ART. III – *Excavation of a burnt mound at Sparrowmire Farm, Kendal*

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ARCHAEOLOGICAL investigation in the vicinity of Sparrowmire Farm was triggered by the submission of a planning application to South Lakeland District Council for a sizeable residential housing development. An archaeological evaluation of the site was conducted by the former Lancaster University Archaeological Unit (LUAU) in May 1999, on behalf of Barratt Manchester Ltd, and a burnt mound was found during the fieldwork. Thereafter, Cumbria County Archaeology Service advised that a further programme of archaeological works should be carried out, involving partial excavation of the mound, together with selective sampling and analysis of peat deposits in the vicinity. Study of the peat was to be conducted immediately adjacent to the mound but also elsewhere in the development area where the peat was considered to be deepest, with the aim of determining the nature of land-use in the area, both before and during use of the mound. The excavation and environmental sampling programme proceeded in July 1999; this article presents the results of the excavation and then considers the analysis of the peat deposits.

Archaeological Context

Burnt mounds are heaps of fire-cracked stones, often forming a horseshoe shape (Buckley, 1991, 3); hearths, and in particular rectangular pits, the latter sometimes containing evidence for a clay or timber lining, have often been found in association with the mounds. These distinctive monuments are usually considered to result from the heating of water in an earthfast tank or trough (the pit) by the introduction of hot stones baked on a nearby fire, the mound developing when stones cracked by thermal stress were cleared from the tank after each use.

The Sparrowmire burnt mound was found some 100 m east of Sparrowmire Farm, and to the west of ribbon development along Burneside Road, in an area of pasture on the northern outskirts of Kendal (at SD 5130 9415; Fig. 1). The site lies in the valley of the River Kent, but is separated from the river by a ridge of higher ground, which Burneside Road follows; the area is nevertheless relatively low-lying, standing at *c.*55 m OD. The undulating ground surface of the vicinity appears to be the product of fluvio-glacial action, being characterised by gravels deposited as glacial outwash, and intervening hollows, in which small lakes later formed. A stream course may until recently have followed a field boundary and associated line of trees aligned east-south-east/west-north-west, crossing the site some 50 m to the south of the burnt mound (Fig. 1). The solid geology below the glacial drift consists of Bannisdale Slates and Coniston Grits, though carboniferous limestone outcrops one mile further north along the Kent Valley (Moseley, 1978).

The date and nature of the first human activity in the Kent valley remains relatively obscure. There is a general lack of palaeoecological evidence for human impact on the landscape of south Cumbria in the Mesolithic and early Neolithic

FIG. 1. Location plan, showing burnt mound and evaluation trenches.

periods and, even in the late Neolithic and Bronze Age, evidence for anthropogenic alteration of vegetation is very limited, being restricted to the Lyth Valley (Hodgkinson *et al.*, 2000, 34, 40-42). This may be partly because deposits suitable for palynological study have yet to be identified and dated in the area. Archaeological evidence suggests that, in the Mesolithic period, there may have been concentrated activity in favourable parts of the South Cumbrian landscape (*op. cit.*, 34) and, by the late Neolithic and Bronze Age, the distribution of artefacts such as stone axes, arrow heads, and axe-hammers suggests widespread if low-intensity human occupation of the region (*op. cit.*, 36, 42-43). No archaeological sites had been identified within the area of the proposed housing development prior to the evaluation, but its river valley position suggested that it fell within a zone favourable to prehistoric settlement activity, and the vicinity had been classified an archaeological hazard area by the Cumbria County Archaeology Service (SMR 17696). Several prehistoric sites and find spots are known from elsewhere in the Kent Valley, including a flint axe found at Mint (SMR 4099), and a burial cairn on higher ground above the site (SMR 2070). Despite palaeoecological evidence for extensive clearance in South Cumbria in the late Iron Age (Hodgkinson *et al.*, 2000, 46), desk-based assessment revealed little further archaeological or historical evidence relating to this part of the Kent Valley, prior to nineteenth century mapping of the area.

Evaluation results

Initial inspection of the site revealed a small subcircular mound, measuring *c.*13 m x 10 m, with a distinct central depression. It was investigated by means of an evaluation trench, Trench 5, positioned so that it clipped the edge of the mound but did not intrude into the central trough (Figs. 1 and 2). An horizon of dark grey to black clay silt and charcoal, with 80% small to medium fragments of stone, some evidently fire-cracked, was found to correspond to the earthwork, and suggested that the feature might be a burnt mound. The horizon was 4.6 m long and 0.2 m deep, and overlaid a deposit of peat.

No further significant archaeological remains were identified by the evaluation. An undated lynchet, recorded in two trenches, was considered most likely to be of later medieval date, and later medieval pottery, recovered from five trenches but concentrated close to the then extant farm buildings, suggested that Sparrowmire Farm itself might also be of late medieval origin.

Excavation results

Two hand-dug trenches, A and B, were excavated across the mound, positioned in opposed quadrants, in order to give a continuous section across the monument from north to south (Figs. 2 and 3). Trench A was later extended to allow the central trough to be more completely investigated. The total area of the mound subject to hand-excavation amounted to *c.*36 m^2, forming approximately a 30% sample; in addition, a machine was used to empty the backfill from Evaluation Trench 5. It should be noted that whilst Fig. 2 provides a plan of the burnt mound, the layers

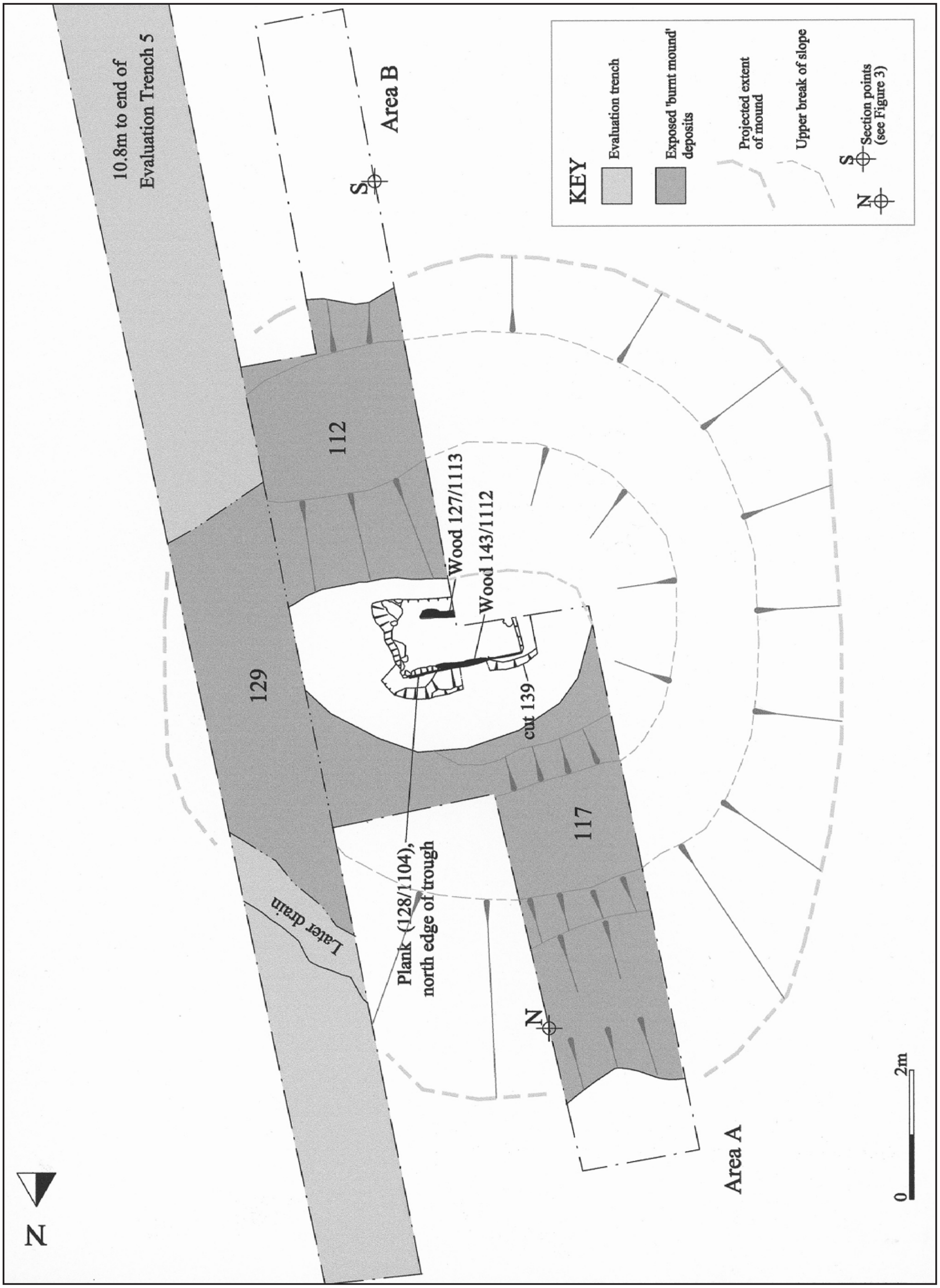

FIG. 2. Plan of burnt mound in Phase 4, with Phase 3 trough still in use.

depicted relate to the last major phase of deposition; Fig. 3 shows a section through the mound, thereby providing reference to the earlier deposits.

Bulk macrofossil samples of 30 litres volume were collected from all suitable deposits, and processed by flotation, with both flots and residues retained on a 500 μm mesh.

Deposits of natural origin

A concentration of large boulders, some of which measured at least 1 m x 0.5 m x 0.3 m, was found below the burnt mound, stratified above deposits of fluvio-glacial sand and gravel. The boulders were identified as being of fine-grained sandstone or gritstone (Ada Pringle *pers. comm.*), probably reflecting the local solid geology of Bannisdale Slates and Coniston Grits (Moseley, 1978). At one point, the boulders appeared to occupy a shallow depression in the sand and gravel, forming a loose tumble which contained many voids. There, a deposit of peat and clay silt had formed around the stones to a depth of at least 0.4 m (134; Fig. 3). To the north of this hollow, interleaving deposits of grey silty clay, reddish brown clayey silt, and brownish yellow clayey sand were considered most probably also to be of natural glacial or periglacial origin (149, Fig. 3). To the south, a thin deposit of peat (141; Fig. 3) had formed above the natural sands and gravels.

Deposition of clay and stone, and construction of a probable primary trough

Two successive deposits, comprising clean grey clay with medium subrounded stones, and grey clay with occasional small fragments of charcoal, were recorded on the northern edge of the natural depression (147 and 137, Fig. 3); together they measured *c.*2.3 m long x 1.0 m wide. They appeared to have been built up against the surface of deposit 149 to the north, but had steep, near vertical, southern and eastern edges; it is uncertain whether these remained as constructed, or whether they were the product of truncation by a later feature (139; *see below Repair of the trough and insertion of a timber lining*). It is suggested that deposits 147 and 137 represent part of a structure built to retain water, possibly created by removal of one or more large boulders from the natural depression described above. Flotation of a macrofossil sample taken from 137 produced small pieces of undifferentiated charcoal, one of which was radiocarbon-dated to 1678-1410 cal B.C. (3240±50BP, AA-34789; Table 1), an elderflower seed (*Sambucus*), a small twig, and a piece of bark.

To the north-east of this putative trough, part of a possible cobbled surface was sealed by a more extensive layer of slightly organic reddish brown clay silt (146, not illustrated). The layer was very mixed towards the top, and contained lenses and other concentrations of charcoal; a macrofossil sample produced charcoal from oak and diffuse porous (alder, birch and hazel) taxa, a *Rubus* sp. thorn, radiocarbon-dated to 1522-1317 cal B.C. (3165±50BP, AA-34790; Table 1), and an undifferentiated cereal seed. The layer had no stratigraphic relationship with the putative clay and stone trough, but predated the cut of a secondary trough (139; *see below Repair of the trough and insertion of a timber lining*). It may predate the burnt mound, or be the product of accumulation by dumping and trampling when use of

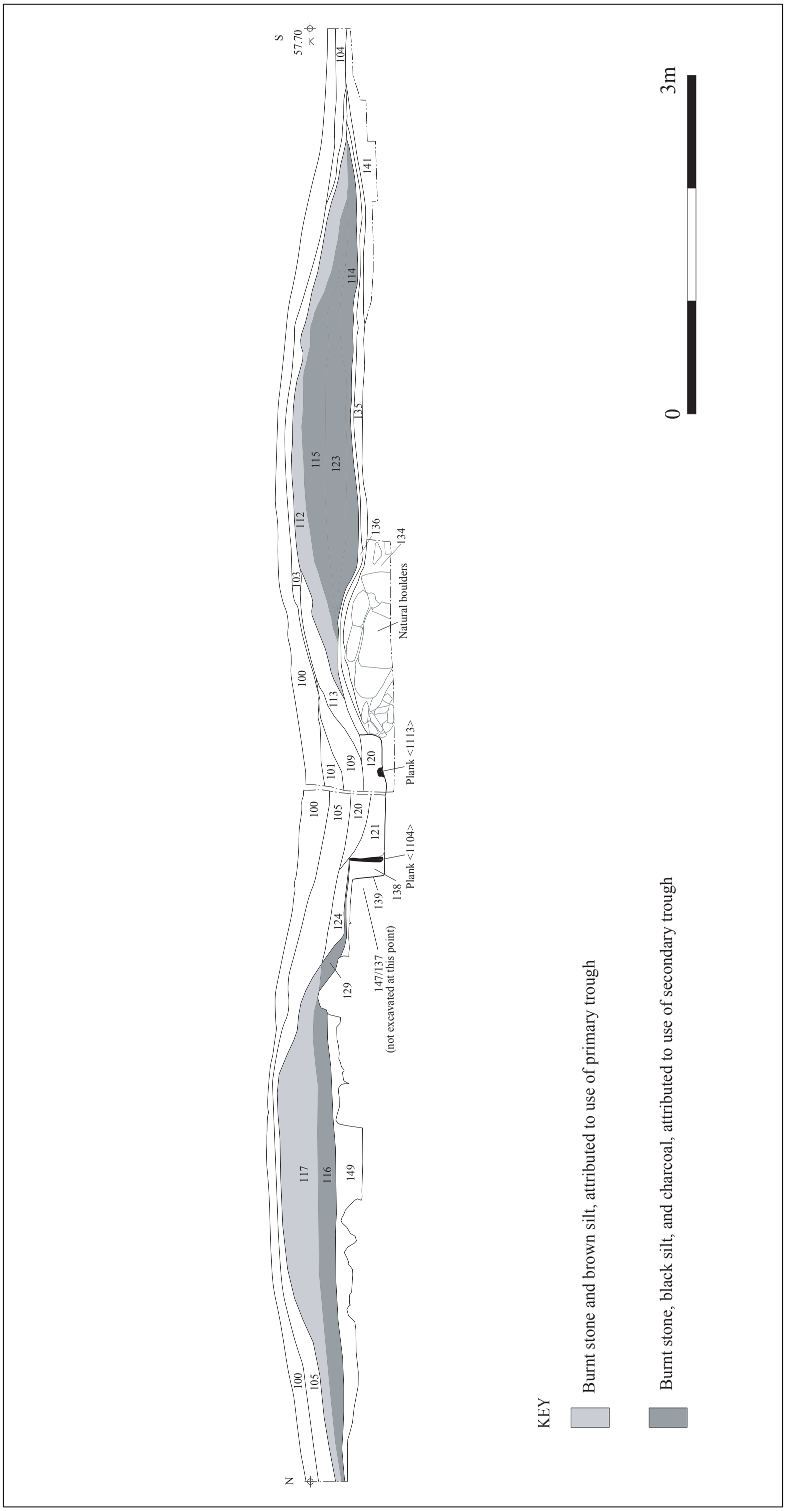

FIG. 3. Composite section through the burnt mound, from north to south.

TABLE 1: Radiocarbon dates from Sparrowmire Farm.

Context no/depth in metres	Material dated	Laboratory code	Radiocarbon age (BP)	Calibrated age range (2σ)
121/1100	Immature alder catkin	AA-34791(GU-8447)	3020±50	1408-1126 cal BC
128/1104	Oak wood	GU-8433	3330±50	1740-1505 cal BC
137/1117	Undiff carbonised wood	AA-34789(GU-8449)	3240±50	1678-1410 cal BC
143/1112	Oak wood	GU-8432	3810±60	2463-2039 cal BC
146/1118	*Rubus* thorn	AA-34790(GU-8448)	3165±50	1522-1317 cal BC
Depth 0.315-0.325	Peat	AA-34508(GU-8434)	5645±60	4667-4350 cal BC
Depth 0.395-0.405	Peat	AA-34792(GU-8446)	6465±60	5526-5316 cal BC
Depth 1.35-1.36	Peat	AA-34507(GU-8435)	10,440±90	10,933-9979 cal BC

the first trough was beginning. The deposit was clearly sealed by the large accumulations of burnt stone which formed the northern side of the burnt mound.

A patchy and intermittent layer of firm light grey clay extended south from the putative clay and stone trough for some 6 m (135; Fig. 3). It was not flat, but arched gently over a natural tumble of stones, suggesting that it was not waterlain, but the product of dumping. The clay covered a number of large flat stones which appeared to have been laid on top of the natural tumble, and it can be suggested that both clay and flat stones had been laid to consolidate the underlying ground when use of the first trough began.

Deposition of burnt stone and charcoal

The formation of the burnt mound itself started when large quantities of fractured, burnt, fine-grained sandstone/gritstone were deposited around the central hollow. The form of the mound suggests that the stone fragments created a circular bank, measuring *c*.12.3 m from north to south, and a comparable distance from east to west (Plate 1 shows the uppermost levels of the mound after the removal of topsoil).

North of the hollow, the bank consisted of fractured stones in a black charcoal and silt matrix (116; Fig. 3); this was 0.2 m thick, and its southern limit lay *c*.0.5 m north of the proposed clay and stone trough. The stone fragments were angular, mostly of less than 60 mm in length, and formed *c*.75% of the deposit. A further deposit of burnt stone and charcoal (129; Fig. 3) had formed after 116, abutting its southern and eastern edges, and extending for some 5.5 m to the eastern edge of Evaluation Trench 5 (Fig. 2). It contained a higher proportion of charcoal and burnt silt than 116, and, in the south-western corner, fewer fractured stones. A macrofossil sample demonstrated that the charcoal was derived from both oak and diffuse porous taxa. The similarity between 116 and 129, and absence of any silt lens between them, suggests that they were deposited consecutively, with little intervening interval.

To the south, the base of the bank had been formed by the dumping of a layer of yellowish grey sandy silt with *c*.30% small and medium fragments of burnt stone, and patches of yellow degraded stone (114; Fig. 3). Above were two successive deposits of firecracked stone in a blackish grey silty matrix, each a maximum of 0.19 m thick, with stone forming *c*.60% of each deposit (123 and 115; Fig. 3). The high charcoal content of 123, together with the presence of burnt clay adhering to the fragments of stone, suggested that the deposit had been subject to *in situ* burning; it may have formed the seat of a fire, although no hearth structure was found.

The fractured stone deposits clearly sealed layers 135 and 146, but had no obvious relationship to the probable clay and stone trough. However, it is argued that they were probably formed when fire-heated stones were placed in water contained within the trough, causing them to crack before being cleared out and discarded in an arc around the central structure.

Repair of the trough, and insertion of a timber lining

After the deposition of burnt stone had begun, the central trough was remodelled. A roughly rectangular pit was excavated or recut (139; Figs. 2 and 3), within which a timber lining was constructed. Crucially, the presence of a large amount of fractured stone within fill 138 (Fig. 3), deposited between the plank lining and the north side of the cut, demonstrates that hot stones had already been used to heat water, and that the wooden lining must therefore represent a secondary trough.

The new cut, 139, measured *c.*2.5 m x 1.7 m x 0.32 m deep, and was aligned east/west (Plate 2); the sides were steep, but were irregular because of the presence of large boulders, especially at the eastern end. Within the cut, the new trough was at least partially plank-lined; a near complete timber plank was found *in situ* along the northern edge, lying on its side and aligned east/west (128/1104; Figs. 2 and 3). It measured 1.99 m long x 0.27 m high, and varied in thickness from 10 mm at the top edge to 40 mm near the base. The plank did not appear to have been burnt, but had started to decay; the top and both ends were in poor condition, and the outer surfaces of both faces had also been lost, so that no evidence of tool-marks was preserved. It was of oak, but had been tangentially-faced, being derived from a position relatively close to the edge of a large tree trunk. This method of conversion meant that the timber contained insufficient rings for dendrochronological dating, but a sample did produce a radiocarbon date of 1740-1505 cal B.C. (3330±50BP, GU-8433; Table 1). The date must be interpreted with caution, as this sample was obtained from a mature oak, and the radiocarbon determination does not indicate the date at which the tree was felled.

Three other timber fragments, probably also derived from planks, were found lying in the base of the cut. One lay beneath the timber lining of the northern side, but extended partially under the backfill to the north of the trough (143/1112; Fig. 2). It measured 0.38 m x 70 mm x 20 mm thick, and was again found aligned east/west. Radiocarbon dating of a sample of the timber gave a date of 2463-2039 cal B.C. (3810±60BP, GU-8432; Table 1). The two remaining timbers shared the same alignment, but were found close to the southern edge of the trough. The larger fragment measured 0.67 m x 100 mm x 30 mm (127/1113; Figs. 2 and 3). It is possible that these two timbers had slipped into the bottom from the southern side, or that they were in fact the remnants of a plank lining to the trough's base, but the early date obtained from 143/1112 suggests the possibility that this timber, at least, may have pertained to an earlier structure. The original lining material of the remaining sides was not established beyond doubt, but traces of decayed organic matter and silt along the western and southern edges suggested that planks had

PLATE 1. The burnt mound after the stripping of topsoil and upper weathering deposits.

PLATE 2. The central part of the mound after excavation of the trough.

formerly been present here, but had decayed. The eastern edge of the trough appeared too irregular to have been lined with timber, because the jagged edges of large boulders there protruded into the cut; remnants of grey clay suggested that this eastern edge may have been lined with clay rather than planking. Although the southern, eastern, and western sides of the trough had not survived intact, it is clear that the feature must have had internal dimensions of *c*.2.0 m x 1.1 m x 0.27 m.

A single stakehole was identified in the base of the cut of the trough, close to the southern side (151; not illustrated). It was at least 0.30 m deep, with a diameter of 6 mm, and was angled downwards from north to south, with an angle of inclination of *c*.1:2 (x:y). It was sealed by the post-abandonment trough fill (121; Fig. 3), but had no clear relationship with either the planks lining the base, or with the cut. The fill contained fragments of decayed wood.

Further deposition of burnt stone

Further deposits of fractured burnt stone and silt were made on top of the existing mound (Figs. 2 and 3). On the northern side, a deposit of 40-80% stone in a brownish grey slightly clayey silt matrix was recorded (117). It measured 6.5 m long from north to south, extending to within 1 m of the trough, and continued beyond Area A to the east and west; it was a maximum of 0.38 m thick. To the south, a much thinner dump was recorded, 112, 4.9 m long but only 0.14 m thick.

Although a distinction was recorded between the lower deposits of burnt stone in a black, charcoal-rich matrix, discussed above (116, 123, and 115; *see Deposition of burnt stone and charcoal*), and the upper deposits of burnt stone in brownish grey silt described here, it cannot be demonstrated that the change in deposition occurred at the same time on both sides of the mound, or that it corresponded to the renovation of the trough. In particular, it may be possible that one or more of the charcoal-rich deposits attributed to use of the primary trough was in fact formed after the secondary timber lining had been inserted. However, the two dumps of stone in brown silt, 112 and 117, were the latest deposits on both sides of the mound, and so it can be argued that both were probably associated with the use of the latest known trough. Furthermore, the decrease in charcoal content probably reflects changes to the way the stones were heated, and perhaps the use of a more contained hearth, which has not been found. It is not impossible that renovation of the trough and provision of a new hearth occurred at the same time.

Disuse of the trough and burnt mound

The timber-lined trough was partially infilled by a deposit of loose burnt stone and clay silt, 121, which appears to have tipped into the feature from the north and west (Fig. 3). Macrofossil samples contained wood and charcoal (mainly oak but also including diffuse porous species, probably birch, alder and hazel), a carbonised stem from a catkin, an immature alder catkin, an oospore of the freshwater alga *Chara/Nitella*, fungal sclerotia, carbonised seeds of buttercups (*Ranunculus* sp.), and a possible cereal grain; the alder catkin gave a radiocarbon date of 1408-1126 cal B.C. (3020±50BP, AA-34791; Table 1).

There is no evidence that this fill was the result of a deliberate process; 121 was very similar to a deposit of loose stone lying immediately to the north, 124, which has been interpreted as slippage from the mound (Fig. 3). Subsequently, the remaining portion of the trough appears to have slowly silted up, as the underlying loose stone was covered by a fill of fine clay silt (120; Fig. 3). Further slippage, erosion, and bioturbation led to the creation of deposits 113, 105/106, 109, 101, and 100 (Fig. 3), which largely, but not completely, infilled the hollow at the centre of the mound; a shallow depression was still clearly visible there at the start of the excavation. Slippage also occurred on the mound's outer edges, but this seems to have been less pronounced owing to the gentler gradient at this part of the stone dump. Bioturbation appears to have loosened the top of the north and south banks of the mound, but little topsoil formed there, so that the burnt stone deposits probably associated with the secondary trough were found only 0.08-0.12 m below the present ground surface.

Finds

Excavation of the topsoil and late slippage deposits produced a small quantity of modern pottery and glass sherds, and occasional fragments of clay pipe. No artefacts relating to the period of use of the burnt mound were found during the excavation, with the exception of the timber planks described above, nor were any artefacts found within the primary fill of the trough.

Palynological Sampling and Analysis

Methodology

Palynological samples were obtained from the deepest peat deposits in the vicinity, located some 30 m to the south-east of the burnt mound. Monolith cores, 0.5 m in length, were taken from the cut face exposed in a machine-excavated trench, down to a maximum depth of 2.06 m. A short monolith, 0.30 m in length, was also taken from the thin band of wood peat seen to run under the south side of the burnt mound. This deposit was first exposed in Evaluation Trench 5 and was subsequently designated context 141 in the later excavation. The stratigraphy of the sediments was recorded in the laboratory and the monoliths subsampled for pollen analysis at 40 mm intervals. Nineteen samples were prepared for analysis using the standard techniques of NaOH, acetolysis, and hot HF acid treatment where necessary (Faegri *et al.*, 1989).

The results of the palynological analysis have been presented as percentage diagrams using the computer programs TILIA and TILIA-GRAPH (Grimm, 1991; Figs. 4 and 5). The percentage values are based on a pollen sum of all types excluding aquatics, ferns (Pteropsida) and indeterminate grains. All types excluded from the pollen sum are expressed as a percentage of the pollen sum; charcoal values are expressed as a percentage of the pollen sum plus charcoal counts. The pollen diagrams are divided visually into local pollen assemblage zones to aid description (Moore *et al.*, 1991, 178-181).

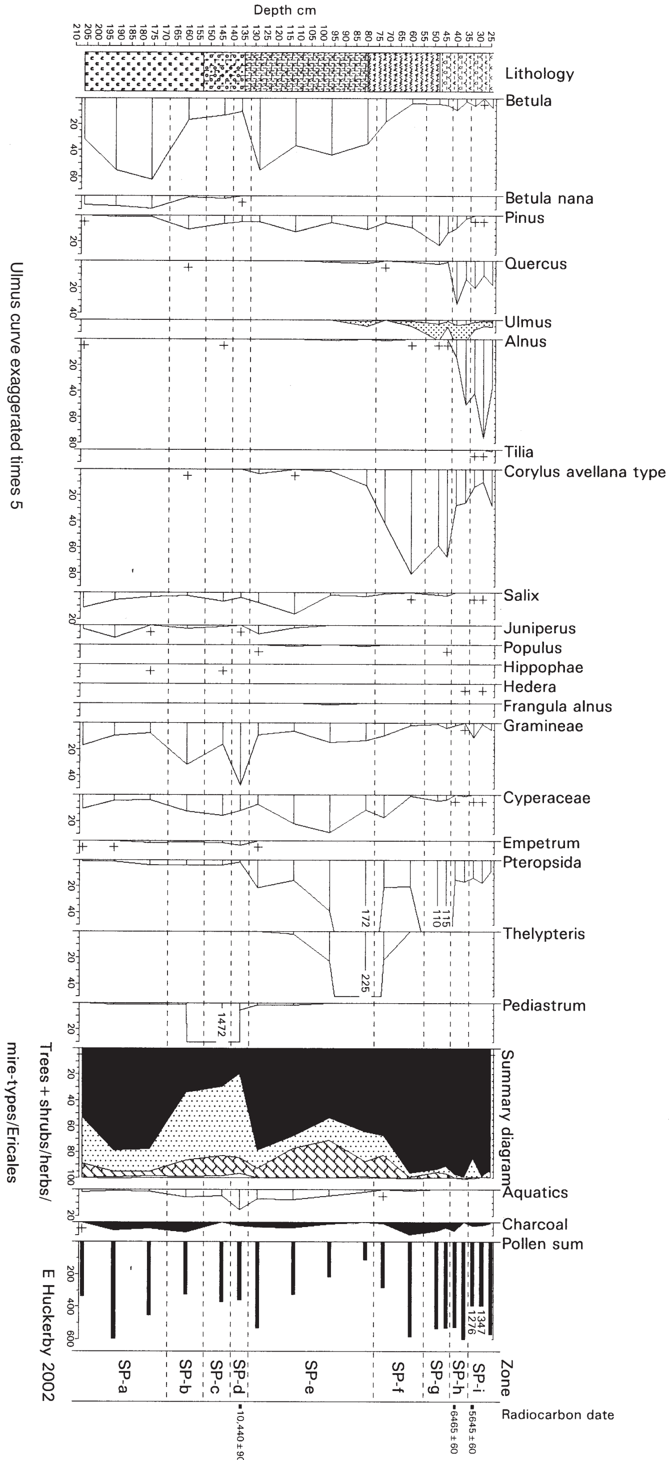

FIG. 4. Percentage pollen diagram of trees, shrubs, and selected herb taxa (values <1% of pollen sum are represented by +).

Samples taken south-east of the burnt mound

The monolith cores taken to the south-east of the burnt mound exhibited the following sediment sequence:

Depth in metres	Description (H1-H10 degree of humification, H10 = highly humified)
0-0.20	Topsoil
0.20-0.27	Highly humified amorphous peat H9
0.27-0.48	As above + wood fragments (Birch) H8
0.48-0.50	Wood + bryophyte peat H6
0.50-0.70	Wood peat H5-6
0.70-0.80	Wood + bryophyte peat H8
0.80-1.35	As above with increasing monocot. fragments including *Phragmites* H5
1.35-1.535	Silty grey clay with pebbles at 1.52-1.535 m
1.535-2.09	Shell marl with bands of bryophyte remains

Nine local pollen assemblage zones were recognised in the pollen diagrams (Figs. 4 and 5). Their characteristics and position in the pollen diagrams are as follows:

- Zone SP-a 1.68-2.06 m *Betula/Juniperus/Salix*
  This zone is characterised by pollen from birch, including the dwarf Arctic birch (*Betula nana*), juniper and willow;

- Zone SP-b 1.52-1.68 m Gramineae/Cyperaceae
  This zone is characterised by grass and sedge pollen and falling tree and shrub pollen;

- Zone SP-c 1.40-1.52 m *Artemisia/Thalictrum*/Cyperaceae
  The zone is characterised by herbaceous pollen types indicative of colder conditions;

- Zone SP-d 1.32-1.40 m Gramineae/*Betula*
  Pollen from grass expands rapidly with rising birch, juniper and willow;

- Zone SP-e 0.75-1.32 m *Betula/Salix*
  Birch pollen dominates this zone with some willow, juniper and pine;

- Zone SP-f 0.54-0.75 m *Corylus*
  This zone is dominated by hazel with some birch;

- Zone SP-g 0.42-0.54 m *Corylus/Pinus*
  Hazel and pine are the major pollen types in this zone;

- Zone SP-h 0.34-0.42 m *Alnus/Quercus/Corylus*
  This zone is characterised by the rapid rise in alder and oak pollen with some elm (*Ulmus*) and falling hazel values;

- Zone SP-i 0.24-0.34 m *Alnus/Quercus*/Gramineae
  Pollen of hazel and elm decreases and that from grasses and other herbs rises.

Interpretation

These deposits probably developed in a small lake which formed in a kettlehole. The pollen recorded in the earliest sediments analysed (2.06-1.68 m SP-a) suggests that the vegetation surrounding the site was that of an open birch, willow and juniper scrub, with a variety of herbaceous plants that are associated with open ground. This is typical of Late-Devensian II (*c.*10,000-9,000 cal B.C.), when the climate briefly became sufficiently warm to support this type of woody vegetation.

Subsequently, the pollen record indicates a change to more open grassland (SP-b 1.52-1.68 m), and then the growth of sedges and herbs such as mugwort (*Artemisia*), meadow-rue (*Thalictrum*), and members of the stitchwort family (Caryophyllaceae) (Sp-c, 1.40-1.52 m), suggesting that the climate became colder in Late-Devensian III (*c.*9,000-8,000 cal B.C.). The redevelopment of grassland (SP-d 1.42-1.32 m) marks the start of the more permanent climatic amelioration of the Holocene period. Peat from 1.35-1.36 m was dated by radiocarbon techniques to 10,933-9979 cal B.C. (10,440±90 BP, AA-34507; Table 1). This grassland was replaced in SP-e (0.76-1.32 m) by birch, juniper, and willow on the drier ground, with a fen-type vegetation of sedges and ferns in the damper areas of the basin. Above 0.76 m, large areas of the surrounding landscape were probably covered by dense hazel woodland. This was followed by a more mixed woodland vegetation with pine and elm. There was a rapid expansion of alder and oak pollen between 0.44 m and 0.40 m, which was dated at 0.395-0.405 m to 5526-5361 cal B.C. (6465±60 BP, AA-34792; Table 1). This rise in alder pollen is characteristic of the mid-Holocene period, and is used to define the boundary between Flandrian I and II (*c.*5900 cal B.C.; Hibbert *et al.*, 1971), alternatively called the Boreal/Atlantic transition (Godwin, 1975), in the later Mesolithic period. The very high values of alder pollen and the macroscopic wood fragments in the peat suggest that alder carr was growing at the site during this time, possibly screening out other pollen types. Reductions in elm pollen, and rises in that from grass, other herb taxa, and cereal-types in Sp-i suggest a possible elm decline. The herbaceous pollen includes a variety of taxa, including bracken (*Pteridium*), cinquefoils (*Potentilla*), daisy-type (Tubuliflorae), dandelion-type (Liguliflorae) and sheep's bit scabious (*Succisa pratensis*). A sample taken from within this zone (at 0.32 m depth) was dated to 4667-4350 cal B.C. (5645±60 BP, AA-34508; Table 1), again within the Mesolithic period. This possible clearance episode appears to have been of short duration and alder pollen values recovered quickly. Immediately above this point, the peat was sealed by modern topsoil, suggesting the loss of more recent peat deposits.

Samples from peat stratified below the burnt mound

The pollen spectrum from the narrow band of highly humified wood peat stratified below the mound had very abundant pollen and fern spores recorded in it. This spectrum appeared similar to the pollen between 0.36 m and 0.24 m in the main pollen diagram for the samples taken south-east of the burnt mound, with 95% tree and shrub pollen, predominantly alder and hazel, and with low values of oak and pine and 2% elm pollen. Peat at a depth of 0.32 m in the monolith sample to the south-east of the mound was dated to 4667-4350 cal B.C. (5645±60 BP, AA-

34508; Table 1) and, therefore, it is suggested that the peat underlying the mound itself is probably of a similar date. This peat was overlain by a light grey clay (135), which the excavators thought was not a natural deposit but a product of dumping to consolidate the moist peat below, when use of the first trough was initiated. Given that charcoal from deposit 137, which probably formed part of the primary trough, was radiocarbon-dated to 1678-1410 cal B.C. (3240±50BP, AA-34789; Table 1), there is clearly an hiatus in the surviving stratigraphy between the underlying peat and the first anthropogenic deposits associated with the mound.

Discussion

Palynological data

In contrast to the Lake District (e.g. Pennington, 1970; 1997), the southern raised mires of Cumbria (Wimble, 1986), the Furness area (Oldfield and Statham, 1963), and the Lonsdale area of Lancashire (Oldfield, 1960; Taylor *et al.*, 1994), there are few published pollen diagrams for the Late-Devensian and Holocene from the eastern margin of Cumbria. Studies from the eastern part of the county include two published pollen diagrams from Skelsmergh Tarn and Kentmere (Walker, 1955), and a published pollen diagram from Wet Sleddale (Chinn and Innes, 1995), but these and other studies lack adequate absolute dating, and are of limited use in correlating vegetational changes to archaeological periods. Thus, although the peat deposits at Sparrowmire were shown probably to predate the burnt mound, and were therefore unable to provide any record of the vegetation at the time of its construction and use, the identification of dated deposits of Late-Devensian/ Holocene age are of considerable regional importance. This study shows a sequence of vegetational changes after the last glaciation which follows the broad regional pattern for north-west England (Hibbert *et al.*, 1971; Pennington, 1969), with grassland communities being replaced first by scrubby woodland, then hazel, and finally by more mixed deciduous woodlands. The basin itself gradually changed from a small freshwater lake to a wet fen, and finally a damp alder carr woodland.

Perhaps the most interesting feature of the palynological data recorded is the possible indication of woodland clearance marked by a slight reduction in the pollen from hazel, oak, elm and alder, with increases in pollen from grasses and weeds (e.g. sorrel, dandelion-type, daisy-type). This brief phase is dated to 4667-4350 cal B.C. (6465±60 BP, AA-34792; Table 1), which places it towards the end of the Mesolithic period. Traditionally, the role of man in the development of the native vegetation was not thought to occur before the "elm-decline", which is believed to have taken place around 3000 B.C. (Hibbert *et al.*, 1971). In recent years the work of Tipping (1994; 1995a; 1995b) and Taylor *et al.*, (1994), amongst others, has provided an increasing body of evidence to suggest that from early in the Holocene the effects of man on the landscape may have been significant. Taylor *et al.* (1994) have found that at Little Hawes Water (SD 479 769), a site to the south of Kendal on the Lancashire/Cumbria border, there are several bands of charcoal associated with evidence of more open woodland conditions in the Mesolithic period. At Sparrowmire Farm, the reduction in tree pollen and the increase in that from herbs and grassland species does not appear to be related to burning, as there is no

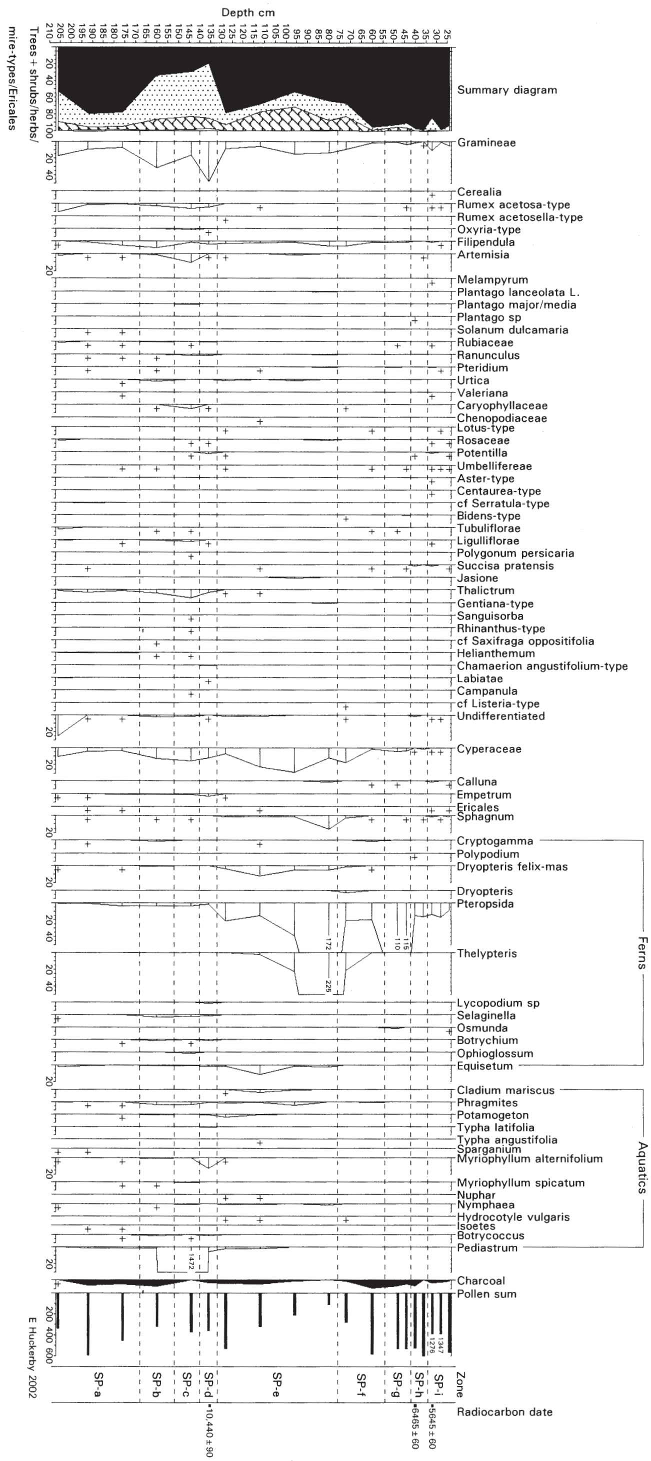

FIG. 5. Percentage pollen diagram of herb taxa (values <1% of pollen sum are represented by +).

concomitant increase in the value of charcoal. However, it is possible that Mesolithic people cleared some trees, resulting in a few open areas where grass and weeds could grow. They may also have started to cultivate some cereal crops, as a small amount of possible cereal pollen was recorded in Zone SP-i, and, though it is difficult to distinguish from some wild grasses (Andersen, 1979), the pollen grain size, and the diameter of the annulus around the pore, suggests that the Sparrowmire Farm examples are likely to be from cereals.

The more recent peat at Sparrowmire has been removed (probably for fuel) and so, from the Neolithic to the present day, there is no information as to the changing vegetation of the area.

Burnt mound

The burnt mound itself may have been sited deliberately in a hollow above a cluster of loose, glacially-deposited boulders; indeed, the trough may initially have been created by the removal of one or more boulders and the enlargement of the resulting hole. The boulders were of fine-grained sandstone or gritstone; burnt stone of the same type appeared to form the burnt mound itself, suggesting that the availability of such stone may have been a factor in its location. The presence of a silty clay deposit of probable natural origin may also have contributed to the attractiveness of the site, having the potential to help retain water, another necessary factor. Away from the boulders, the contemporaneous ground surface appears to have been stripped down to clay or peat before activity on the site commenced. As described above, the surviving peat is probably considerably older than the mound, suggesting that any ground surface, buried soil, or peat deposit relating to the period immediately before the construction of the mound, was removed in antiquity. It is difficult to determine why this should have been done. One possibility is that turf was needed for an associated structure, of which we know nothing, but this need not be the case; it might equally be argued that the ground surface was reduced by the cutting of peat for fuel.

The presence of a deposit of fragments of burnt stone, immediately behind the timber lining found *in situ* at the north side of the trough, appears to demonstrate conclusively that use of the site for heating water had begun before the timber was installed, and that the planks found derive from repair or replacement of the trough. This implies activity at the site over a period of time. However, once use of the site had begun, there was no evidence for any substantial break in the deposition of burnt stone, in that no relict turf horizons or pronounced lenses of silt were detected within the structure of the mound. Evidence was recovered, though, for a change in the way in which the site was managed, perhaps coinciding with the repair of the trough. The prevalence of charcoal and black sooty silt in the lower levels of the mound seems to suggest that fires were at first lit on the mound, and that the burnt stones became mixed with the ashes. This is reinforced by the identification of the possible remains of a fire on the southern bank of the mound within Area B. The absence of charcoal from the matrix of brown silt found between the stones towards the top of the mound suggests that the hearth or hearths used for heating the stones may have been more contained, and that the ashes were not mixed with fragments of stone removed from the trough.

Although not specifically kidney-shaped, the form of the mound appears to correspond closely to other such monuments identified in Britain and Ireland (Barfield and Hodder, 1987, 370; English Heritage, 1988). Most dated examples appear to derive from the early, middle or late Bronze Age, a period of some 1000 years (English Heritage, 1988), although in Ireland, similar sites may have been used until the late medieval period (Buckley, 1991, 5). On balance, it appears likely that all phases of the construction and use of the Sparrowmire mound can be attributed to the Bronze Age. With one exception, the calibrated radiocarbon dates obtained from organic material preserved within the monument cluster towards the middle of the second millennium B.C. A *Rubus* thorn and undifferentiated carbonised wood fragments recovered from early in the sequence of deposition produced radiocarbon dates of 1522-1317 cal B.C. (3165±50BP, AA-34790) and 1678-1410 cal B.C. (3240±50BP, AA-34789) respectively (Table 1), and these can probably be regarded as *terminus post quem* dates for the construction and use of the primary trough. A sample from the timber lining of the secondary trough gave a date range of 1740-1505 cal B.C. (3330±50BP, GU-8433; Table 1), but this must be treated with caution because of the derivation of the sample from a relatively mature oak, which was probably of considerable age when felled and used to construct the trough. An immature alder catkin produced the latest in the cluster of dates (1408-1126 cal B.C. (3020±50BP, AA-34791; Table 1)), reflecting its derivation from a late deposit which appears to have formed in the trough after the disuse of the feature; this last date range can be regarded as a *terminus ante quem* for use of the site.

The broad range of all the dates cited means that it is impossible to determine the time span over which the site was occupied, though the stratigraphic evidence suggests at least two phases of use. The one radiocarbon date which lies outside the second millennium was derived from a timber underlying the lining of the north side of the secondary trough (2463-2039 cal B.C. (3810±60BP, GU-8432; Table 1)). In view of the two radiocarbon dates pertaining to the construction or earliest use of the mound, it would be rash to suggest that this timber belongs to an original trough, and that the mound continued in use for several hundreds of years. Rather, the third millennium date must be regarded as anomalous, perhaps representing the use of a very old tree, conservation and re-use of an old timber, or the disturbance of an earlier feature.

No artefacts or animal bones were derived from contexts contemporary with the construction and use of the trough and mound, other than the timber plank and plank fragments which lined the secondary trough. The significance of this is difficult to ascertain, as it is uncertain whether bone would have survived within the deposits encountered. Analysis of the plant macrofossil samples from the burnt mound has likewise proved relatively uninformative. The charcoal was predominantly from oak, with lesser quantities being from birch, alder, or hazel, and possibly some of the smaller shrubby taxa, such as blackberry (*Rubus* sp.). These trees and shrubs were likely to have been growing adjacent to the basin when the mound was constructed and in use, and the range of species present perhaps suggests a degree of regeneration, possibly after clearance. The recovery of *Chara/Nitella* oospores suggests the presence nearby of standing water, and in addition, the topography of the site indicates that, until recently, a stream course probably ran 50 m south of the mound. This is noteworthy, as recent study of the Shropshire Wetlands has suggested a correlation between burnt mounds and stream and river valleys, but a lack of association with meres and mosslands (Leah *et al.*, 1998, 122). The recovery of a single undifferentiated cereal grain from the period of construction and use of the trough/mound hints at the possible cultivation, processing, or consumption of cereals in the vicinity of the site, but the quantity of evidence is far too small for any viable conclusions to be drawn. However, neither the excavation nor earlier extensive evaluation trenching revealed any evidence for prehistoric settlement in the locality, suggesting the possibility that the mound may have been relatively isolated from any settlement area, even if it stood in a landscape which may have been exploited for the cultivation of crops.

It has been suggested that burnt mounds may have been used as cooking sites (O'Drisceoil, 1988), as saunas (Barfield and Hodder, 1987), or for fulling (Jeffery, 1991). In Ireland, documentary records and the use of mounds and troughs within folk memory have been considered to suggest a cooking function; the stones were heated and dropped into water which was then used to boil meat. Modern experiments have confirmed that this is practical, and other processes such as the extraction of grease from animal bone also appear feasible (Barfield, 1991). However, the absence of animal bones from the majority of burnt mound sites is a potential argument against their use primarily for cooking. Although it is often assumed that acidic soils are responsible for the lack of animal bone, it has been argued that some burnt mounds are associated with neutral soils, and that it is unsafe to assume that bone would not survive unless this has been demonstrated (*ibid.*). In view of this, the use of many burnt mound sites for sweat bathing has been proposed; certainly, where structures have been identified around troughs, cooking would have been a very hot and steamy business, and in these instances use as saunas is perhaps more plausible. Archaeological evidence for fulling is almost non-existent in Britain, despite abundant historical evidence for the textile industry (Jeffery, 1991); the possibility that the troughs associated with some burnt mounds were used for fulling, cleansing, or dyeing wool, or for felting, cannot be dismissed.

At Sparrowmire, the artefactual and ecofactual evidence for the use of the site is certainly limited, and the structure of the mound itself allows few inferences to be made. It can be observed that the area between the trough and mound of burnt stone was restricted, so that there would have been little space for people to occupy a steam-filled canopy, but conversely, an inclined stakehole found below the trough may have been associated with some form of covering structure. The lack of contemporary finds, and lack of evidence for settlement activity in the immediate vicinity, are also noteworthy, but it must be accepted that the available evidence does not point decisively to any one of the three main possible functions advanced above.

Burnt mounds are rare in Cumbria, other examples being known from Torver Common, near Coniston (Jamie Quartermaine *pers. comm.*), Drigg, on the West Cumbria coast (LUAU, 2001), and the former Garlands Hospital site, Carlisle (LUAU, 1996). The probable burnt mound at Drigg was investigated because it faced imminent destruction by coastal erosion; a potential timber trough was found in close association, and a possible second burnt mound was identified *c.*100 m away, but it has not yet proved possible to obtain a date for the monument. The burnt mound at Garlands Hospital was identified in an evaluation trench. It measured at least 10 m long x 0.2-0.3 m high, and a possible pit was found immediately to the north, but again, the monument was undated. Together, the three sites now excavated confirm that burnt mounds exist in Cumbria, and are not restricted to a particular locality or type of landscape, although those at Drigg and Sparrowmire are relatively close to probable palaeochannels. Moreover, the excavation at Sparrowmire Farm has, for the first time, confirmed the Bronze Age date of a Cumbrian burnt mound. Little new evidence was found at Sparrowmire to contribute to the longstanding debate over whether mounds of this type were primarily used for cooking, or as saunas (Barfield and Hodder, 1987; O'Drisceoil, 1988), but the lack of finds or other clear indication of function is hardly surprising, as this lack represents one of the most common characteristics of this enigmatic form of monument.

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