Thorpe Bulmer

[NZ 453 354]

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Introduction

Thorpe Bulmer is a steep-sided depression, probably a kettlehole, in the east Durham coastal till plain. The site is important for preserving full Late Devensian and high-resolution late Holocene sedimentary records. Detailed macrofossil and palynological investigations of the deposits were published by Bartley *et al.* (1976) as part of a wider study of the vegetation history of south-east Durham. They also radiocarbon dated key late Holocene horizons from the upper part of the sequence. The solid and drift geological context of the area has been discussed by several authors (Smith and Francis, 1967; Catt, 1991a; Lunn, 1995; Smith, 1995; Teasdale and Hughes, 1999). Thomas (1999) has classified the Quaternary deposits of the area and assigned the Thorpe Bulmer sediments to the Bamburgh Formation. Stevens and Atkinson (1970) have described the area's soils and Beaumont (1970) and Evans (1999) have considered the geomorphology. The pollen record from Thorpe Bulmer has been discussed by various authors in reviews of the vegetational history of the wider north-east England region (Turner, 1979; Donaldson and Rackham, 1984; Innes, 1999). The site is also known as 'Hart Bog SSSI'.

Description

This site lies on the south-eastern fringe of the East Durham Magnesian Limestone plateau (Smith and Francis, 1967; Lunn, 1995) at about 80 m OD, 1 km to the south-west of Thorpe Bulmer farm and several hundred metres to the south of a deeply incised wooded valley, Thorpe Bulmer Dene. It comprises a steep-sided basin in the undulating coastal till plain and is considered by Bartley *et al.* (1976) and other authors (Beaumont, 1970) to be a kettlehole formed by the melting of a large ice block within the morainic till, during local ice wastage upon deglaciation. The basin, up to 100 m in diameter, is surrounded by farmland, but its steep south and west sides are planted with conifer woodland. There is no apparent inflow or outflow. More than 8 m of Late Devensian and Holocene sediments have been proven in the central southern part (Bartley *et al.,* 1976). A systematic coring survey of the whole basin has not been undertaken, primarily because of the extremely wet nature of the bog surface, which makes access to parts of the site impractical. The southern part of the basin is covered by a *Sphagnum* moss peat deposit over 1 m thick, which is quaking in places and depresses markedly when walked upon, but which is mostly cohesive enough to allow coring to take place. *Calluna vulgaris* and *Empetrum nigrum* also occur, and for the latter this is one of only two places in lowland County Durham. This surface *Sphagnum* layer appears to be a peat raft overlying either a water body or an extremely dilute limnic mud layer. No sediment has been retrievable from this extremely wet layer in the bog stratigraphy. The very wet *Sphagnum* peat area has a marginal fringe *of Juncus* and *Salix,* which extends to cover much of the basin's northern part (Figure 8.50). The whole site is botanically rich and has an important invertebrate fauna. A stratigraphical section through the southern part of the basin (Figure 8.51) was published by Bartley *et al.* (1976), who recovered a sediment core almost 8 m in length from a point on their transect not far from the site margin. Here the stratigraphical hiatus caused by the probable water body was very thin and, beneath a 50 cm surface layer too wet to be retained, the following major units were recorded. Only the major macrofossil components are included in these summaries.

	Depth (m)
Surface fresh *Sphagnum* peat with remains of *Polytrichum, Aulacomnium* and other mosses and abundant seeds and fruits of aquatic plants, notably *Caltha, Potentilla palustris, Cirsium palustre, Lychnis* and *Carex* spp.	0.51–1.65
Peat composed of *Acrocladium* moss with *Equisetum* rhizomes and abundant seeds and fruits of aquatic plants, mostly those listed above	1.65–2.50

A layer of water or material too wet to be retained in the corer	2.50–2.69
Mossy detrital peat of a content similar to that between 1.65 and 2.50 m	2.69–3.00
Fine wet clay with abundant organic material, including many seeds and fruits of aquatic plants. *Potamogeton, Carex, Potentilla* and *Acrocladium* important	3.00–3.33
Moss peat dominated by *Hylocomium*, with other mosses and with much Sphagnum and *Eriophorum vaginatum* remains nearer the centre of the basin	3.33–3.47
Dark brown detritus with abundant bark, twigs and other remains of *Betula pubescens, B. pendula* and *Salix,* with rarer *Quercus* and *Populus.* Abundant remains of a wide range of aquatic plants	3.47–5.72
As above, but with an increasing clay content and remains of *Chara*	5.72–5.95
Grey clay with occasional *Chara* oospores and many plant remains. Notable are *Potamogeton, Betula nana, Hippuris, Ranunculus, Armeria, Selaginella* and *Drepanocladus aduncus*	5.95–6.81
Black, organic clay with many plant remains, notably *Betula pubescens, B. nana, Menyanthes, Carex* and *Selaginella*	6.81–7.02
Clay with *Aulacomnium palustre* moss	7.02–7.15
Black, organic clay with *Betula pubescens, B. nana* and *Carex* cf. *rostrata.* Only *B. nana* remains below 7.40 m	7.15–7.60
Calcareous grey clay with remains of *Betula nana, Eleocharis palustris, Hippuris* and*Potamogeton*	7.60–7.85
Dark brown organic material with abundant fragmented moss remains and seeds of *Potamogeton* cf. *lucens, Lychnis flos-cuculi* and *Carex* sp.	7.85–7.92
Sand	7.92 +

This almost continuous column of sediment was subjected to pollen analysis, with sampling at particularly close intervals in the Late-glacial levels. The Late-glacial pollen diagram is shown as (Figure 8.52) and the Holocene part of the pollen record is shown as (Figure 8.53). In all, 16 pollen assemblage zones or subzones were recognized, of which 11 are shown on (Figure 8.52) and six on (Figure 8.53), with zone TBVI being common to both. The characteristic pollen taxa in these 16 phases of vegetation history are summarized in (Table 8.11), with phase TBI at the base of the succession.

Three horizons in subzone TBIXa were radiocarbon dated. The start of the subzone was dated to 2064 ± 60 years BP

(SRR-404), the end to 852 ± 60 years BP (SRR-405) and the mid-sub-zone peak of *Cannabis* pollen to 1730 ± 120 years BP (GaK-3713).

Interpretation

Much of the importance of this site lies in the Late-glacial sediments, which have been subject to very high-resolution pollen analysis and so provide a very sensitive climatic and environmental signal. Their value is diminished, however, without supporting radiocarbon dating so that regional correlation with the established pattern of Late-glacial events in other pollen diagrams is uncertain. Bartley *et al.* (1976) interpret pollen zones TBII to TBIIIc to be of Late-glacial interstadial age because of greatly increased levels of *Juniperus* and then tree *Betula* pollen and because they correspond with the highly organic layers within the pre-Holocene lithology. The lowermost clay unit and pollen zone TBI therefore were deposited during the cold climatic phase pre-dating the main Late-glacial interstadial. This generally is supported by the zone TBI vegetation of pioneer, cold-tolerant, open habitat taxa, particularly Cyperaceae and Gramineae. Low frequencies of *Betula* pollen and no macrofossil remains suggest no local tree birch growth, although *B. nana* and *Salix* were likely to be present around the site. There are complicating factors in the lower part of this basal zone, including thin, highly organic lenses, a peak *of Juniperus* at the base of the pollen record and a smaller peak of the thermophilous *Corylus* in the same levels. Intrusive reworked material may be a factor and interpretation of the lowest part of the profile requires caution. Early Late-glacial *Corylus* records are not uncommon in the region (e.g. Blackburn, 1952; Bartley, 1962) and may result from long-distance transport of the grains.

(Table 8.11) Characteristic pollen taxa of the 16 pollen assemblage zones and subzones from Thorpe Bulmer (Bartley *et al.,* 1976).

Phase	**Major taxa**	**Lesser taxa**
TBIXc	Gramineae, Cyperaceae	*Plantago lanceolata,* Ericaceae
TBIXb	Gramineae, *Taraxacum, Plantago lanceolata, P. majormedia*	*Alnus,* Cyperaceae
TBIXa	*Alnus,* Gramineae, *Cannabis*	*Plantago lanceolata*
TBVIII	*Corylus*	*Quercus, Alnus*
TBVII	*Corylus*	*Betula*
TBVI	*Betula*	*Salix, Filipendula*
TBVb	*Betula, Filipendula, Salix*	*Juniperus, Empetrum*
TBVa	Gramineae, *Empetrum*	Cyperaceae, *Betula, Galium*
TBIVc	Cyperaceae, *Thalictrum*	Gramineae, *Ranunculus, Artemisia*
TBIVb	Cyperaceae, Gramineae	*Thalictrum, Artemisia,* Caryophyllaceae
TBIVa	Cyperaceae, Gramineae	*Rumex,* Caryophyllaceae
TBIIIc	*Betula, Filipendula*	Gramineae, Cyperaceae, *Empetrum*
TBIllb	Gramineae, Cyperaceae	*Betula, Juniperus, Filipendula*
TBIIIa	*Betula, Empetrum*	*Juniperus, Filipendula*
TBII	*Juniperus*	*Helianthemum,* Cyperaceae, Gramineae
TBI	Cyperaceae, Gramineae	*Betula nana, Salix, Juniperus,* Ruderals

The first phase of the main Late-glacial interstadial at Thorpe Bulmer, zone TBII, is characterized by the dominance *of Juniperus* to such a degree that juniper scrub must have been abundant locally. This very high peak of *Juniperus* pollen immediately prior to the first Late-glacial *Betula* expansion occurs at other sites in the Tees lowlands area, such as Romaldkirk (Bellamy *et al.,* 1966). A good example is Seamer Carrs (Jones, 1976a) where these pollen changes and the shift to interstadial environments took place substantially before 13 042 ± 140 years BR Elsewhere, as at Kildale Hall (Jones, 1977b) and Neasham (Blackburn, 1952), *thisfuniperus* peak is not apparent. Local factors may be decisive. At Thorpe Bulmer and other sites such as Neasham, the continued substantial presence of *Helianthemum* and other herb pollen during the *Juniperus* phase suggests that juniper cover was never so dense as to suppress growth of lower stature taxa. High *Juniperus* pollen frequencies are a feature of Late-glacial interstadial diagrams to the north of Thorpe Bulmer, although their timing varies. These occur either as percentages continually in excess of that for *Betula,* as at Cranberry Bog in the Durham lowlands (Turner and Kershaw, 1973) or as a very high peak as at Bradford Kames in the Northumberland coastal plain (Bartley, 1966). In the Thorpe Bulmer area these expansions of *Juniperus* are probably successional towards developing *Betula* woodland dominance, but elsewhere may also be linked to climatic fluctuation during the interstadial. There is good evidence for such climatic change at Thorpe Bulmer, where *Betula* pollen abundance indicates birch woodland establishment in zone TBIIIa, with increases in taxa such as *Empetrum* and *Filipendula.* In zone TBIIII, the decline in *Betula* frequencies, which occurs with increases in Gramineae, Cyperaceae and *Juniperus* and peaks for open-ground herbs including *Rumex, Ranunculus, Helianthemum* and *Plantago majormedia,* points to climatic deterioration. This change is reversed again in zone TBIIIc, with *Betula* and *Filipendula* restored to abundance. This very clear interstadial double *Betula* peak has been observed in the north and east Yorkshire area, as at Tadcaster (Bartley, 1962), Kildale Hall (Jones, 1977b), Seamer Carrs (Jones, 1976a) and The Bog, Roos (Beckett, 1981). The vegetation reversion is most likely the result of climatic oscillation. Thorpe Bulmer is unlike the other sites, however, in that the earlier *Betula* peak is much the greater of the two. Usually the earlier *Betula* peak is a weaker signal prior to the main interstadial *Betula* forest phase, as at The Bog, Roos, where it is dated to 13 045 ± 270 years BP (Beckett, 1981). Local factors _at Thorpe Bulmer may account for the lower frequencies of the later *Betula* peak, such as high Gramineae and Cyperaceae pollen influx from lake-fringing wetland vegetation. This atypical *Betula* pollen curve and the lack of radiocarbon dating control for the interstadial makes comparison with other regional vegetation histories uncertain, despite the high-resolution pollen record. Consistently lower interstadial *Betula* frequencies at sites farther north suggest that Thorpe Bulmer may have been near to the northerly limit of closed *Betula* forest during this period, which may account for site-specific features of the birch pollen curve. Thorpe Bulmer is as yet the most northerly site where the dual *Betula* peak has been observed.

The phases of the succeeding zone TBIV correlate with the Loch Lomond Stadial severe cold climate stage, with mineral sediment deposited in the basin and *Artemisia, Tbalictrum,* Gramineae and Cyperaceae dominating a sedge-tundra type vegetation. The high-resolution sampling has produced a rich arctic–alpine and bare-ground type herb record for this period, with Caryophyllaceae and *Ranunculus* abundant and *Artemisia norvegica* recognized as a separate pollen curve. High *Selaginella* values at the start of the cold phase are an interesting feature. The transition from the Stadial to the Holocene temperate phase occurs in zone TBV and is noteworthy as an excellent example of this classic plant succession from tundra to birch forest. Sedge-tundra and bare-ground taxa are diminished by a rise in Gramineae as a more stable grass sward developed, also favouring *Galium* and *Empetrum.* Establishment of a rich shrub flora followed via a tall herb association in which thermophilous *Filipendula* was abundant. *Junzperus* and *Salix* characterized the shrub vegetation in turn, with *Populus* also present and probably more important than its poorly preserved pollen suggests. Steadily rising *Betula* values indicate the immigration of tree birches to the vicinity and peak *Betula* frequencies record establishment around the site of thick *Betula* woodland, with subsidiary *Sorbus,* in zone TBVI. High values for aquatic herb pollen at Thorpe Bulmer also are typical of lake sediments during this environmental transition period.

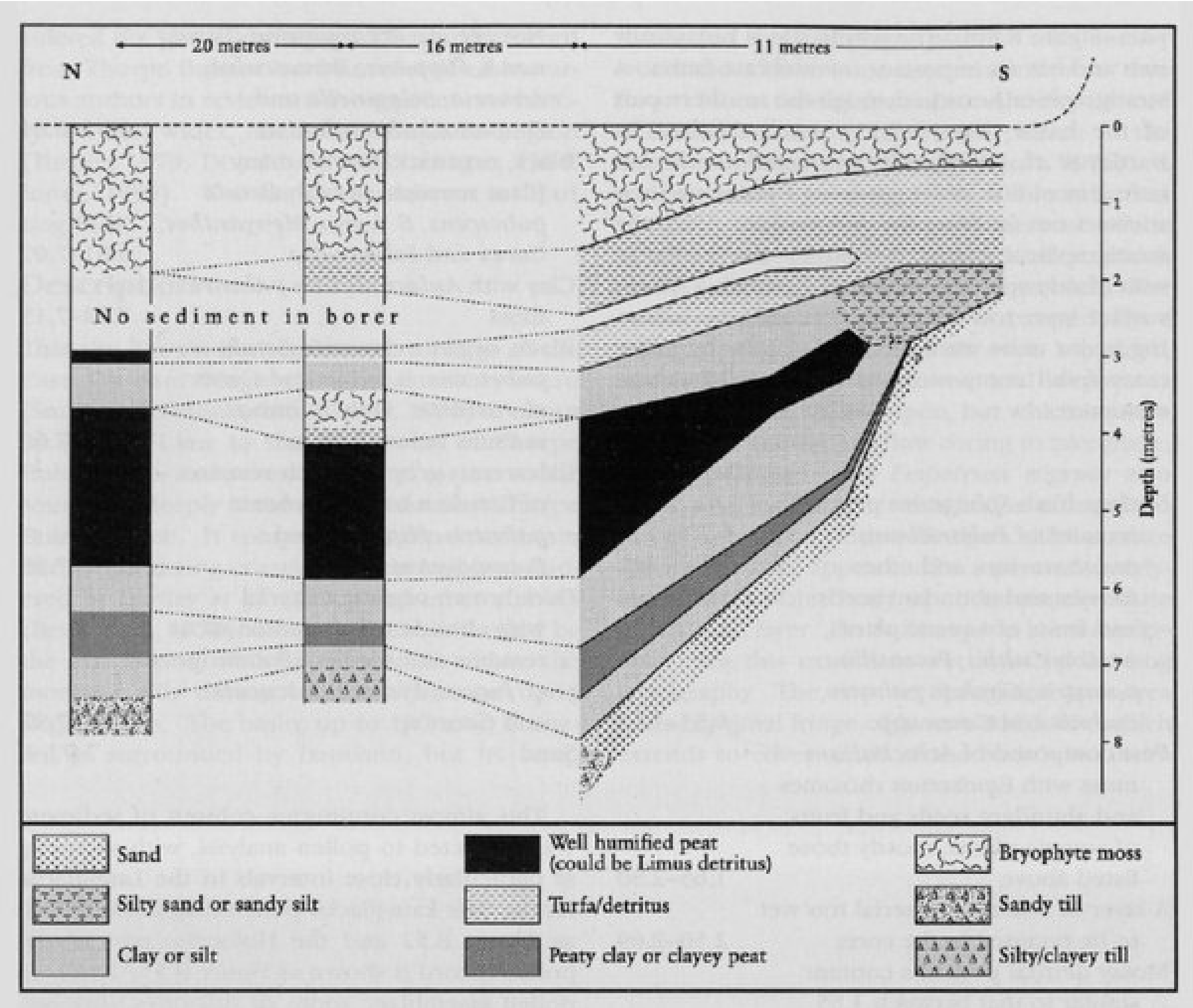
The earlier Holocene pollen record, with high *Corylus* frequencies swiftly replacing high *Betula* values at the zone TBVI to TBVII boundary, is typical of the vegetation history of this area (Bartley *et al.,* 1976) and of the wider region (Innes, 1999). Thorpe Bulmer differs from other sites in south-east Durham, however, in that the dominance of *Corylus* persists until the rise of *Alnus* pollen in the mid-Holocene, with *Pinus, Ulmus* and *Quercus* very poorly represented. These trees are much more common at other sites in the area during this period (Bartley *et al.,* 1976). At Thorpe Bulmer there seems to have been very little accumulation of sediment between the *Alnus* rise and later prehistoric times, with a complete standstill after the apparent *Ulmus* Decline at the end of zone TBVIII. The first radiocarbon dated horizon is early in zone TBIXa, with a date of 2064 ± 60 years BP The good series of three dates in zone TBIXa suggests that this date is accurate, and so Thorpe Bulmer is of almost no value for the study of environmental history between the *Alnus* rise *c.* 7000 years BP and *c.* 2000 years BP The upper 3 m of the deposit, however, contain a most important record of agriculture around the site from late pre-Roman Iron Age times onwards, with high frequencies of Gramineae, *Plantago lanceolata* and other weeds of open, cleared ground. The major peak in *Cannabis*-type pollen, dated 1730 ± 120 years BP, must relate to fields of the crop adjacent to the site in Romano-British times, and the input of clay to the lake sediment indicates the erosive effects of ploughing on the catchment soils. Other arable indicators also are abundant for a period of more than a millennium. Although the *Cannabis*-type and other arable pollen record ends by 852 ± 60 years BP, very open conditions continue to the surface and there must have been a continuous agricultural exploitation of the area around Thorpe Bulmer from pre-Roman times to the present day. This important high-resolution record of human land use would be greatly enhanced by radiocarbon dates on these later levels.

Conclusions

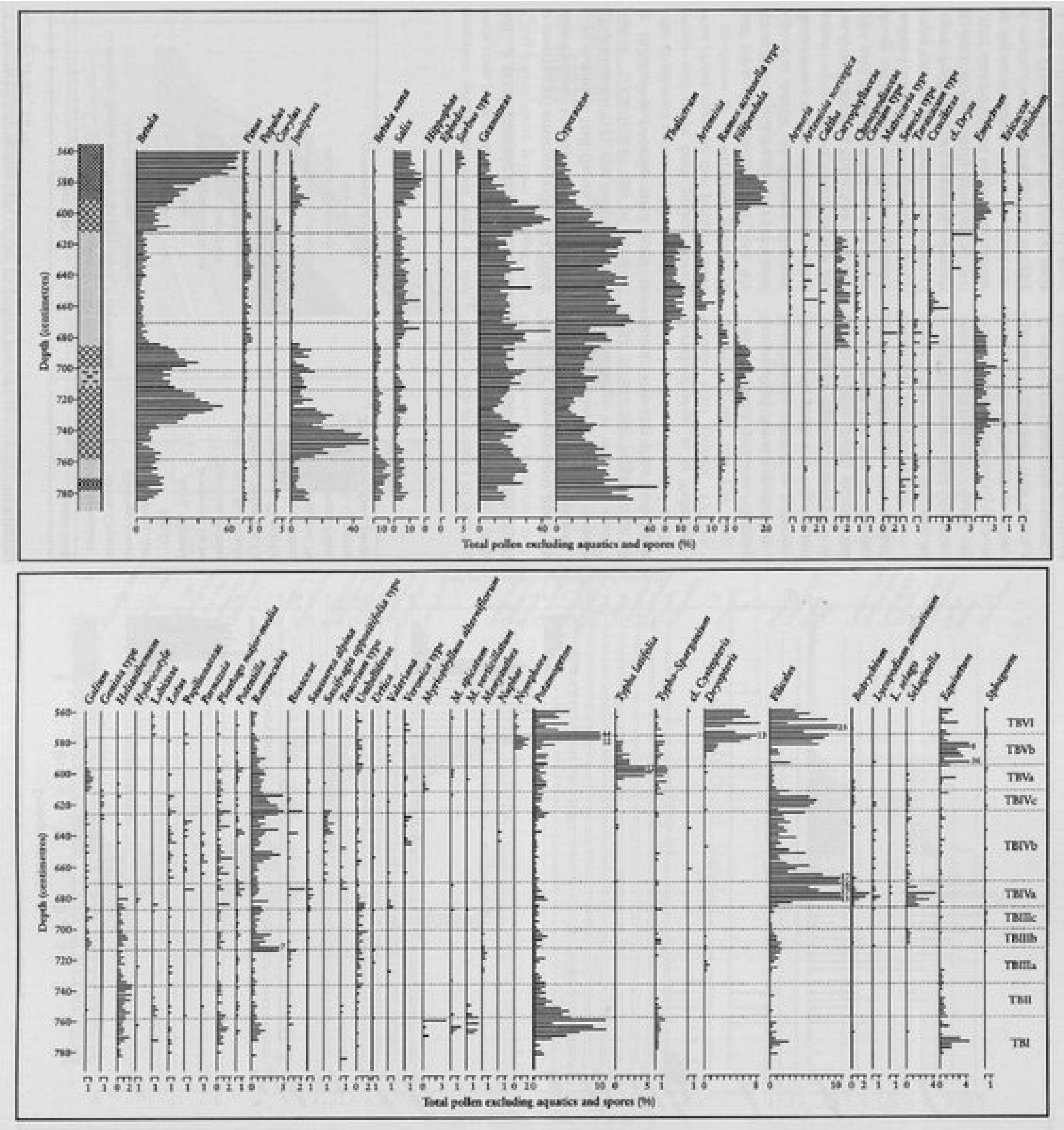
Thorpe Bulmer is a key site for the study of Late-glacial environmental change in north-east England because of its very high-resolution data covering that period. It is the northernmost site known to contain dual *Betula* peak evidence for vegetation-climatic reversion in the earlier Late-glacial interstadial and is unusual in that the first of the *Betula* peaks is significantly the larger. Radiocarbon dating control for the Late Glacial succession would greatly enhance its value. The poor mid-Holocene sediment record reduces the site's importance, but high-resolution pollen data are available for the later Holocene, where the very high percentages of *Cannabis*-type pollen are exceptional. Thorpe Bulmer is an important example of long-term forest clearance from the late Iron Age onwards, with intensive arable cultivation throughout Roman and early medieval times.

[References](#)

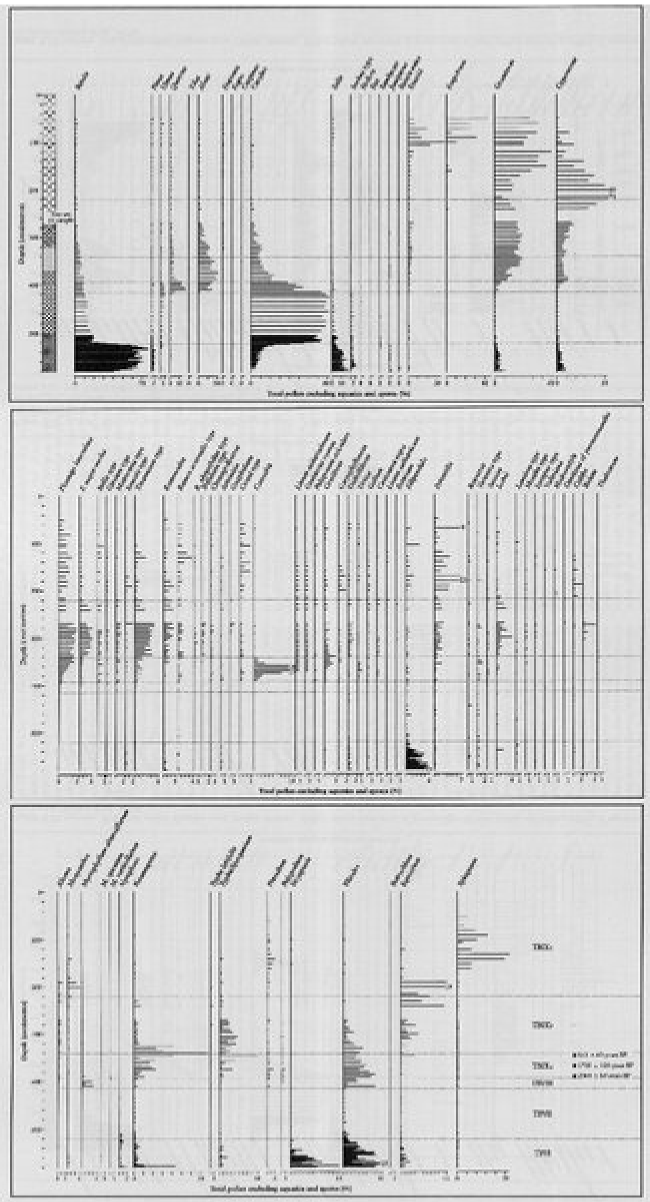
(Figure 8.50) Peat exposed at Thorpe Bulmer. (Photo: Robert van den Nordt.)



(Figure 8.51) Stratigraphical section through Thorpe Bulmer (Bartley et al., 1976).



(Figure 8.52) Late-glacial pollen diagram from Thorpe Bulmer. Pollen values expressed as percentage of total pollen excluding pollen of aquatics and spores (Bartley et al., 1976). See (Figure 8.1) for key to the stratigraphical log.



(Figure 8.53) Holocene pollen diagram from Thorpe Bulmer. Pollen values expressed as percentages of total pollen excluding pollen of aquatics and spores (Bartley et al., 1976). See (Figure 8.1) for key to the stratigraphical log.

Phase	Major taxa	Lesser taxa
TBIXc	Gramineae, Cyperaceae	*Plantago lanceolata*, Ericaceae
TBIXb	Gramineae, *Taraxacum*, *Plantago lanceolata*, *P. major-media*	*Alnus*, Cyperaceae
TBIXa	*Alnus*, Gramineae, *Cannabis*	*Plantago lanceolata*
TBVIII	*Corylus*	*Quercus*, *Alnus*
TBVII	*Corylus*	*Betula*
TBVI	*Betula*	*Salix*, *Filipendula*
TBVb	*Betula*, *Filipendula*, *Salix*	*Juniperus*, *Empetrum*
TBVa	Gramineae, *Empetrum*	Cyperaceae, *Betula*, *Galium*
TBIVc	Cyperaceae, *Thalictrum*	Gramineae, *Ranunculus*, *Artemisia*
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TBIIIa	*Betula*, *Empetrum*	*Juniperus*, *Filipendula*
TBII	*Juniperus*	*Helianthemum*, Cyperaceae, Gramineae
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