, on the periphery of the settlement site and may thus be regarded as being marginal both in terms of vegetation and human activity. They were probably situated in a woodland edge, with trees actually growing *in situ*, but were open enough to record the fate of more distant woodland, as well as the plateau vegetation, from which the large amounts of grass pollen were most likely derived. Although fluctuating, the high grass levels throughout the pollen diagrams indicate that the plateau (or at least a part of it) was probably kept patent from the time the peat started to form. The woodland at the three sampling sites was dominated by *Alnus* (alder) and the pollen assemblages, including willow, Filicales (c.f. *Dryopteris*), meadowsweet, and sedges show that the site supported alder carr vegetation.

The ecotonal nature of the site and its topographical heterogeneity might also explain some of the variation in the pollen record in the areas of overlap between the three cores.

Description and Discussion of Pollen zones

Pollen zones for each core will described and discussed individually.

Buxton 2

Pollen Zone B2(1): The two samples included in B2(1) represent the Flandrian I deposits in the diagram. *Alnus*(alder), *Quercus*(oak), *Betula*(birch) and Coryloid (*Corylus/Myrica* [hazel/sweet gale]) were the main contributors to the tree pollen sum but *Pinus* (pine), *Ulmus* (elm), *Tilia*(lime), *Salix* (willow), were also present in the vicinity. *Prunus* (c.f. sloe), *Crataegus* type (c.f. rowan) and *Hedera* (ivy) were also represented in the marginal woodland.

Gramineae (grass) averaged 55% while meadowsweet reached a level of 13% at the base, though dropping to 1.3% subsequently. It is important to note the relatively high level of *Calluna* (heather/ling) and the representation of other indicators of open habitat such as *Rumex* (docks), *Potentilla type* (e.g. tormentil, silverweed, cinquefoil), *Galium* type (bedstraws), *Plantago lanceolata* (plantain), and *Pteridium* (bracken).

The several large grass grains, ranging from 40-65μ must be noted. In spite of being embedded in glycerol jelly which is known to swell pollen, these grains fell within the size criteria for cereal; they also had other cereal-like features such as large annuli. However, as they could not be located for further inspection and, since the hypothesis of arable farming in Flandrian I would be exceedingly contentious, no claim could be made for these grains being of cereals. It is likely that in view of the proximity of the river, they were of grasses known to produce large pollen grains such as *Glyceria fluitans*.

The pollen record for the base of the peat indicates that the site was dominated by alder carr vegetation with lush growths of meadowsweet and willow fringing a fairly open grassy area. The microscopic charcoal in the peat showed that there was continuous burning of the local vegetation throughout the period and that soil impoverishment had already started, allowing the spread of heather. The relative abundance of oak, birch and hazel suggests that they were probably growing on or around the plateau but that pine, elm and lime were growing further away, their pollen being filtered by the dense carr vegetation so that they are poorly represented in the diagram. The representation of elm by a single grain is remarkable by its paucity, and evidence from other sites suggests that it was more abundant regionally (Conway 1954; Hicks 1972). Presumably, the filtering effect of the carr vegetation contributed to the low elm record.

The summary diagram shows an overall increase in woodland at the end of the zone and it would seem that this was due to a spread of oak and hazel at the expense of birch.

Pollen Zone B2(2): This zone covers the period from about (7000 bp) to (6100 bp) and the summary pollen diagram indicates that at the beginning of the zone there was an overall increase in the woodland, involving most of the trees and shrubs. Alder and birch increased quite markedly and oak maintained its previous level. However, the summary diagram shows that woodland fluctuated throughout the zone and that there was an overall decline after the initial expansion. The fluctuation in woodland was due mainly to the rise and fall of alder, oak and birch, and hazel seemed to be little affected. *Fraxinus* (ash) made its first appearance, elm and lime were represented consistently, and willow seemed to decline.

Cyperaceae (sedges) increased progressively; grass declined but recovered towards the end of the zone, a similar pattern seen in the heather curve. One notable appearance was that of a spore of *Sphagnum* which might have actually been growing in the carr itself. *Sphagnum palustre*, for example, is common in mesotrophic peatland habitats today; as well as being a component of open, flushed bogs, it is shade-tolerant and will form loose carpets in wet fen woodland and even along streamsides (Daniels 1985). Plants indicative of open conditions such as thistle, docks, bracken and bedstraws were well represented, their maxima being associated with the grass decline and the appearance of ash.

The fate of the vegetation during the period represented by B2(2) was a complex one but the evidence points to the initial spread of alder carr a little further (possibly onto the plateau), with the depression of woodland edge plants such as meadowsweet and willow. The increase in *Potentilla* type might suggest that the plant involved was a fen species such as *Potentilla palustris* (marsh cinquefoil). Although the alder carr may have spread, the woodland canopy itself was probably more open than before. *Polemonium caeruleum* (Jacob's Ladder - see Table 1) was found at the end of the zone; today, this is a rare plant confined to limestone areas of Derbyshire and a few locations in northern England and is characteristic of tall herb communities, especially along river banks. Its presence confirms the mesotrophic nature of the woodland and also that shading at the site was relatively light. The consistent representation of elm and lime, the appearance of ash and the presence of open habitat plants point to there being less obstruction to extra-local pollen entering the site and also suggest a rather open canopy.

The decline of grass might also indicate considerable pressure on the plateau grassland allowing the spread of ruderals. It is possible that animals were encouraged by rich browse and grazing on the plateau, and grasses were exploited to the extent that their flowering was depressed. This might indicate quite intense grazing pressure and implies a high density of animals.

Pollen Zone B2(3): This pollen zone covers the period from (6100 bp) to about (5100 bp) and records dramatic changes in the vegetation at Lismore Fields. The curves for alder, oak, birch and hazel all behave in the same way which indicates that changes were unselective. At the beginning of the zone alder and hazel declined while birch continued the fall which had started at the end of the previous zone; oak appeared to be unaffected but willow seemed to disappear.

The decline in tree species was accompanied by a decline in the epiphytic fern *Polypodium* and this may indicate that trees deep within the carr itself were being removed. The demise of the woodland species was also accompanied by an increase in sedges, meadowsweet and weeds such as docks, bedstraws, thistles, *Urtica* (stinging nettle) and plantain. *Potentilla* type was also present in relative abundance throughout the zone and, in view of the expansion of other weeds typical of open, disturbed and/or grazed grassland, it is possible that, in this instance, the species involved was *Potentilla anserina* (silverweed) or *Potentilla erecta* (tormentil). *Melampyrum* (cow wheat), a plant associated with burning and disturbance of woodland, was also represented. Heathland appears to have spread, with heather continuing the expansion which had begun at the end of the previous zone, and bracken being consistently represented. Cereal pollen was sustained in the record.

At about (5800 bp), alder, birch and hazel recovered slightly but the tree canopy must have remained open since the open habitat indicators and cereal pollen remained at their previous levels. Meadowsweet and sedges appear to have been sensitive to relatively small changes in the woodland and their rise and fall seem to be closely correlated with the expansion and contraction of the alder carr.

Great changes appeared to have occurred at about (5650 bp) with alder, birch, hazel and oak being reduced. It is also interesting that elm pollen disappeared from the record at this point while pine failed to be represented even earlier. Lime continued and ash appears to have benefited from the decline of the major woodland species as did willow and c.f. rowan. There was obviously a clearance of local woodland which allowed shrubs to flower more prolifically and more distant woodland species, either to spread into the open areas or at least disseminate their pollen more freely.

The clearance was most intense toward the end of the zone and woodland seems to have been removed in an unselective fashion. The record suggests that the taller trees were being systematically removed, not only from the carr but also from extra-local woodland. Intense grazing pressure is possibly suggested by the relatively high levels of silverweed/tormentil and docks, and the reduction in heather and plantain. Heather cannot tolerate intense trampling or grazing, especially by sheep (Gimingham 1975), and even plantain pollen fails to be recorded if flowering stalks are removed before anthesis.

At the very end of the zone, birch and hazel had started to recover and were followed by alder and oak at about (4950 bp) in the following zone.

Pollen Zone B2(4): The woodland seems to have been neglected at about (4050 bp) and all the major trees, including elm, recovered to some degree from the previous thousand years of impact. The woodland edge appears to have extended, and willow and meadowsweet pollen declined as well as many of the open habitat weeds.

Birch and hazel might have started to encroach onto the heathland areas some time before, and heather and bracken declined quite markedly at the beginning of the zone. The heather decline might have been due to grazing stress which made it vulnerable to invasion by bracken and then birch (Miles 1981). The pollen record certainly suggests that this had started to happen in the latter part of B2(3).

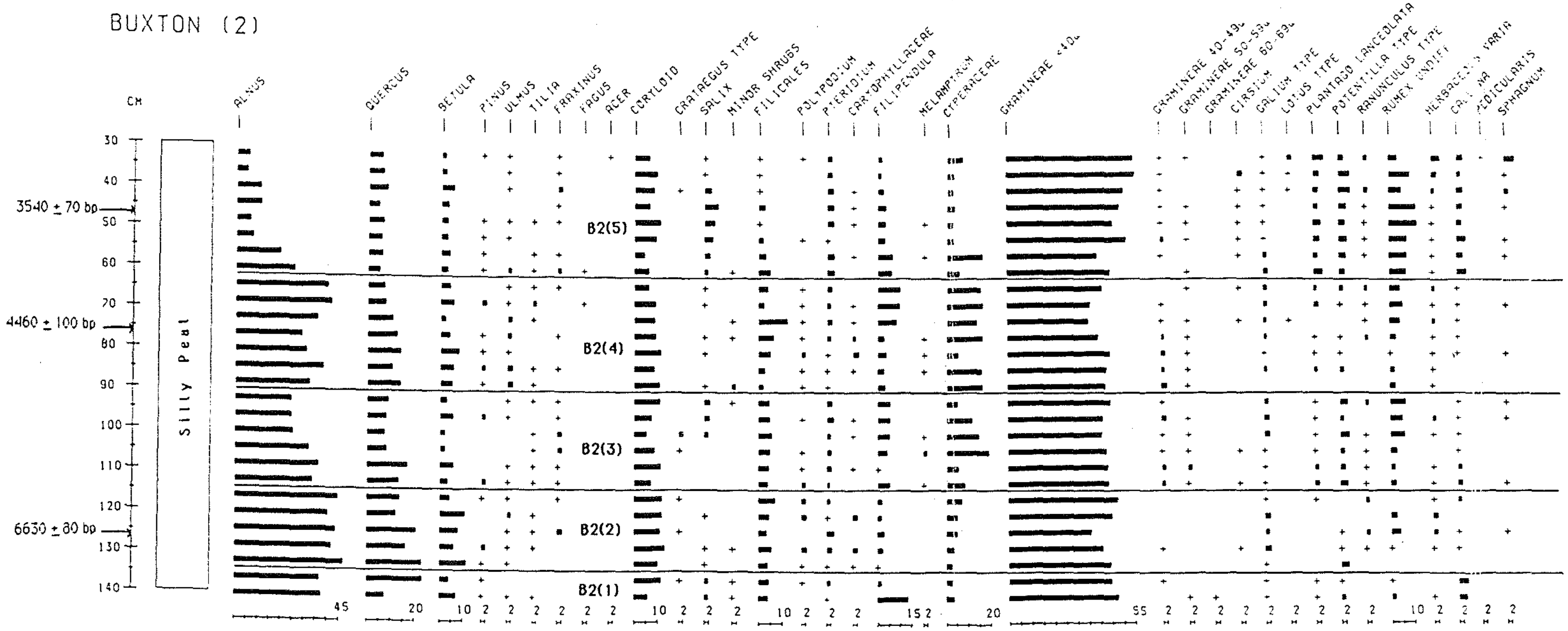
The presence of spherules in the peat (see Figure 7) in this zone might also indicate an increased local wetness. The spherules certainly suggest standing water at the site and it is possible that the long period of exploitation of the local terrain had caused changes in local hydrology. Nevertheless, at the beginning of B2(4), cereal pollen grains were more abundant than before so the area was not abandoned although it would seem that grazing pressures had been lessened to some degree.

From about (4650 bp) the pattern of vegetation appears to become rather complex with the alder carr being exploited and then allowed to recover, and with oak, birch and hazel fluctuating although declining slightly, but progressively, throughout the zone. It is difficult to interpret the nature of these changes since the rise in alder might actually mean that the carr was more open with pollen being more freely dispersed. Certainly, meadowsweet and sedges were high and towards the end of the zone, ruderals and weeds were once more becoming abundant while grass declined as well as cereals. The decline in grass and cereal pollen could, of course, be due to the filtering effect of the tall herb vegetation at the edge of the carr. Change in the canopy is indicated by the decline of Filicales and *Polypodium* and the appearance of *Fagus* (beech)as well as the enhancement of ruderals.

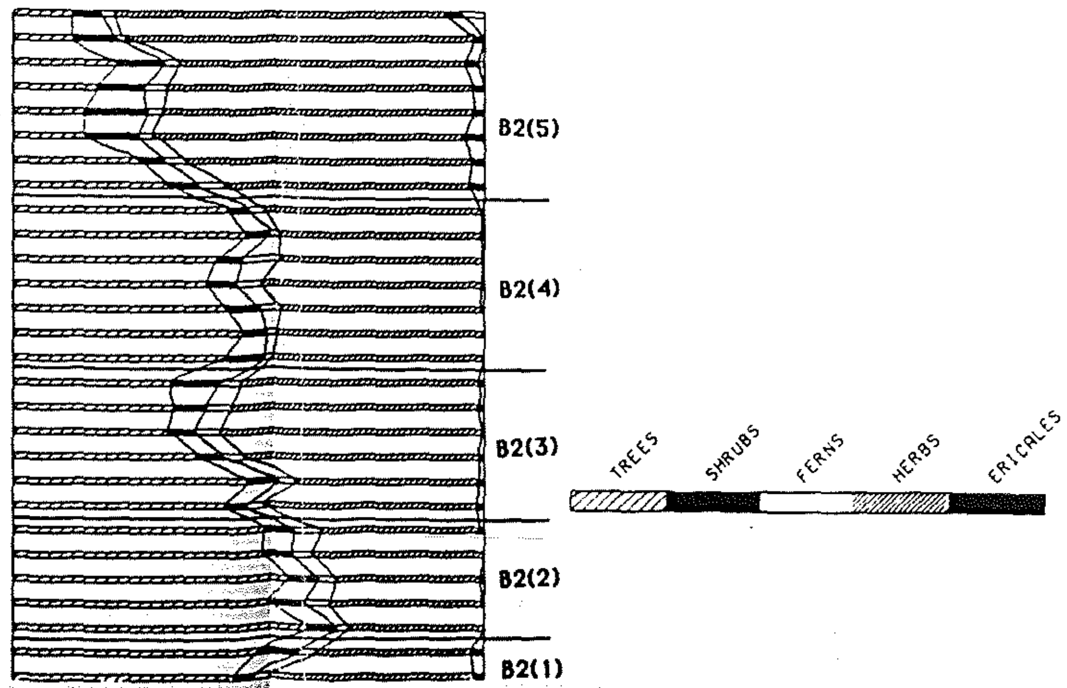
Pollen Zone B2(5): At about (4000 bp) there seem to have been very significant changes in the vegetation at Lismore Fields; there was a decline in oak and birch and the tall herb community, and a very marked fall in alder, while, at the same time, the open habitat weeds and heathland areas expanded along with willow. These effects were intensified at about (3700 bp) when both hazel and willow scrub expanded and cereals were better represented.

It seems that the carr vegetation was being systematically removed allowing a regional element of the pollen rain as well as the extra-local component to be represented. Thus elm and ash increased and beech was represented. The increase in the hazel/willow scrub could actually indicate extensive use of these shrubs through coppicing which enhances flowering.

From about (3300 bp) the locality seems to have been much more open, with all the local trees probably being exploited in some way or other, and the ground flora increasing in diversity (see also Table 1). The spread of heath is indicated by not only bracken and heather but also a marked increase in *Sphagnum* and the presence of *Pedicularis* (lousewort), a plant characteristic of bog surfaces and poor, acid grassland.



Percentage of total pollen & spores, excluding *Alnus*



SUMMARY DIAGRAM

FIGURE 9

Depth (cm)	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	128	132	136	140
Shrubs & Climbers																												
Genista type								0.5																				
Hedera																+									+			+
Lonicera																+												
Prunus type											+				+												+	
Ulex type												+			0.5													
Viburnum								+																				
Dwarf Shrub																												
Vaccinium			+																									
Pteridophyta																												
Thelypteris palustris																								+				
Herbs																												
Anthemis type	+													+							+		+					
Aster type		+	+	+	+																							
Bidens type									+				+		+					+								
Centaurea nigra type	+																											
Chenopodiaceae																								+				
Geum						+																						
Hypericum perforatum type		+	+								+																	
Lamium type																									+			
Liguliflorae	0.9	0.4				0.6	+																					
Plantago media/major										+																		
Polemonium																						+						
Sinapis type										+	0.5	+																
Stachys type		0.7																+				+						
Succisa	+	+		+	+				+				+	+														
Teucrium																												+
Trifolium type	0.6		+				+	+	+														+	+	+			
Umbelliferae	0.6		+	0.4	0.5			+										+			+		+					
Urtica type		+	+														0.9	+		+								
Valeriana																							+					

+ = Single Grain

Values = % Total Pollen & Spores minus Alnus

BUXTON 2 - MINOR TAXA TABLE 1

Buxton 4

Pollen Zone B4(0): This zone represents much of the pollen diagram but, as indicated by the radiocarbon dates and discussed previously, the deposits probably accumulated very rapidly and the whole zone is likely to be equivalent to the period represented by the transition of zones B2(4) and B2(5) in Buxton 2.

Pollen Zone B4(1): Radiocarbon dates indicate that the zone covers the period from 3940 bp to (3250 bp) and is considered to be equivalent to B2(5) of Buxton 2. Interpolation of the radiocarbon dates suggests that the uppermost sample of B2(5) was equivalent to the base of B4(2) of Buxton 4. However, pollen evidence suggests that the interpolation must be treated with caution here and that it is most likely that B4(1) is equivalent to the whole of B2(5).

The stratigraphy of the peat for this zone indicates that trees were growing (and falling) *in situ* and that although alder dominated the woodland, it declined systematically throughout the zone until at about (3250 bp) where it fell to 9% TP. Trees, shrubs and other woodland plants were well represented and while B4(1) was similar to B2(5) of Buxton 2, in spite of being only a few metres distant, it seems to have been dominated much more by woodland during the period than was Buxton 2.

It is possible that, either the site at Buxton 4 was indeed deeper within the carr and that the small distance had a marked effect on the pollen record, or that younger material somehow had been incorporated into the basal deposits of B4(1) distorting the radiocarbon date. The complexity of depositional events at Buxton 4 have already been discussed, and it is possible that the lower part of B4(1) represents vegetation events which occurred earlier. Nevertheless, this point is of academic interest since a complete record for the period exists in Buxton 2 and the latter part of B4(1) certainly has a high degree of similarity with B2(5). At Buxton 4, in spite of the possible greater influence of the woodland, the picture is one of increasingly open conditions with the spread of heathland and disturbed ground.

Pollen Zone B4(2): Very great changes seem to have occurred in local vegetation in zone B4(2) which, according to interpolated radiocarbon dates covers from about (3150 bp) to (2750 bp). As already discussed, caution must be taken with these interpolated dates and the pollen record suggests that the date of (3150 bp) is a little early.

The very sudden changes in stratigraphy and the pollen record would suggest that there might be a hiatus in the record at the B4(1)/ B4(2) boundary and only greater frequency of radiocarbon dating could resolve the uncertainty in depositional events. Nevertheless, it may be said that somewhere in the region of (3000 bp) the woodland seems to have been neglected and alder and other carr vegetation, including Filicales, sedges and meadowsweet, recovered.

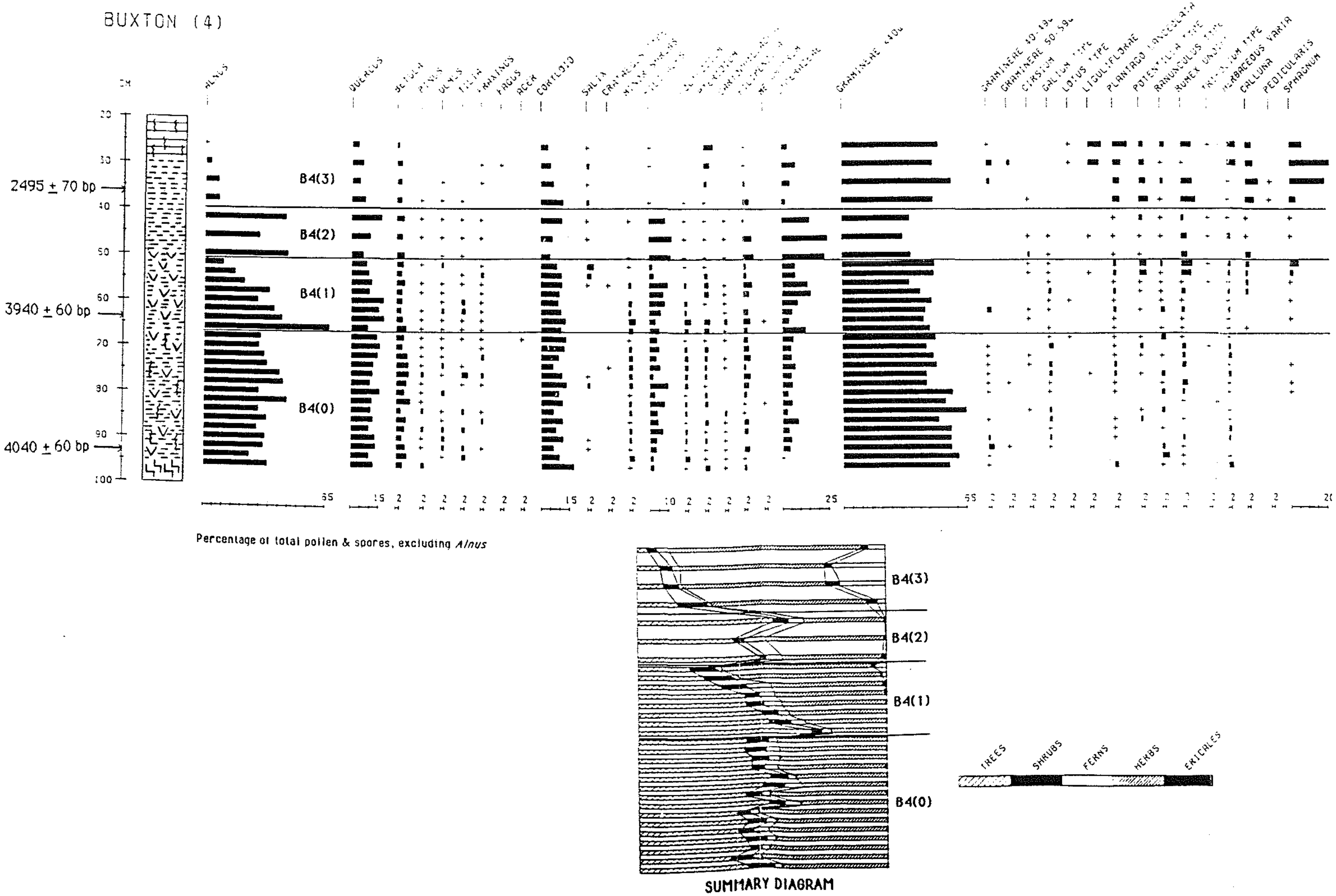

BUXTON (4)
2495 ± 70 bp
3940 ± 60 bp
4040 ± 60 bp
B4(3)
B4(2)
B4(1)
B4(0)
Percentage of total pollen & spores, excluding *Alnus*
SUMMARY DIAGRAM
TREES
SHRUBS
FERNS
HERBS
ERICALES

FIGURE 10

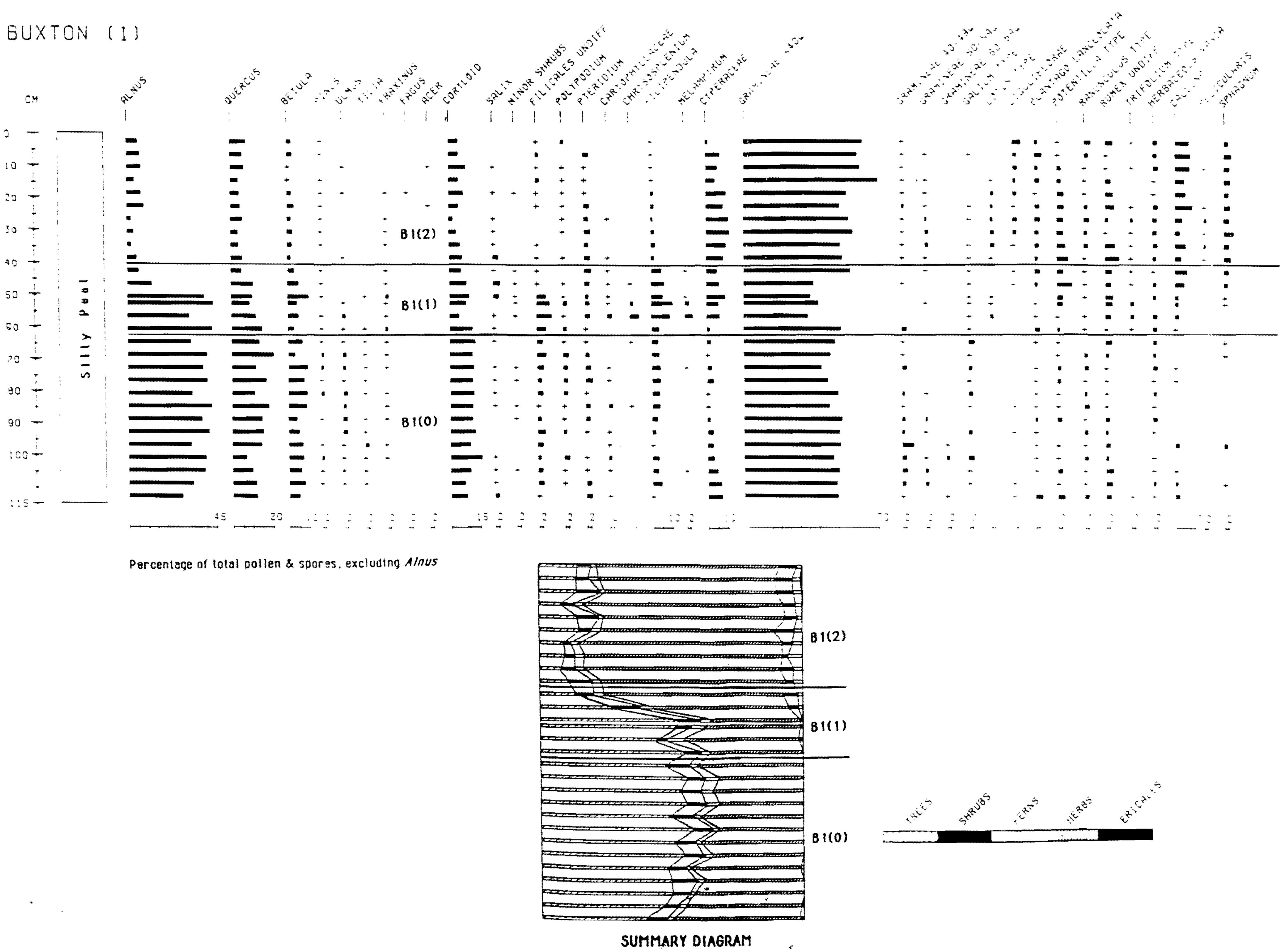

BUXTON (1)
CM
ALNUS
QUERCUS
BETULA
ULMUS
TILIA
FRAXINUS
FAGUS
ACER
CORYLOID
SALIX
MINOR SHRUBS
FILICALES UNDIFF
POLYPODIUM
PTERIDIUM
MELAMPYRUM
CYPERACEAE
SPHAGNUM
Silty Peat
B1(2)
B1(1)
B1(0)
Percentage of total pollen & spores, excluding *Alnus*
SUMMARY DIAGRAM
TREES
SHRUBS
FERNS
HERBS
ERICALES

FIGURE 11

Depth (cm)	1	2	3	4	5	6	7	8	9	10	11	12
Climbers												
Hedera			+									
Herbs												
Anthemis type	+			+								
Bidens type							+				+	
Campanula type						+						
Caryophyllaceae										+	+	+
Centaurea nigra type				+								
Cirsium									+			
Galium type			+				+					
Lotus type				+								
Papaver			+									
Pedicularis			0.6									
Potentilla type			+	+	0.6	+						
Ranunculus type	+	0.5					+	+				
Rumex undiff			+			+						
Trifolium type			+	+								
Umbelliferae		+			+							

+ = Single Grain

Values = % Total Pollen & Spores minus Alnus

BUXTON 3 - MINOR TAXA TABLE 4

Interpretation of Pollen Diagrams in terms of the Archaeology at Lismore Fields

Introduction and Background

Important archaeological remains of the activity of both Mesolithic and Neolithic peoples were found at Lismore Fields during the three-year period of excavation although no artefacts later than Neolithic were recovered (Garton 1987). The lack of evidence for later occupation of the site is interesting in view of the fact that every peat and soil sample analysed for pollen contained abundant microscopic charcoal. It is inconceivable that natural fires could have occurred with such frequency so as to provide this continuous charcoal record, so it must be concluded that there was some level of continuous exploitation of the environs of Lismore Fields by people.

If the radiocarbon dates for the peat cores are to be believed, and there is little evidence to deny their authenticity, then the vegetation record obtained from pollen analysis of these deposits spans the period from the Mesolithic period (7250 bp) to possibly Medieval times. It would seem that people have been having some impact on the area around Lismore Fields for more than the last seven thousand years.

From the archaeological and palynological records, it is difficult to determine a strict chronology for the prehistoric cultures which occupied Britain. Simmons and Innes (1987) reviewed the evidence to suggest that Later Mesolithic societies occupied northern England (including the Buxton area) from 8500-5300 bp, and that they had some considerable influence on the vegetation. This period covers the latter part of the chronozone Flandrian I and most of Flandrian II, Flandrian II spanning from about 7500-5000 bp and being equivalent to the Atlantic Period/Zone VIIa (West 1970; Godwin 1975). The Buxton 2 diagram covers much of Flandrian II and reveals evidence of impact on the local vegetation; the findings of Mesolithic artefacts on site strengthens the view that the changes were wrought by man's activities rather than by natural events.

The Flandrian II/III boundary was taken at about 5000 bp which coincided with the decline of elm in pollen diagrams, an event shown by radiocarbon dating to be more-or-less synchronous over much of the British Isles (Smith & Pilcher 1973). The elm decline has been attributed to various causes, and the related literature is very large indeed, but consensus of opinion holds that whatever the nature of the phenomenon, man's activities contributed to it. The elm decline and earliest Neolithic sites appeared to be contemporaneous and it has been conventional to assume that 5000 bp heralded Neolithic agriculture. However, there is now a large body of evidence to suggest that Neolithic peoples began to have an impact on British vegetation much earlier and that the elm decline occurred after farming practices had become firmly established in the British landscape.

Elm pollen was recorded only in very low percentages in the Lismore Fields diagrams despite alder being removed from the pollen sum; the highest value recorded was 2% TP (excluding alder) in Buxton 4, and this value was never reached in either the Buxton 2 or Buxton 1 diagrams. Before its decline, elm was certainly a little more abundant elsewhere in the Pennines, reaching about 8% TP (including alder) on East Moor (Hicks 1971). However, it must be remembered that taphonomic processes at Lismore Fields would have been very different from those on East Moor and, as stated elsewhere, the low values for extra-local species could be a function of filtering effects from the marginal tall herb vegetation of the alder carr. The lack of a classic elm decline at Lismore Fields might have been because of its very low status in the pollen diagram but it is very interesting that between about (5700 bp) and (5400 bp), a period of general woodland decline, elm disappears altogether from the Buxton 2 diagram. Furthermore, at about (4950 bp), a more conventional date for the elm decline, elm actually increases in value.

There are many reports of pre-elm decline woodland clearance in what was conventionally thought to be the Mesolithic and, indeed, evidence suggests that the activities of Mesolithic peoples certainly resulted in the creation of clearings in the vast and dense woodland which covered much of Britain in the Flandrian II period (Smith 1970; Simmons & Innes 1987; Smith & Cloutman 1988). Furthermore, although many of these clearings were temporary, some are known to have remained patent even to the present day (Dimbleby 1962; Keef, Wymer & Dimbleby 1965). However, there are also reports of possible cereal cultivation in this period (summarised by Edwards 1989) which must be attributed to Neolithic peoples, and it is quite feasible, indeed probable, that Mesolithic and Neolithic communities co-existed for some considerable time in the British Isles. The degree of overlap of one prehistoric culture with another is exceedingly difficult to determine from pollen analysis, and only when there are authenticated artefacts and reliable radiocarbon dating can the presence of specific cultural groups be identified ; even then, artefact assemblages may be mixed so that impact on vegetation cannot be ascribed wholly to one cultural group or another.

In the absence of authenticated botanical evidence of crop plants, it is impossible to distinguish between the woodland clearances caused by Mesolithic hunter/gatherer communities and those caused by Neolithic farmers. Both seemed to have used fire extensively, and when charcoal remains are examined they are invariably found in those horizons of peat and lake deposits which coincide with woodland clearance episodes (Simmons & Innes 1987; Smith & Cloutman 1988). Furthermore, the successional sequences following clearance episodes must have been subject to so many variables, such as local climate and soils, topography, and composition and density of both plant and animal communities, that any attempt to differentiate Mesolithic from Neolithic clearances from patterns of woodland regeneration must be doomed to failure.

The pollen evidence (reviewed by Smith 1981) from a number of sites in northern England, including the Pennines, suggests that Neolithic peoples had little impact on upland vegetation in the region. Hicks (1971) suggested that there was a small-scale movement of Neolithic folk into the East Moor area (east of Buxton) at about 5000 bp and that they created small, temporary clearings in the woodland, growing cereals in the open areas. She suggested that this kind of activity prevailed, though more intensely, throughout the middle/late Neolithic. Shimwell (1977), on the other hand, has quoted archaeological evidence that the extensive limestone plateau, which covers a large area to the south and east of Buxton, was continuously occupied from the Late Neolithic to the Middle Bronze Age, and his pollen analyses of plateau soils indicate that extensive open grasslands resulted from their pastoral activities. The limestone plateau has many sand/clay-filled hollows in the limestone which Shimwell saw as being used as watering places for the stock of Neolithic and Bronze Age pastoralists. His pollen evidence indicates quite early, intensive land use and deforestation of the limestone, with woodland being confined to the surrounding dales, although it must be stressed that Shimwell had no absolute chronology and relied on correlation of his pollen data with those of other workers for dating his pollen diagrams. Other work in the Pennines, already quoted, also suggests that although the evidence indicates relatively slight exploitation of upland woodland in the Neolithic, the canopy itself was fairly open at many sites.

As in the transition of Mesolithic to Neolithic, difficulties arise when attempting to differentiate the Neolithic from Early Bronze Age impact on vegetation since the two cultures merged in many ways, not least, in their farming practices. At many upland sites in the British Isles, such as the extreme western edge of the Pennines, there appears to have been an intensification of woodland clearance in the Bronze Age and this often correlated with the spread of heath and bog (Tallis & McGuire 1972), while on the Pennines to the east of Buxton, Bronze Age activity seems to have resulted in series of temporary and 'medium-sized' clearances (Hicks 1971 & 1972).

Shimwell claims that extensive clearance of woodland from the limestone plateau had already resulted in soil impoverishment by the Early Bronze Age, and there are many instances where vegetation changes in the Bronze Age are thought to have coincided with deterioration in climate and soil quality. There is considerable evidence (reviewed by Tinsley 1981 & Turner 1981) that it became colder and wetter from between 3200 bp and 2600 bp and that peat growth accelerated over large areas of the uplands; there is also broad agreement that the demise of woodland and spread of bog in the Middle Bronze Age was caused by a combination of climatic and anthropogenic factors. It is now well established that deterioration in climate, coupled with the practice of burning and removing woodland, enhances leaching, run-off, and erosion, and leads to a loss of soil fertility. This, in turn, is associated with peat formation, the spread of bog, and the failure of woodland to regenerate, especially where stocking densities of grazing animals are relatively high. Indeed, Shimwell reports that there was abandonment of the limestone plateau and a movement of peoples onto the gritstone plateaux areas, such as the East Moor, during the Middle and Late Bronze Age because of deterioration of the soils beneath the limestone plateau grasslands. This may be the reason why Hicks reported only 'medium' sized woodland clearances in the Bronze Age. Earlier pastoralists might have favoured the limestone areas and were forced to migrate onto the gritstones at a relatively late date.

Woodland was cleared from large areas of the British Isles from the Iron Age onwards and at many sites such as Nidderdale Moors in Yorkshire (Tinsley 1975), tree pollen percentages dropped to modern levels. Large tracts of the Pennines were opened up and there were large-scale clearances on the East Moor, to the east of Buxton, while extensive and prolonged clearances also occurred to the north-west of East Moor (Tallis & Switsur 1973). Shimwell showed that woodland regeneration which had occurred on the limestone plateau in the Late Bronze Age, presumably as a result of the abandonment discussed earlier, was reversed quite dramatically in the Iron Age and there was a marked spread of heath and bog accompanied by soil podsolisation. There is much evidence for a deterioration in the climate in the Southern Pennines from about 2600 bp (Tallis 1964), and increased wetness in Derbyshire , as well as elsewhere in Britain, is indicated by a recurrence surface (the Grenzhorizont) in many upland peats. The Iron Age was thus one of poor climate and, in the north of England, pastoralism with some arable farming seemed to dominate the landscape. A clear picture of the Iron Age and post-Iron Age landscape is reviewed by Turner (Turner 1981).

From the Iron Age to Medieval times, Shimwell reports the limestone plateau to have been neglected but the effects of the Roman invasion were certainly felt elsewhere in Derbyshire. Hicks showed that the period of Roman occupation coincided with an extension of arable farming and the development of mixed farming. She recorded *Juglans* (walnut), *Cannabis/Humulus* (hemp/hops) and considerable amounts of cereal pollen. A mixed economy was also recorded to the north-west of East Moor, at Featherbed Moss (Tallis & Switsur 1973). However, it has been suggested that although the uplands did not receive the same degree of attention from the Romans as did the lowlands, there was, nevertheless, further incursion into the woodland. Hicks suggests that extensive mining of the Derbyshire lead mines resulted in a great need for timber for smelting and this, coupled with the enhancement of cereal growing, had a marked effect on local woodlands. Nevertheless, it would seem that the Roman influence in Derbyshire was for a shorter period than the 400 years experienced by the south of England.

After the Roman occupation, woodland was unable to regenerate naturally in Derbyshire by virtue of the advanced deterioration of the soil and the spread of peat in the uplands as well as continued pastoral farming; and it would seem that, to greater or lesser degree, the landscape has been deforested ever since.

What must be stressed most emphatically is that the pollen records for Lismore Fields cannot be used to construct a regional model. As stated previously, the nature of the site was such that local and extra-local vegetation must have dominated the pollen spectra, and it is envisaged that the vegetation history of only the immediate landscape would have been recorded with any degree of resolution. The very close proximity of the pollen site and the authenticated archaeological remains emphasises the importance of Lismore Fields since such finds are so very rare. It also means that any natural influences upon the vegetation were probably masked by the greater ones of man's hand.

The Mesolithic Period

Conventionally, the Mesolithic period covers all of Flandrian I and Flandrian II (the period up to 5000 bp), although it has been suggested that the end of 'pure' Mesolithic culture in the Pennines occurred a few hundred years earlier, a date of 5380 ± 80 bp being given for Dunford Bridge B (Radley, Tallis & Switsur 1974). Presumably, it has been envisaged that Mesolithic and Neolithic cultures coexisted or merged in the following few centuries. If this chronology is correct for the Buxton area then, in the Buxton 2 diagram, the whole of pollen zones B2(1), B2(2) and B2(3) might show evidence of Mesolithic activity with the last two levels of B2(3) overlapping with the Neolithic.

Figure 13 has been constructed using Heim's postulate that anything less of 50% TP of tree pollen indicates open conditions. The term 'open conditions' is rather vague but the diagram is useful to compare the relative amounts of tree pollen recorded at various times in the history of the site. Any plot to the left of the 50% central line is taken to mean woodland clearance.

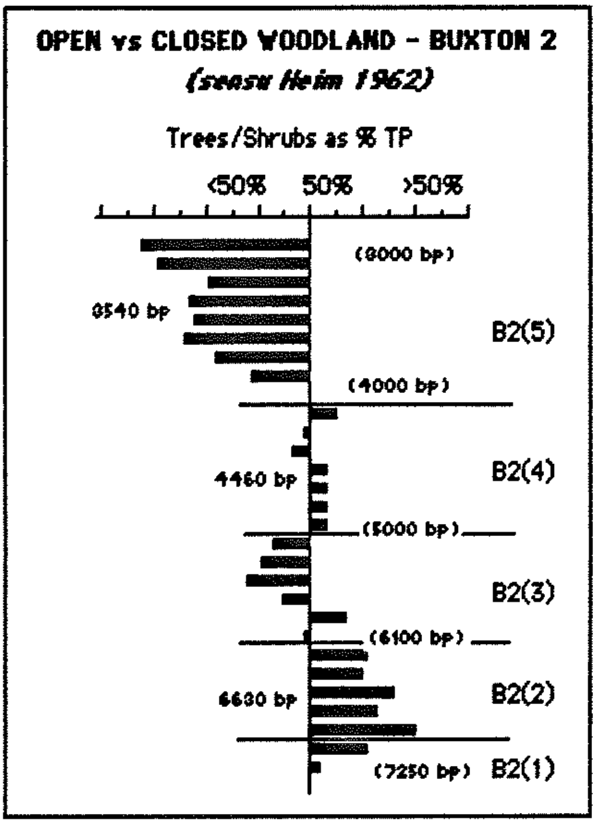


FIGURE 13

A striking feature of the base of the diagram is the relative openness of the woodland canopy. Trees then increase to a maximum at the start of B2(2) and then fluctuate and steadily decline up to about (6100 bp).

When the detailed pollen diagram and table of minor taxa (Figure 9 and Table 1) are examined, it is obvious that, although there was a well established carr vegetation, the plateau itself was probably quite open at peat initiation, with scattered oaks and hazel and a few birch. The canopy must have been open to allow *Hedera* (ivy) to flower and for (c.f.) sloe to be recorded.

The extent of the clearance cannot be ascertained because all extra-local and regional pollen would be under-represented due to the filtering effects of the carr vegetation. Nevertheless, a relatively open landscape with grassland as well has heath is suggested by the record of plantain, docks and grass.

Microscopic charcoal was abundant in the peat and it is likely that Mesolithic people were manipulating the environment with fire. The mounting evidence for such Mesolithic activity, as well as the benefits of woodland clearance in terms of an increase in the diversity of plant and animal resources, has been discussed at length in the literature already quoted, and there is little to doubt that Mesolithic folk were exploiting Lismore Fields in a way which would improve the quality of their subsistence. The clearing of the plateau would have improved browse and grazing for wild ungulates and the pollen spectra certainly suggest that open spaces were being pressurised by animals.

Another important point is that the peat deposits themselves must have started to accumulate around (7250 bp), and it is possible that this very clearance of the woodland contributed to its initiation as well as to the acceleration of soil impoverishment which allowed heathland to invade the plateau. Radley *et al* (1974) showed that increasing heather pollen at peat initiation was correlated with Mesolithic occupation and it must be remembered that the Atlantic period is thought to have been much wetter than the preceding Boreal. Evidence for this has been reviewed by Simmons *et al* (1981). It is generally considered that woodland clearance, coupled with increased precipitation, resulted in soil impoverishment and erosion over considerable areas, with peat formation and spread of heath often being a natural corollary.

The recovery of woodland at the end of B2(1) seems to have been largely due to the increase of oak and hazel at the expense of birch. It seems that in the thousand years between the latter part of B2(1) and the end of B2(2) there was regeneration of the woodland in the locality. From the start of B2(2), all trees and shrubs increased in frequency while grass, plantain and heather declined; but charcoal remained abundant in the peat, and the middle of zone B2(2) showed evidence of clearance, with bracken and docks increasing and ash making an appearance. The continued relatively high levels of hazel might support the popular hypothesis that the shrub was being encouraged by some form of management. Whether this clearance phase was due to a series of small incursions into the woodland over a long period of time, or whether an area near the pollen sites was kept cleared cannot be elucidated because of the lack of resolution in the pollen diagram. But what is fairly obvious is that Lismore fields continued to be used by Mesolithic people throughout the period, though perhaps not so intensively as earlier.

Mesolithic/Neolithic Transition

It was stated earlier that 'pure' Mesolithic cultures occupied the Pennines up until about 5300 bp, probably overlapping with Neolithic people, so they might have continued to occupy the Buxton area throughout nearly the whole of zone B2(3). Edwards (1989) has discussed the nature of the Mesolithic/Neolithic transition mainly in relation to Scotland and Ireland, reviewing examples of a considerable number of radiocarbon dated archaeological sites in the British Isles. The earliest overlapping sites are to be found in Ireland (particularly at Ballynagilly) but most overlap somewhere in the region of about 5300 bp and afterwards. Edwards discusses the kind of palynological evidence which is available for identifying early Neolithic activity and questions the standard ideas of pre-elm decline (i.e. before about 5000 bp) clearances being caused only by Late Mesolithic peoples, as well as the elm decline being equated with the commencement of Neolithic agriculture. The evidence presented by the palynological data from Buxton would certainly add weight to his scepticism.

The Neolithic Period

When considering the fate of woodland at Lismore Fields, it is difficult to separate effects on the carr vegetation from extra-local and regional components. For example, at times the fate of alder follows that of other trees while at other times, it behaves in a reciprocal fashion. This does affect the curves in Figure 13 but there is no doubt that at the start of zone B2(3), at approximately (6000 bp), the immediate area was cleared of trees and scrub. The reduction of the canopy meant that the pollen of trees outside the carr found its way into the site, but the most dramatic event was the start of a continuous record for cereal pollen. This, coupled with the marked increase in weed pollen, including plantains and heather, points to the commencement of agriculture on the plateau and thus the activity of Neolithic settlers.

This early date for the Neolithic is at variance with the findings of other research in the Pennines where, as stated earlier, there are records of only small scale clearances much later on. Indeed, Hicks (1971) considered that her elm decline dates from Totley Moss and Hipper Sick, of 3040 $\pm$ 140 BC and 2820 $\pm$ 110 BC respectively, to be evidence of early Neolithic presence and yet these dates are about a thousand years after the first evidence of Neolithic impact at Buxton. This underlines the importance of Lismore Fields in the archaeological and palynological record; it is one of the very rare instances where relatively deep, polleniferous peat and artefactual evidence for the Mesolithic and Neolithic are combined.

Figure 13 shows that at about (5800 bp) there was some recovery of the woodland, with both the local and extra-local trees increasing. However, there was no reciprocal drop in open habitat indicators and cereal pollen actually increased. This is difficult to interpret precisely but it is obvious that the plateau continued to be occupied.

Figure 13 and the pollen diagram show that at (5650 bp) there was the start of an extensive and prolonged clearance of woodland. Alder, oak, birch and hazel all declined synchronously and even pine and elm disappeared from the record, while heliophytes like ash, (c.f.) rowan and willow increased, taking advantage of the open space. The nadir of the woodland occurred at about (5500 bp) after which it gradually recovered. It is interesting that Grimston /Lyles-Hill type pottery was found at the site and this is generally dated to about 5500 bp (Garton 1987).

There is little doubt that the pollen record has revealed the activity of early Neolithic settlers. Whether they displaced or merged with the indigenous Mesolithic population can only be speculated upon but as evidence from other sites in the area suggests a continued occupation of Mesolithic peoples in the Pennines until 5300 bp, both cultures must have been living in the region at the same time.

There was a regeneration of the woodland at about (5000 bp) and this is shown quite clearly in Figure 13 at the B2(3)/B2(4) boundary. Of the recorded trees and shrubs only ash and willow declined whilst others increased, hazel having recovered at the end of B2(3). It would seem that there was a general closing of the canopy with a decline in ruderals and other weeds as well as the heathland. However, the area was subject to continuous management; although trees and shrubs fluctuated, the woodland failed to reach its former levels ever again and the pollen from weedy grassland was certainly finding its way into the carr by about (4800 bp). Furthermore, between about (5000 bp) and (4650 bp) cereals were better represented than before, and charcoal was abundant, showing that the site was still occupied. This continued occupation has been proved by the radiocarbon dating of plant materials from the excavated Neolithic buildings situated just 70 metres away from the pollen site. A series of six radiocarbon dates of charcoal, wheat and flax span the period from 5270 $\pm$ 70 bp to 4680 $\pm$ 70 bp (Jones 1990) and these dates coincide exactly with the period just described.

This irrefutable evidence of human activity and the record of cereal pollen during what seems to be a period of woodland regeneration is enigmatic. It is possible that pollen from vegetation to the south of the site, on the opposite site of the Wye, was influencing the pollen record more strongly than that in the immediate environs of the settlement. It is obvious that the pollen record is exceedingly sensitive to very local changes in woodland and that slavish interpretation of pollen data in the absence of other evidence is fraught with danger.

It is exceedingly interesting that the buildings were dated to the 'mature' Neolithic and yet the site had been occupied for more than seven hundred years before. It is, of course, possible that the actual find of Neolithic buildings represents only a small proportion of such constructions which might have been erected at various locations on the site from (6000 bp) when settlement of the area probably first occurred.

The transition between zones B2(3) and B2(4), and the first part of B2(4), probably cover the 'mature' Neolithic while the rest of B2(4) most likely relates to the period when Late Neolithic and Beaker/Early Bronze Age people shared the landscape. It would seem that after (4650 bp) there was a decline in the woodland although there was a period of recovery for the alder carr between (4300 bp) and (4100 bp). These changes in the vegetation are difficult to interpret, partly because of lack of resolution in the pollen diagram, but it does seem that impact on the local woodland from about (5000 bp) to (4000 bp) was less intense than in the previous thousand years. The presence of spherules shows that there was standing water on the site and it is possible that very local changes in hydrology had allowed alder to encroach. Indeed, the pollen data seem to be reflecting changes that were very local indeed, and there is no doubt from the plethora of evidence presented (radiocarbon dated crop plants and charcoal, continuous record of microscopic of charcoal, relatively high levels of cereal pollen, and a continued record of pollen from weedy grassland) that the environs was continuously exploited. The recovery of the alder carr from (4300 bp) which was also accompanied by a decline in cereal pollen, might simply indicate that the centre of activity on the plateau had moved slightly away from the area of the pollen site. Certainly, cereal pollen did not disappear and from (4200 bp) to the end of the millennium, pastoral indicators such as plantain and silverweed/tormentil increased.

Bronze Age

Zone B2(5) of Buxton 2 and Zones B4(1) and B4(2) of Buxton 4 overlap and between them they represent the period from about (4000 bp) to approximately (2750 bp). There is little doubt that some dramatic event, or series of events, took place at about (4000 bp) which resulted in great changes in the surrounding vegetation. The similarities and differences between the pollen spectra for the two sites has already been discussed (see page 19) and, because of the possible difficulties with the sedimentary sequence at Buxton 4 in B4(1), it was deemed safer to interpret events from the Buxton 2 diagram. The problems are highlighted by Figure 14 which shows that although B4(1) of Buxton 4 is equivalent to B2(5) of Buxton 2, the former site shows greater fluctuation in the woodland record whereas Buxton 2 indicates massive and sustained woodland clearance. This disturbance of the woodland at about (4000 bp), happened the same time as the large influx of colluvium into Buxton 4, and probably caused such great instability in the plateau soils that they slumped downslope into the Buxton 4 site (and, as intimated earlier, into the Buxton 1 site).

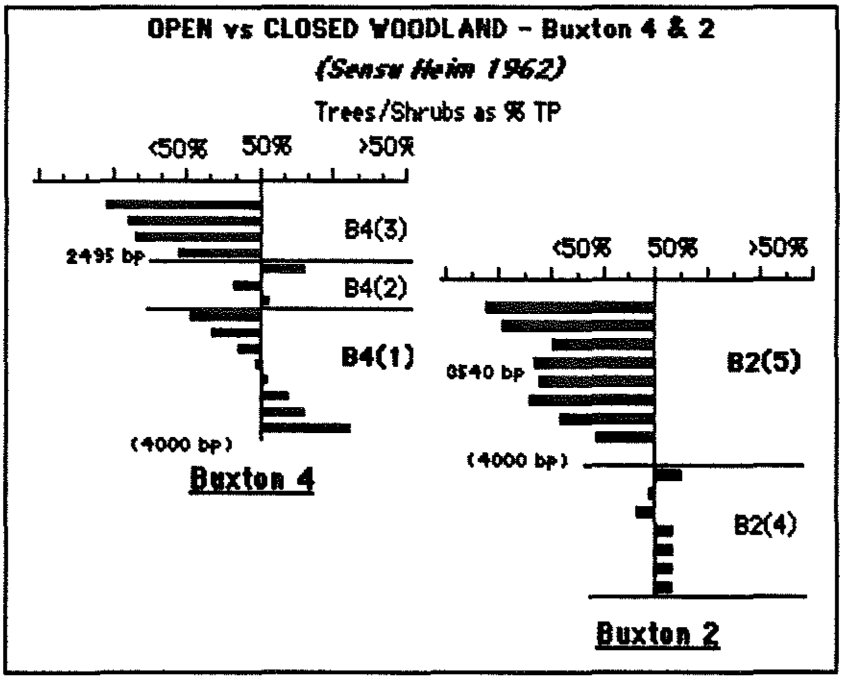


FIGURE 14

The detailed vegetation changes for B2(5) have already been described (see Page 18) and it is clear that, in spite of the lack of archaeological evidence, Early Bronze Age folk used the area very extensively. The alder carr was greatly diminished and oak trees were also affected. It would seem that the local landscope was opened up more than ever before and, as already suggested, there is evidence of a considerable degree of management, possibly with hazel and willow coppicing, cereal growing and/or processing, and a large expansion of grazed pasture and heath. These findings are in agreement with those of Shimwell (1977) who reported that the limestone plateau had been converted to large areas of pasture by the Early Bronze Age.

Tinsley (1975) reported extensive clearance in the North Yorkshire Pennines at 3880 ± 100 bp and she attributed these to the activities of Beaker folk. She envisaged these people as using the uplands for pasture, the upland woodland being easier to fell than the dense lowland forest. She also attributed the failure of the upland woodland to regenerate in terms of exposed climate. Tallis & Mcguire (1972) showed that the earliest Bronze Age clearance on the western edge of the Pennines occurred at 3540 ± 120 bp, associated with Middle Bronze Age burial mounds. Soil pollen analysis of one of the barrows showed that it was constructed in a fairly open environment and that the turves were brought from open woodland some distance away (Dimbleby 1962). Hicks (1972) reported smaller and later Bronze Age clearances from the East Moor, the clearance at Leash Fen, for example, occurring at 3450 ± 110 bp. The archaeological evidence suggested to her that the people responsible were Urn Folk. A pastoral economy was more important but cereal pollen was found at Hipper Sick suggesting some arable activity. It would seem, therefore, that the extensive clearance at Lismore Fields, presumably by Beaker/Early Bronze Age peoples at about (4000 bp), was rather early when compared with other sites to the north-west and to the east but, perhaps, contemporaneous with the limestone plateau clearances.

From about (3300 bp), even more alder was removed and pasture seems to have expanded; and there is evidence of soil impoverishment with the increase of *Sphagnum* and the appearance of lousewort - indicators of wet, acid soils or even bog. Tallis and McGuire (1972) also showed pronounced clearances in the Middle and Late Bronze Ages which resulted in the spread of heath and bog in the western Pennines. Similar occurrences are reported by Pennington (1970) from the Lake District at 3030 ±140 bp and she envisaged the demise of the local oak woodland being caused by Middle Bronze Age peoples felling the woodland to create pasture. These changes in vegetation occurred during the period of worsening climate, discussed earlier, and there is little doubt that soil fertility was reduced during these times. Indeed, as already stated, Shimwell considered these changes in soil fertility to be the motive force in the movement of Middle Bronze Age peoples from the limestone plateau to the relatively unexploited, and thus temporarily richer, gritstone areas.

The peat stratigraphy and pollen record from Lismore Fields do not give information about the climate but the reduction in woodland and the spread of grassland and heath/bog taxa from (3300 bp) are certainly in agreement with the situation found elsewhere at around this time.

Late Bronze Age

The Late Bronze Age is represented by Zone B4(2) of Buxton 4 and very great changes in the vegetation were recorded. The start of the zone was somewhere about (3000 bp) and dramatic changes in the pollen record were accompanied by changes in the peat stratigraphy. These changes have already been described (Pages 19 & 20) and since the differences in the pollen spectra between Zone B4(1) and B4(2) occurred so sharply, it is possible that there was a hiatus in the peat at the junction of the two zones. Figure 14 [zone B4(2)] summarises the fate of the woodland and also shows the suspiciously acute change at the boundary with Zone B4(1).

The lack of wood fragments in the peat (see Figure 10) has been interpreted as representing a period of greater stability in the alder carr, and with the great increase in carr vegetation, including Filicales, meadowsweet and sedges, it would seem that alder trees were able to colonise the previously open areas very quickly. The recovery of carr was soon followed by a sustained increase in oak, and hazel and grassland weeds, although still represented, were reduced. Indeed, grass pollen declined and there was no evidence whatsoever of cereals. It would seem, therefore, that the site was abandoned from about (3000 bp) to somewhere around (2700 bp). Unfortunately, lack of resolution in the pollen diagram frustrates greater precision but it is possible that the area was abandoned for the same reasons as for the limestone plateau earlier, as discussed by Shimwell. Buxton lies in a zone of heterogeneous geology and it is feasible that resources were more varied than on the limestone plateau so that occupation could continue longer.

Iron Age/Romano-British

The Iron Age/Romano-British periods are represented by zone B4(3) in Buxton 4 and zone B1(2) of Buxton 1. The very sharp changes in pollen spectra of Buxton 4 give cause for some concern and, just as there might have been an hiatus between zones B4(1) and B4(2), so there might have been one between B4(2) and B4(3). The evidence is not conclusive but the marked changes between two levels might indicate either marked compaction, or removal of peat.

It is interesting that the boundary between B4(2) and B4(3) was dated to about (2600 bp), the date at which there appears to have been a marked deterioration in climate in the Southern Pennines (Tallis 1964, Hicks 1972). Although, there was no recurrence surface in the Lismore Fields stratigraphy, it is possible that increased wetness and run-off was responsible for the removal of some peat in the Buxton 4 profile at about this time, and this would account for the very marked changed in the pollen spectra over such a small depth of peat. There was certainly an increase in *Sphagnum*, and lousewort was recorded, both indicating wet conditions in surface soils.

At about (2600 bp), the carr vegetation was reduced to the lowest level in its history and oak and birch trees were also removed, followed by hazel. The abundance of microscopic charcoal, and very great increase in weedy grassland, as well as heath and bog, show that Iron Age peoples were exploiting the area intensively and continuously, and their activity might have contributed to any possible loss of peat from Buxton 4.

The large impact on local soils and vegetation in the Iron Age is quite remarkable since so little archaeology of the period has come to light in the region. However, the various pollen diagrams from the Pennines (reviewed by Turner 1981) all record extensive Iron Age clearance and, from East Moor, Hicks recorded a very large clearance of forest and creation of areas of pasture from 425 BC to AD 30. She attributed the lack of artefactual evidence in the uplands to the possibility of the Celtic farmers inhabiting the flanks of the hills and confining their arable activity to the lowlands, with the impact on the uplands being due to transhumance.

At the beginning of the Iron Age at Lismore Fields, the main use of the land was probably for pastoral farming since initially there were no records of cereal pollen grains; these findings agree broadly with those of Hicks although her first records of clearances related to Iron Age pastoralism were later than at Lismore Fields. Hicks recorded just the occasional cereal pollen grain during the Iron Age on East Moor and reported that arable agriculture only gained importance after the Roman invasion, the Roman occupation for the region being between AD 40 and AD 410. At Lismore Fields, however, cereals seem to have been grown somewhere in the district in some quantity from about (2300 bp) and especially around (2100 bp). Indeed, the site seems to have been exploited particularly intensively at about (2100 bp) with a marked recurrence surface occurring in the peat (see figure 10). Interference of local vegetation and soil was probably so severe that changes in hydrology probably resulted, causing enhanced peat growth and, hence, the recurrence surface. The evidence from Lismore Fields, that cereals were grown or processed very near to the site from about (2300 bp), suggests sustained settlement of the area by Celtic farmers rather than just the seasonal exploitation of transhumance, and this makes the dearth of archaeological finds even more perplexing.

As already stated, the Roman occupation of the region began in AD40 (about 1900 bp), this being the interpolated date for the top-most level of B4(3). The pollen diagram (Figure 10) shows that by this time, the alder carr had been reduced to virtual extinction and the plateau seems to have presented a completely open landscape, with extensive weedy pasture and boggy heath, possibly fringed with a few trees.

The boundary between zones B1(1) and B1(2) in Buxton 1 (see Figure 11) has been dated by correlation with Buxton 4 to about (1800 bp). SLOTSEQ indicated that zone B1(1) is equivalent to both B4(2) and B4(3) but examination of Figure 7 shows that there is probably a hiatus somewhere in the middle of zone B1(1) and only the upper half of the zone is equivalent to the two zones of Buxton 4. Nevertheless, when Figure 15 is examined, it can be seen that there is good agreement between the overlap areas of the two cores.

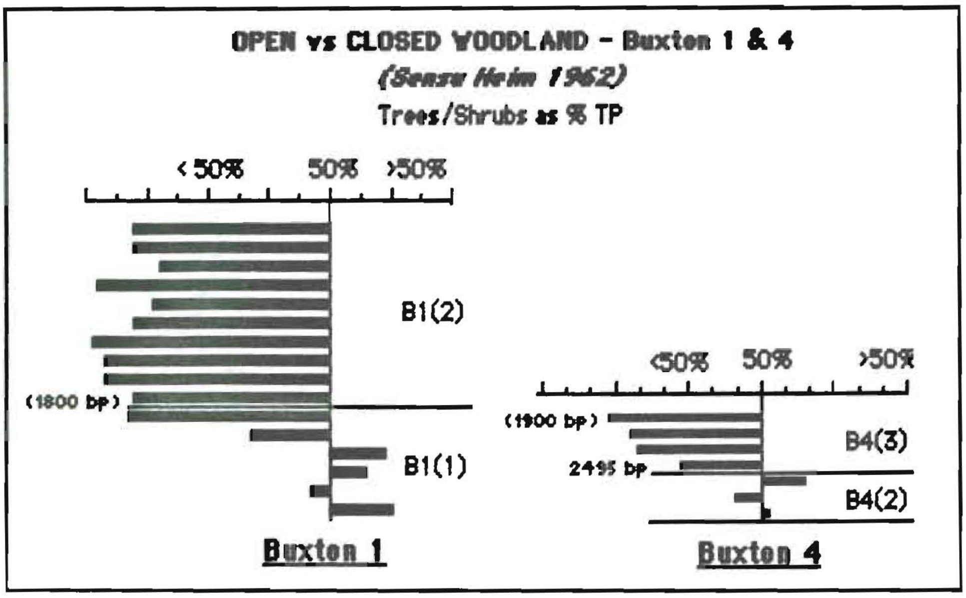


FIGURE 15

Zone B1(2) thus covers the time of Roman occupation and later. Figures 11 and 15 show that the landscape continued to be managed just as in the earlier Iron Age although there was a more intense removal of woodland - even *Hedera* (ivy) and *Sambucus* (elder) were removed (see Table 3). It is possible that this represents the removal of even dead trees and scrub, but whether this means that they were used as resources, or whether they were cleared primarily to create more pasture, is a matter for conjecture.

There certainly was extensive weedy pasture with areas of boggy heath, although with heather failing to reach more than about 10% TP, it is unlikely that it was growing close to the pollen sites (Evans & Moore 1985). The persistently high levels of sedges might also indicate that the grassland had become rather wet, and this is supported by the relatively high levels of lousewort. The area seems to have been used primarily as pasture during the early years of the Roman occupation but cereals were still grown somewhere in the area.

The considerable increase in cereal pollen in the samples between 34-26 cm might reflect a later enhancement of arable farming by the Romans. Hicks (1971) stressed the need for increased cereal production during the occupation for supplying the garrison at a number of forts in the area. Cunliffe (1985) has also pointed out that increased productivity from the British landscape was essential during the Roman occupation, not only to supply military, domestic and bureaucratic establishments, but also in order to provide the percentage demanded to support the Roman economy. Hicks' pollen diagrams recorded relatively large amounts of cereal pollen, as well as occasional grains of other crops such as walnut and possibly hemp, between AD 40 and AD 420. It is possible, therefore, that the samples between 34-26 cm at Lismore Fields might represent the major part of the Roman occupation. There is certainly little evidence of the neglect of the landscape reported by Shimwell for the limestone plateau; on the contrary, there seems to have been quite intense exploitation of the environs of the site with woodland being systematically removed, considerable cereal production, and intensive grazing, as evidenced by the diversity and abundance of grassland, heathland and pastoral indicators such as plantain, tormentil, docks, daisies, and many others.

Post-Roman

At 22 cm there appears to have been a recovery of alder and hazel trees and Figures 11 and 14 give the impression of a relaxation in the management of the landscape. The changes in the vegetation were not profound but there was certainly some recovery of the woodland with the spread of ferns, probably growing in amongst the trees. The pasture also seems to have become a little drier with lousewort being reduced, although *Sphagnum* was consistently represented. Heather seems to have spread and this may be a result of neglect of the pastures.

It is impossible to assign a date to these events but it is tempting to suggest that they mark the withdrawal of the Roman garrisons and colonists and the dawn of the Dark Ages. The slight recovery of woodland in the fourth century is well documented in pollen diagrams from all over Britain, and it has been assumed that tribal warfare and Saxon invasion with ensuing neglect of the land was the cause. The evidence from Lismore Fields is tentative but, nevertheless, as convincing as that from other upland sites (e.g. Moore 1969).

It is impossible to determine a chronology for the events in the pollen diagram (Figure 11) after the tentatively assigned Dark Ages, but it is probable that the record extends into Medieval times. It is obvious that Lismore Fields continued to be exploited, presumably mainly for pasture, to the end of its recorded vegetation history. Indeed, although the plateau is now covered by modern houses and gardens, to this day, grazing horses in the open area of the playing field continue the tradition of its management.

CONCLUSION AND SUMMARY

Deep peat deposits situated within metres of prehistoric settlement sites are very rare, and the sequences at Lismore Fields may be considered to be of national importance. The peat formed on a small terrace of the southern branch of the River Wye and the site was dominated by alder carr for much of its history. The topography of the site and the dominance of alder carr meant that the vegetation record throughout most of the peat profile was essentially a very local one and no regional picture of vegetation change could be inferred although, of course, the pollen spectra would reflect more regional changes as the local woodland canopy was opened up.

Radiocarbon dating has shown that the peat started forming at about (7250 bp), and the analysis of three adjacent profiles (Buxton 1, 2 and 4) revealed details of the vegetation history of the site from Mesolithic to possibly Medieval times. Analysis of a buried soil from the archaeological site a revealed a succession from acid grassland and hazel scrub to boggy heathland and open pasture, but as no chronology was available for the profile, and as its pollen spectra differed so radically from those of the peat cores, it could not be correlated accurately with the peat sequences.

The various analyses carried out on the three peat profiles demonstrated that the depositional sequence was complex, with colluviation affecting both the Buxton 1 and Buxton 4 peat profiles, obtained from sites just 1.3 metres apart. Buxton 2 was about 3.5 metres from Buxton 1 and about 5 metres from Buxton 4; it did not seem to have been affected by colluviation and gave a continuous record up to about (3000 bp). The cores overlapped temporally so that a complete record was obtained by interpolating radiocarbon dates between Buxton 2 and 4, and by a core correlation computer technique (SLOTSEQ) between Buxton 1 and 4. Detrended Correspondence Analysis was also used to show the relationship between Buxton 1 and 2, and the buried soil. This technique showed that there was probably at least one hiatus in the peat of Buxton 1 and led to the decision to obtain peat from Buxton 4.

The finding of abundant microscopic charcoal in every sample of the peat and soil indicated that there had been more-or-less continuous occupation of the environs Lismore Fields since at least the inception of peat accumulation in about (7250 bp), and this was confirmed by the pollen record. The proximity of abundant water and the heterogeneous geology, and thus soils, around Buxton means that resources would have been varied for settlers, with wild animals being attracted to the river and the variety of substrates supporting different assemblages of plant communities. The site would have been a favoured one for settlement by prehistoric peoples.

The base of the peat profile showed that towards the end of the eighth millennium before present, Mesolithic peoples were managing the area, presumably by fire; the woodland canopy was fairly open and grassland and heath were well established. The site continued to be used throughout the

Mesolithic at varying degrees of intensity and these findings support the archaeological evidence for Mesolithic settlement of the plateau.

At about (6000 bp), Neolithic farmers started to have an impact on the vegetation of the area and there was an intensive, prolonged and unselective clearance of the local woodland. Both pastoral and arable agriculture was practised and cereal pollen was continuously recorded. However, evidence presented by Jones (1990) suggests that predominately emmer wheat was being brought onto the site for processing rather than being grown *in situ*. Indeed, Jones reported that Lismore Fields provided the only concrete evidence available for waste from cereal processing in the Neolithic. Unfortunately, the pollen evidence can throw no light on the proximity of cereal fields, since the cereal pollen in the peat could easily have been derived from residual pollen on wheat ears being thrown into the pollen rain through winnowing and threshing.

The woodland reached its lowest level at about (5500 bp) and pottery from the period was also found. After that date the canopy around the pollen site started to close although it never regained its former cover, and cereal pollen was more abundant than ever during this period of apparent woodland regeneration. Indeed, radiocarbon dating of charcoal, wheat and flax from the Neolithic buildings excavated just 70 metres from the pollen site, revealed that domestic dwellings were occupied very close indeed to the pollen site during this episode. It is possible that pollen of trees and other woodland species were actually being derived from the area on the other side of the River Wye and that the plateau remained patent throughout the period.

Between about (5000 bp) and (4000 bp), the site was continuously exploited and woodland never regained its pre-Neolithic status. However, impact on the surrounding woodland was less intensive than it had been in the previous millennium and it is possible that the site became rather wet between about (4300 bp) and (4100 bp) with the centre of human activity moving slightly further away from the southern arm of the river.

At about (4000 bp), a large disturbance of the woodland by Early Bronze Age folk seems to have been accompanied by the creation of unstable soils which slumped down onto the river terrace. Lismore Fields were opened up more than they had ever been before, with the creation of large areas of pasture and heath. This situation also prevailed on the limestone plateau to the east and south of Buxton but clearance of areas to the north and north-east of Buxton came later and were possibly less extensive. It has been suggested that worsening climate and resulting soil impoverishment of the limestone plateau forced Middle Bronze Age people to migrate to the relatively untouched, and thus more fertile, gritstone areas so that later impact on the woodland in these areas it to be expected. Middle Bronze Age peoples continued to exploit Lismore Fields even though there was some evidence of accelerating soil impoverishment during the period , but the site does seem to have been abandoned during the Late Bronze Age. Abandonment could not have been complete, however, since charcoal was consistently found in the peat covering this period.

In spite of the lack of artefacts, as elsewhere in the region, it was obvious that Iron Age pastoralists had a dramatic effect on the local vegetation. They seemed to have arrived at Lismore Fields at about (2600 bp), much earlier than on East Moor, and appear to have settled permanently. From about (2300 bp) they grew some cereals and at (2100 bp), cereal growing seems to have become increasingly important. Their exploitation of the area was so intense during this period that local hydrology and peat accumulation were markedly affected.

By the time of the Roman invasion the landscape around Buxton was largely deforested and Lismore Fields seems to have supported wet pasture. However, during the Roman occupation, woodland resources were exploited almost to extinction unlike on the limestone plateau which seems to have been largely neglected. Cereals were grown more intensively than in the previous hundred years or so, presumably to satisfy the needs of increased population, both military and domestic, and the demands of Rome.

There is tentative evidence from the pollen record that, after the Roman occupation, there was a relaxation of landscape management with some recovery of woodland and it is suggested that this represents the Dark Ages. The pollen record probably covers up to Medieval times but in the absence of radiocarbon dates, this contention is conjectural.

The pollen record indicates that Lismore Fields was occupied and exploited from the Mesolithic through to possibly Medieval times with a period of abandonment (though not total) in the Late Bronze Age. There were no archaeological remains found on the site later than Neolithic so that the continued use of site might seem surprising. It is, of course, possible, that after the Neolithic period, dwellings were constructed some distance away from the immediate area of the pollen site. The limited amount of archaeological excavation possible in the time allowed would be thus unlikely to reveal their presence even though the record of the activity of their occupants was demonstrated by pollen analysis.

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Depth (cm)	25	29	33	37	41	45	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	83	85	87	89	91	93	95
Shrubs & Climbers																														
Acer																+														
Crataegus										+									+											
Hedera					+			+		+																+				
Ilex							+																							
Prunus																+														
Ulex type										+																				
Herbs																														
Allium												+				+				+						+				
Anthemis	+		+																		+									
Artemisia											+							+												
Bidens type	1.3	+	+																											+
Caltha	+							+			+							+												
Capsella													+																	
Centaurea nigra type		+																												
Chenopod									+													+								
Epilobium				+														+								+				
Geum																											+			
Hyp perf		+																												
Lathyrus						+				+																				
Myosotis	+	+						+																						
Papaver	+																													
Rubus																	+													
Scilla type						+																				+				
Sinapis tyoe	0.6														+					0.8				+		+			+	
Stachys	2										+			+			+			+	+									
Succisa						+					+			2			+			+										
Teucrium																				+										
Trollius				+				+																						
Umbelliferae II		+		+	+	+	+	1.1	+			+					+		0.8						0.7		+			+
Valeriana										+																				
Vicia sylvatica type						1.2					+		+	+			+													+

+ = Single Grain

Values = % Total Pollen & Spores minus Alnus

BUXTON 4 - MINOR TAXA TABLE 2

The lack of wood fragments in the peat was correlated with high alder levels in the pollen diagram and might actually indicate a greater stability in the carr woodland; the high frequency of wood in zone B4(1) was correlated with a steady decline of alder and might have been the result of extensive lopping and felling of trees. Woodland a little further away from the carr followed the rise in alder, with oak and hazel gradually increasing throughout the zone.

The regeneration of local woodland is reflected in decline in ruderals, other weeds and heathland plants such as bracken, heather and *Sphagnum*. The complete absence of cereal pollen also points to the site possibly having been neglected.

Pollen Zone B4(3): This zone records yet another dramatic change in the local vegetation. At about (2600 bp) the carr woodland was reduced to very low level along with a reduction in oak woodland. Once again hazel and willow increased, presumably either because shading effects were removed, or they were being coppiced. The plateau seems to have been more open than ever and indicators of grazing such as silverweed/tormentil and plantain increased along with the spreading bog and heath, as indicated by bracken, heather, lousewort and *Sphagnum*.

There was progressive and extensive woodland clearance of the carr and surrounding region, the only trees being represented at the end of the zone being alder (single pollen grain), oak, birch and hazel - all at reduced levels. The weed flora became more diverse with Liguliflorae (e.g. dandelion) reaching high levels, and cereals being well represented. At about (2100 bp), the peat stratigraphy changed from being humified to relatively unhumified peat with abundant rootlets, and this indicates a possible rise in water table and faster peat growth at the site.

Buxton 1

Pollen Zone B1(0): This zone was shown by SLOTSEQ to be equivalent to much of zone B4(0) in Buxton 4 (see Figure 7), and the lowest two levels of zone B4(1). As already discussed, it probably reflects the colluvial event recorded in Buxton 4 and will be ignored in this description.

Pollen Zone B1(1): Figure 7 also shows that this zone is correlated with most of zone B4(1) and all of zones B4(2) and B4(3) in Buxton 4. When the pollen diagram is examined critically, there are marked similarities in the pollen spectra between zone B1(1) and those of Buxton 4. However, as mentioned previously, there appears to have been some truncation of the Buxton 1 profile in zone B1(1) so that much of the record is missing. For this reason, this zone will be largely ignored in this description.

Pollen Zone B1(2): Using the SLOTSEQ correlation of Buxton 1 and Buxton 4, and the actual and interpolated radiocarbon dates, it would appear that zone B1(2) covers the period from about (1900 bp) to possibly Medieval times although, as stated previously, the latter dating is conjectural.

Depth (cm)	2	6	10	14	18	22	26	30	34	38	42	46	50	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108	112
Shrubs & Climbers																													
Crataegus type					0.9															+		+	+				+		
Hedera											+	+		+					+										
Sambucus												+	+																
Ulex type															+														
Dwarf Shrub																													
Erica type																					+								1.1
Vaccinium type	+																												
Pteridophyta																													
Equisetum			+	0.7																									
Herbs																													
Anthemis type								+	+			+						+	0.5				+						
Artemisia										+																		+	
Aster type								0.5				+																	
Bidens type		0.7		+	+	0.7	0.5		+	+	+																		
Centaurea nigra type			+				+													+									
Chenopodiaceae										+												+				+			
Cirsium	+		0.9			+			0.6						0.6	0.4	+		0.7								+	+	
Digitalis													+																
Geum																+	+												
Hypericum perforatum type								+			+																		
Lathyrus								+							+														
Lathyrus palustris									0.6																				
Leguminosae																													+
Papaver											+																		
Plantago media/major	0.7																												
Polygonum convolvolus type		+			+																								
Sinapis type			+			+			+																				
Stachys type	+		+			+			+	0.6		+			+		0.5	+			+	+	0.4			+			
Umbelliferae	+	+					1.1	+			+	0.5	0.4								+		+					+	
Urtica type						+										+		+			+		+	+			+		
Valeriana															0.4	+													
Vicia sylvatica type								+												+									

+ = Single Grain
Values = % Total Pollen & Spores minus Alnus

BUXTON 1 - MINOR TAXA TABLE 3

The last two levels of the previous zone [B1(1)] had recorded the extensive clearance of woodland that had been shown in Buxton 4 at about (2600 bp), and the whole of zone B1(2) shows that the clearance was permanent. The carr vegetation, and woodland further away, had been largely cleared and open habitat communities dominated the locality. Grasses, sedges, and the weeds of open pasture grassland and disturbed ground were very well represented. Areas of wet heath were well established throughout the period, as evidenced by the prevalence of heather, *Sphagnum*, lousewort and bracken, and cereals were present throughout the zone, although less frequently later in the diagram.

Although not differentiated by zoning, there do appear to be changes in the pollen spectra from 22cm to the top of the diagram. It can be seen that there was a slight regeneration of the woodland with alder, birch, hazel increasing. The upper part of the zone also shows elm, beech, *Acer* (maple) and c.f. rowan (see Table 3) being represented. Grasses increased as well as heather while ruderals and weeds continued to be well represented. These events would indicate some neglect of the area so that woodland and heathy wasteland encroached into the locality.

Zone B1(2) indicates a very open terrain with few trees in the region and extensive areas of poor grassland and heath.

Buxton 3

This diagram was not zoned since the soil profile was shallow and only twelve samples were analysed. The problems associated with pollen analysis of buried soils are well known, not least, the difficulty of differential preservation and the movement of palynomorphs throughout soil profiles. The literature on the problems is large but salient points have been summarised by Dimbleby (Dimbleby 1985).

In view of the relatively small number of pollen taxa found in Buxton 3, it is likely that differential preservation had influenced the spectra but, nevertheless, it is possible to see patterns of change within the soil profile which appear to be valid. DECORANA analysis suggested that the soil pollen record was of a later period than the peat cores (Figure 8). However, it must be remembered that DECORANA reveals only ecological dissimilarity and cannot resolve temporal differences.

The soil profile shows that trees were at a low level throughout its history but that hazel was an important component of the plateau vegetation. At its maximum, hazel reached 40% TP whereas it never exceeded 15% TP in any of the peat cores. Grass levels were slightly lower than in the peat deposits but heather was exceedingly high, increasing throughout the profile.

At the base of the profile the plateau was dominated by areas of acid grassland and hazel scrub, with *Succisa* (devil's bit scabious) indicating flushed areas. However, heathland became increasingly important, and boggy heath gradually became co-dominant with the grassland. The top half of the profile was dominated by Ericales (heathers and e.g. bilberry), *Sphagnum* and other heathland plants such as lousewort and tormentil. It indicates a more 'managed' environment with a more diverse flora (see Table 4), including plantain, thistle, *Ranunculus* type (e.g. buttercup), *Papaver* (poppy), *Trifolium* type (e.g. clover) and *Anthemis* type (e.g. yarrow). It appears that hazel scrub was cleared away, allowing open pasture and heath to spread.

Cereals were found throughout the profile but only at very low levels, similar to those found throughout the peat profiles.

The pattern of change seen in the soil profile suggests that the soil had not been ploughed or disturbed excessively since if considerable mixing had occurred, each pollen taxon would be expected to have a relatively homogeneous distribution throughout the profile and changes would not be observed.

The very high levels of hazel and heather also suggest that the soil post-dated even the uppermost level of Buxton 1. On the other hand, it is tempting to suppose that the soil profile was contemporaneous with zone B1(2) of Buxton 1 and that hazel and heather were simply growing away from the edge of the plateau so that they were relatively poorly represented in the peat. It must be borne in mind, however, that this suggestion is purely conjectural in the absence of radiocarbon dates.

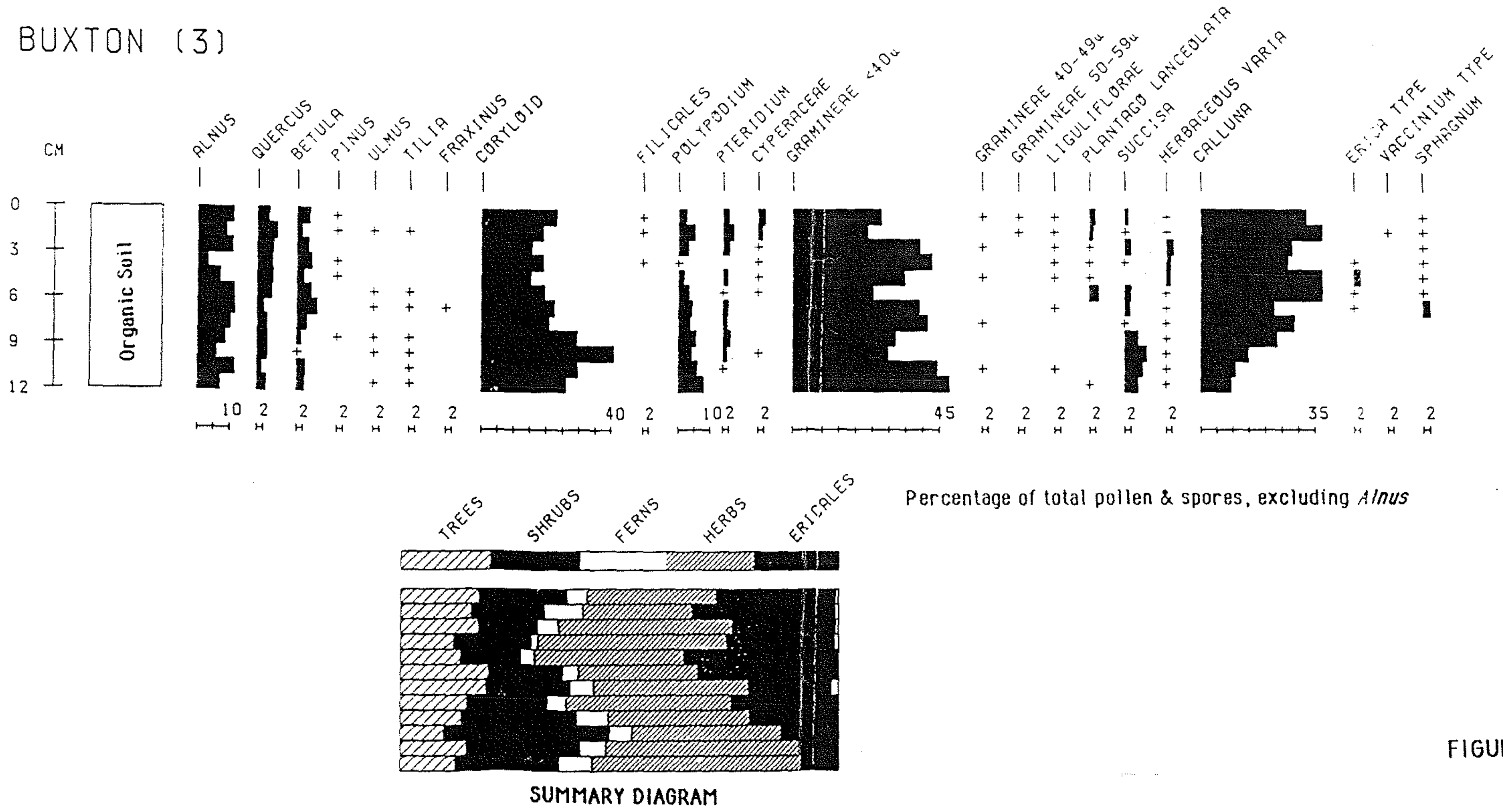
BUXTON (3)
CM
Organic Soil
ALNUS
QUERCUS
BETULA
PINUS
ULMUS
TILIA
FRAXINUS
CORYLOID
FILICALES
POLYPODIUM
PTERIDIUM
CYPERACEAE
GRAMINEAE <40u
GRAMINEAE 40-49u
GRAMINEAE 50-59u
LIGULIFLORAE
PLANTAGO LANCEOLATA
SUCCISA
HERBACEOUS VARIA
CALLUNA
ERICA TYPE
VACCINIUM TYPE
SPHAGNUM
Percentage of total pollen & spores, excluding *Alnus*
TREES
SHRUBS
FERNS
HERBS
ERICALES
SUMMARY DIAGRAM

FIGURE 12