Kildale Hall

[NZ 609 097]

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Introduction

This site lies just within the Devensian ice advance limit in the Cleveland Hills, North Yorkshire. It preserves a full sequence of minerogenic and organic Late Devensian, Late-glacial and early to mid-Holocene lacustrine and peat deposits, which have been investigated by a range of litho- and biostratigraphical analyses and radiocarbon dated. Jones (1971, 1977a, b) reported the lithostratigraphical results and detailed pollen and bryophyte macrofossil analyses, and Keen *et al.* (1984) have published Mollusca and Ostracoda faunal assemblages. The Late Devensian deposits are included in the Bingley Bog formation by Thomas (1999). A dis-articulated *Bos primigenius* skeleton associated with charcoal and silt occurs in the early Flandrian sediments (Jones, 1976b). Kildale Hall has been discussed in reviews of vegetation history and early Holocene human environmental impact (Innes and Simmons, 1988; Simmons *et al.,* 1993; Innes, 1999).

Description

Kildale Hall is a small, steep-sided, sediment-filled depression, probably a kettlehole, in Devensian glacial and periglacial deposits (Hemingway, 1993). It lies at 168 m OD in the upper valley of the River Leven on Kildale Moor, an area that forms the watershed between the Leven and the River Esk, and which has a deep covering of glacial drift, including recessional moraine material (Gregory, 1962a, b, 1965). The Leven was formerly an eastward draining headwater of the Esk, but was diverted westwards into the Kildale valley by the deposition of an outwash barrier on deglaciation (Best, 1956; Gregory, 1962a, b, 1965; Jones, 1999). Dead-ice wastage was a feature of deglaciation in the western Cleveland Hills, with in-situ melting of ice blocks and kettlehole formation. The Cleveland Hills were glaciated in the Devensian but the higher main watershed and the southern valleys of the North York Moors were not (Wilson, 1948; Jones, 1999), and so the site lies close to the maximum Devensian ice margin.

The major investigation at Kildale Hall was conducted by Jones (1971, 1976b, 1977a, b), who completed two transects of cores across the wetland and found it to consist of two main topographical areas. A small steep-sided hollow over 6 m in depth occurs in the central part of the site, surrounded by a larger area of shallow sediments, which is uniformly about 1.5 m deep. The stratigraphical section across the site is reproduced as (Figure 6.29). The deep central depression contains a silty clay with subangular pebbles, which overlies the basal sands and gravels. There are almost no plant remains in this lower silty clay but it is succeeded by a thick shell marl, up to 3 m deep, which contains abundant moss remains and is very silty in places. Many moss species were recorded (Jones, 1977a) including two, *Paludella squarrosa* and *Sphagnum teres,* for which this was their earliest record in the UK (Dickson, 1973). Moss fragments from the lower boundary of this thick marl were radiocarbon dated to 16 713 ± 340 years BP (SRR-145). The marl is sealed by a second silty clay unit, which extends out of the central deep hollow and forms the basal unit above the glacial sands and gravels in the shallow wetland area of the site. It is very poor in plant macrofossils, with a few ericoid fragments and some *Carex* stems, probably intrusive from above. Across the whole site this upper silty clay is succeeded by a second shell marl, much thinner than the earlier deposit, which grades laterally into a *Carex* sedge peat and is covered by it in the centre of the basin. An almost complete skeleton of *Bos primigenius* (aurochs) was found stratified in the lower part of this sedge peat in the shallow, marginal part of the site, associated with silt and charcoal. Historically, red deer and reindeer bones had been found deep within peat deposits elsewhere in Kildale valley (Cameron, 1878) and it was the discovery of the aurochs skeleton at Kildale Hall that first prompted the investigation of the site. Peat adjacent to the bones yielded a radiocarbon date of 10 350 ± 200 years BP (Gak-2707), but the bones themselves subsequently have been dated (Burleigh *et al.,* 1983) to 8270 ± 80 years BP (BM-1725). A thin wood peat lay upon the sedge peat and was itself covered by surficial, disturbed sediment.

Pollen analyses were conducted on two cores, core A covering the deep sequence from the central hollow and core B from the shallow sequence at the location of the *Bos* bones. The pollen diagram from core A, calculated as percentages of the total pollen sum, is shown as (Figure 6.30). Five local pollen assemblage zones were identified. The earliest, zone KA-1, is dominated by herbaceous taxa, mainly Gramineae, Cyperaceae, *Artemisia, Rumex acetosa* and *Epilobium.* Zone KA-2 is characterized by increased tree pollen, reaching 25% of total pollen, with Cyperaceae most reduced and *Juniperus* rising late in the zone. The radiocarbon date of 16 713 ± 340 years BP spanned the lower boundary of this zone. In zone KA-3 tree pollen fall to less than 10% of total pollen, with Cyperaceae, *Salix* and *Artemisia* increased. In zone KA-4 tree pollen percentages, particularly *Betula,* increase sharply to 40% of total pollen. Gramineae and *Filipendula* increase, whereas *Salix, Juniperus* and Cyperaceae decline. In KA-5 tree pollen values fall sharply and Gramineae and Cyperaceae dominate the assemblage. *Filipendula* declines, whereas *Artemisia, Rumex acetosa* and Ranunculaceae pollen increase.

The pollen diagram from core B at Kildale Hall is shown as (Figure 6.31). Five local pollen assemblage zones were identified. The earliest, zone KB-1, contains low tree pollen percentages, mainly of *Betula* and *Pinus. Salix, Empetrum,* Gramineae and Cyperaceae are the most abundant taxa. Zone KB-2 in contrast is dominated by *Betula* and *Pinus* pollen, with *Ulmus* and *Quercus* recorded. *Salix* values are particularly high. In zone KB-3 *Betula* values decrease sharply and *Pinus* dominates the tree pollen assemblage. Isolated peaks of taxa such as *Salix* and Gramineae occur during the zone. In zone KB-4 *Corylus* values rise sharply and characterize the assemblage with *Pinus.* Non-tree taxa percentages decline sharply to very low values. In zone KB-5 *Alnus* pollen frequencies rise to over 50% of total tree pollen. *Corylus* falls sharply, whereas *Quercus, Ulmus* and *Tilia* gradually increase. The main elements of the litho-, pollen and macrofossil stratigraphy from the deep central hollow are tabulated in (Figure 6.32), reproduced from Keen *et al.* (1984).

Keen *et al.* (1984) re-examined the deep marl and silty clay sequence from core A and extracted Mollusca and Ostracoda assemblages from the two marl deposits, although no fauna were recovered from the two silty clay units and Ostracoda were less common in the upper marl. They identified two molluscan suites. Although Mollusca were abundant in the lower marl they represented only a few aquatic bivalve and gas tropod species, with a very few terrestrial types also recorded. *Lymnaea peregra* and *Pisidium hibernicum* dominated the assemblage. The same aquatic molluscan species occurred in the upper marl also, but were greatly outnumbered by marsh and land snail counts. Among the latter, *Limax* spp. and *Oxyloma pfeifferi* were most abundant, whereas *Pisidium* spp. were no longer present. In the top of the upper marl and in the *Carex* peat, land snails are the only taxa recorded, with *Nesovitrea hammonis* and *Punctum pygmaeum* most common. Ostracoda were present in the lower marl and the lower part of the upper marl, but did not persist in the stratigraphy as long as the molluscan fauna. Two taxa, *Candona candida* and *C. marchica,* overwhelmingly dominate the assemblage.

Interpretation

The deep Late-glacial sequence from Kildale Hall is the most important feature of the site, with a multi-proxy data set allowing detailed environmental reconstruction from the early stage of the Late Devensian. The pollen stratigraphy in core A records an initial vegetation of pioneer, open habitat communities dominated by grasses and sedges and tundra-type herbs at the time of deposition of the lower silty clay, in an unproductive lacustrine environment, under still severe cold climate conditions. The change to a shelly marl, rich in moss remains, corresponds with pollen evidence for the spread of juniper and willow shrub–heath communities and some establishment of tree birches. A rich tall herb flora developed and the pollen and moss macrofossils recovered from the shell marl indicate a now highly productive aquatic system, with rapid silting of the lake basin, fringed by eutrophic reedswamp and rich fen vegetation (Jones, 1977a). The restricted ostracod fauna from the lower part of this shelly marl, mainly *Candona candida,* also points to rapid accumulation of organic-rich, pond-floor litter (Keen *et al.,* 1984). The molluscan fauna support this and the water body at Kildale Hall in this period appears to have been poorly oxygenated and rapidly shrinking (Keen *et al.,* 1984). Both the pollen and ostracod data record a climatic reversion in phase KA-3 and the marl body contains more minerogenic sediment. Keen *et al.* (1984) interpret the rise of *Candona marchica* in this zone and the record of *Paralimnocythere* cf. *diebeli* as indicating low temperatures. The sharp fall in *Betula* pollen and other woody taxa and the rise of sedge tundra herbs agrees with this climatic interpretation. Zone KA-4 can be interpreted as a return to warm climate, stable soil, interstadial conditions with spread of *Betula* woodland and greatly reduced open ground. Zones KA2, 3 and 4 correlate with the Late-glacial

Interstadial. The double *Betula* peak of zones 2 and 4, and the short vegetation reversion of zone 3, mirror the evidence reported from sites in north-east England, such as Seamer Carrs (Jones, 1976a), Tadcaster (Bartley, 1962), Thorpe Bulmer (Bartley *et al.,* 1976) and The Bog, Roos (Beckett, 1981), which cover this period. Like these other sites, Kildale Hall preserves clear evidence of the division of the interstadial into two warm phases separated by a period of colder conditions. Zone KA-5 clearly correlates with the Loch Lomond Stadial severe cold stage, with soliflucted clay sediment in the basin and dominantly *Artemisia,* grass and sedge tundra■type vegetation. This phase and the succeeding Holocene amelioration of climate and spread of woodland are similar to the environmental history recorded at many sites in the region and are unexceptional (Innes, 1999). Erdtman (1927) reported a comparable long Holocene pollen record from a nearby site at Kildale Moss. The evidence from the few sites that combine pollen and faunal records, such as Bingley Bog (Keen *et al.,* 1988) and Skipsea Withow (Gilbertson, 1984b), is analogous to that from Kildale Hall.

The importance of the Kildale Hall early Late Devensian record is given added significance by the very early radiocarbon date of 16 713 ± 340 years BP for the onset of biogenic deposition after the withdrawal of the local ice cover. The relationship of this date to dates of little more than 18 000 years BP on moss fragments in sub-till silt (Penny *et al.,* 1969) from Dimlington in Holderness would suggest either that the maximum extension of ice cover in east Yorkshire was short lived, or that there were very local differences in the timing of ice advance and retreat in this region. The latter is most likely, as Eyles *et al.* (1994) have shown that deglaciation in the east Yorkshire area was locally complex, with ice-lobe surging and retreat, although McCabe *et al.* (1998) point out that there is evidence in the east Yorkshire lowlands for only one major ice oscillation after about 18 000 years BR McCabe *et al.* (1998) also quote ice-core and marine records showing that the last deglaciation cycle and retreat from the Devensian glacial ice maximum began about 21 000 years BP, but was a complex process interrupted by major climate shifts that caused ice readvance events. Significantly they conclude that a major deglaciation phase at the southern extremity of the British ice sheet occurred at about 17 000 years BP. This could lend credence to the Kildale Hall date of *c.* 16 700 years BP for the start of organic deposition, which otherwise seems very early, despite its location adjacent to unglaciated, nunatak terrain in the North York Moors. Other dates on basal organic material in kettleholes elsewhere in north and east Yorkshire are in the order of little more than 13 000 years BP, for example, 13 045 ± 270 years BP at The Bog, Roos in Holderness (Beckett, 1981), and 13 042 ± 140 years BP at Seamer Carrs, in the Cleveland lowlands (Jones, 1976a). At both these sites, however, there is a considerable depth of polleniferous sediment, insufficiently organic to date, beneath the dated horizon. Sediment accumulation after deglaciation clearly began significantly before 13 000 years BP at these and probably most such sites in this region (Walker *et al.,* 1993). As the original authors acknowledged (Jones, 1977a, 1999; Keen *et al.,* 1984) and other workers have commented (Tipping, 1991b), the very early date from Kildale Hall is almost certainly too old owing to 'hard water' error. The moss fragments dated at Kildale Hall may well have been of eutrophic aquatic taxa, easily influenced by the hard water factor. At other sites where highly calcareous sediments make the results of the technique unreliable, as at Bingley Bog in west Yorkshire (Keen *et al.,* 1988), radiocarbon dating has been avoided. Lowe *et al.* (1995a) have discussed the problems of dating early Late Devensian sediments and had to reject several dates on basal aquatic macrophyte material from their site at Gransmoor in east Yorkshire. The Kildale Hall date nevertheless remains valuable in providing an age estimate for the initial stages of the Late Devensian period in this region. The true date for first organic colonization of the deglaciated terrain is probably intermediate between the Kildale date and the later dates from Seamer Carrs and The Bog, Roos. Wintle and Catt (1985), however, have reported two thermo-luminescence dates averaging 17 000 years BP for a solifluction deposit underlying till in north Humberside to the west of Dimlington. This unglaciated phase is very similar in age to the Kildale Hall radiocarbon date. A further factor is that the interpretive value of all of the conventional radiocarbon dates mentioned above is greatly compromised by their very large standard deviations. Radiocarbon AMS dating of terrestrial plant macrofossils, as advocated by Lowe *et al.* (1995a), would greatly improve the diagnostic value of the early Late Devensian record from Kildale Hall.

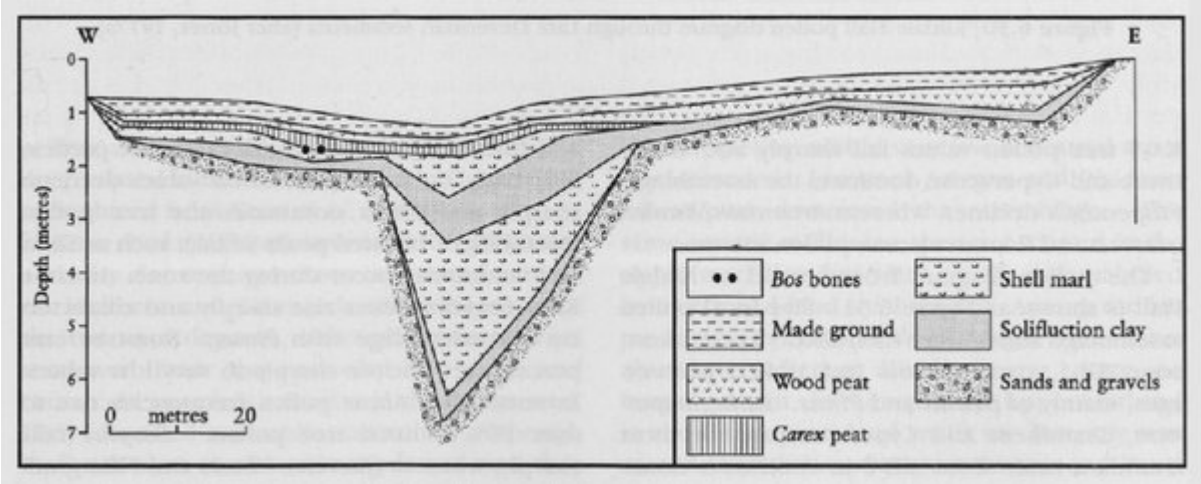
The other date of 10 350 ± 200 years BP, on manly peat adjacent to the *Bos* bones, is almost certainly also made too old by hard water influence, although not to such a great degree because the peat contains an early Holocene pollen assemblage. *Betula* and ericaceous charcoal at this level in the mire is accompanied by silt inwash and fluctuations in the pollen spectra. The evidence suggests burning of *Empetrum* heath and birch scrub around a small swamp-fringed lake, encouraging several weed taxa and causing some erosion of catchment soils. It is an early example of fire disturbance of vegetation in a region noted for such effects in the rest of the Holocene (Simmons *et al.,* 1993). Dating of the bones themselves has shown their association with the disturbance effects to be false (Burleigh *et al.,* 1983). Sinking of

skeletons and other material through soft limnic sediments to an older level is not uncommon. The same process affecting the stratigraphical position of a *Cervus elaphus* skeleton has been reported from nearby Seamer Carrs (Tooley *et al.,* 1982). Although not contemporaneous, the bones and the charcoal and pollen data at Kildale Hall both remain possible evidence of human activity around this wetland area in the early to mid-Holocene.

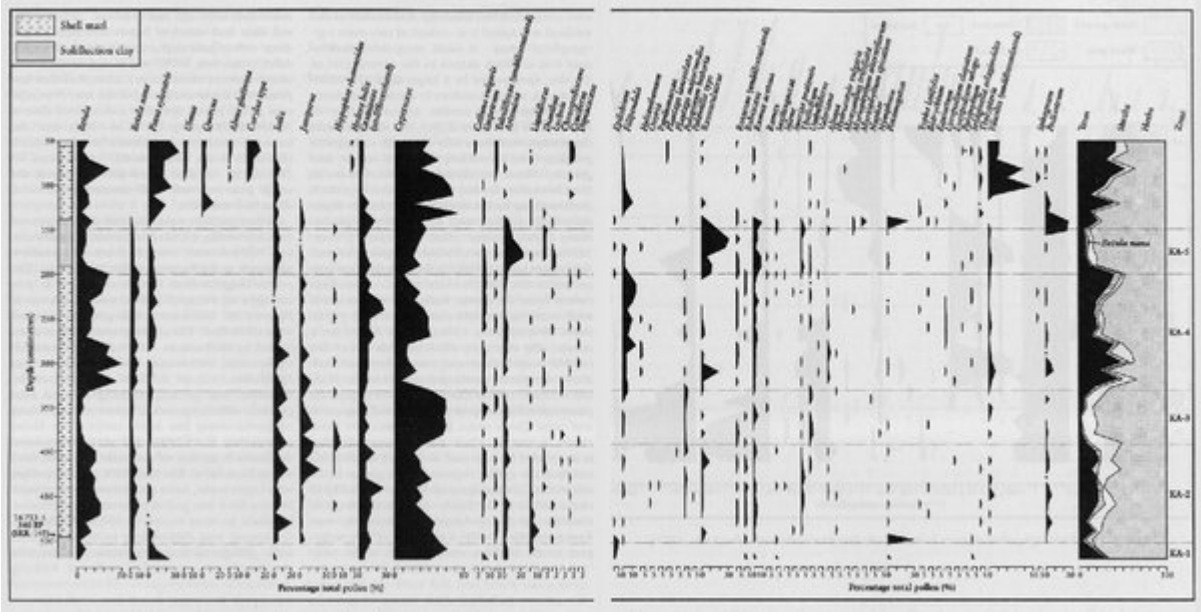
Conclusions

Kildale Hall is a key site for the application of integrated faunal and floral research to a complete Late-glacial sequence, with great potential for study of the pre-interstadial Late Devensian and for the deglaciation chronology of northeast Yorkshire. Improved dating control is required for that potential to be realized. The Holocene sediments contain important evidence for possible Mesolithic environmental influence.

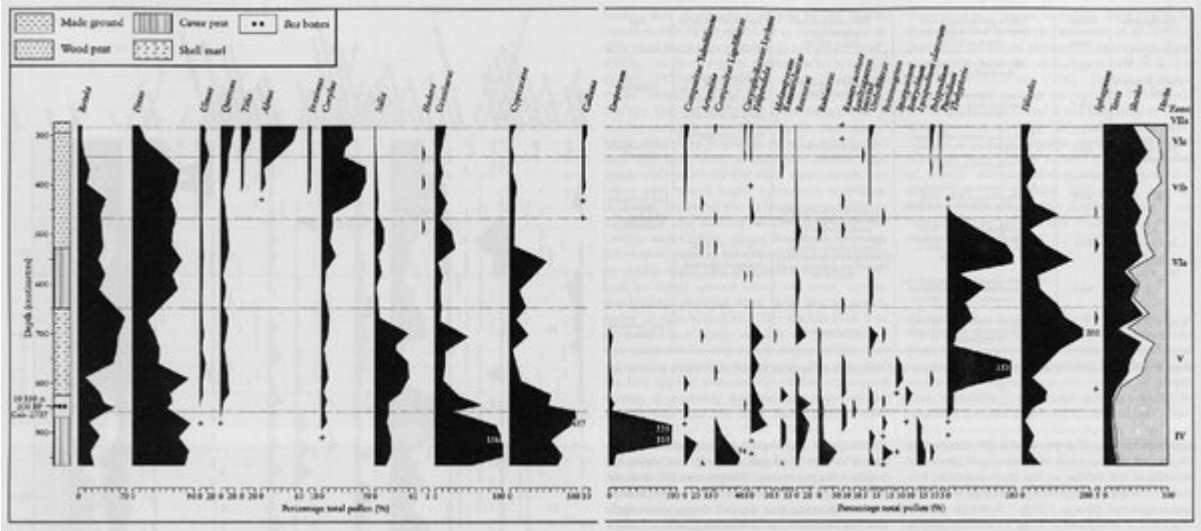
References



(Figure 6.29) Kildale Hall stratigraphy (after Jones, 1977a).



(Figure 6.30) Kildale Hall pollen diagram through Late Devensian sediments (after Jones, 1977a).



(Figure 6.31) Kildale Hall pollen diagram from the early Flandrian sediments (after Jones, 1977a).

Stratigraphy	Pollen assemblage zone	Pollen assemblages and inferred local vegetation (Jones, 1977a)	Plant macrofossil assemblages (Jones, 1977b)	Radiocarbon dates (Jones, 1977a)	Age
0.55–1.38 metres Shell marl	KB-2	*Betula–Salix–Filipendula* woodland and heath	*Sphagnum papillosum* stems and leaves	10 350 ± 200 BP (Gak-2707) (on *Carex* peat from an open section 20 metres to the west of borehole and in an equivalent stratigraphic position)	Flandrian
	KB-1	Gramineae–*Empetrum–Filipendula* grass and shrub heath with scattered trees			
1.38–1.90 metres Silty clay with sub-angular stones	KA-5	Cyperaceae–*Artemisia–Rumex* herbaceous and shrub heath communities, some tree growth in sheltered localities	*Carex* stems; ericoid fragments		Late Devensian Zone III
	KA-4	*Betula*–Cyperaceae–*Filipendula* herbaceous and shrub heath communities: open birch woodland	*Sphagnum teres, Paludella squarrosa, Camptothecium nitens, Acrocladium giganteum, A. cuspidatum, Drepanocladus aduncus, Cratoneuron communtatum, Campyllium stellatum* stems and leaves		Late Devensian Zone II (Windermere Interstadial)
1.90–4.96 metres Shell marl 3.20–3.90 metres High silt content	KA-3	Cyperaceae–*Juniperus–Salix* increase in herbaceous and shrub heath communities; decline in tree birch growth		16 713 ± 340 BP (SRR-145) (on moss fragments separated from the marl matrix)	
	KA-2	Cyperaceae–Gramineae–*Betula* better developed herbaceous and shrub heath communities; tree birches			
4.96–5.20 metres Silty clay	KA-1	Cyperaceae–Gramineae–*Artemisia* sparse herbaceous and shrub heath communities	*Carex* fragments		Late Devensian Zone I

(Figure 6.32) Summary of stratigraphy, palaeobotany and radiocarbon dates at Kildale Hall. (after Keen et al., 1984).