IX

Excavations at Wallsend Colliery B Pit, 1997

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INTRODUCTION

THE excavation reported in the following pages is one of several being conducted by Tyne and Wear Museums Department of Archaeology on behalf of North Tyneside Council in and around Wallsend Roman Fort as part of a £7.5 million redevelopment of the site as an archaeological park. Although much of the archaeological interest of the area concerns the Roman period, the present site was found to contain the surprisingly well-preserved remains of Wallsend B Pit, a monument of foremost importance in terms of both our national industrial archaeological heritage and the early industrial development of the north-east coalfield. For this reason it has been decided to publish this report separately from the Roman material.

The first shaft at Wallsend which successfully reached the rich High Main seam, sunk in 1780, became known as the A Pit, and was situated *c.*70 yards to the south of the B Pit site, to the west of Wallsend Roman Fort (fig. 1). The B Pit shaft was sunk almost as soon as the High Main seam was won, and by 1802 six interconnected shafts had been sunk in the Wallsend area, the large number being required due to the difficulty of ventilating the workings. The renowned mining engineers, John Buddle senior and junior—the latter known in his time as "King of the Coal Trade", were successive "viewers" or managers of the Wallsend colliery: the extensive papers of Buddle junior have been helpful in trying to associate elements of the archaeological sequence at B Pit with attested events. By the 1830s the mine was in decline, suffering badly from flooding. The last B Pit structures seem to have been demolished by the 1850s, although the shaft remained open for ventilation until 1969 (after 1908 as an air shaft for the Rising Sun colliery).

The 1997 excavation which took place from February to April was sited 20 m (NGR NZ 299 660) north-west of the west gate of Wallsend Roman Fort (Segedunum) and was originally undertaken with the intention of locating and laying out for display Hadrian's Wall ditch and the defensive ditches of the fort. It was known that the Wallsend colliery B Pit had occupied the site (indeed, the concrete cap for the shaft was still visible), but colliery structures located during excavations by Tyne and Wear Museums on the line of Hadrian's Wall to the west of the site in 1991–2 were

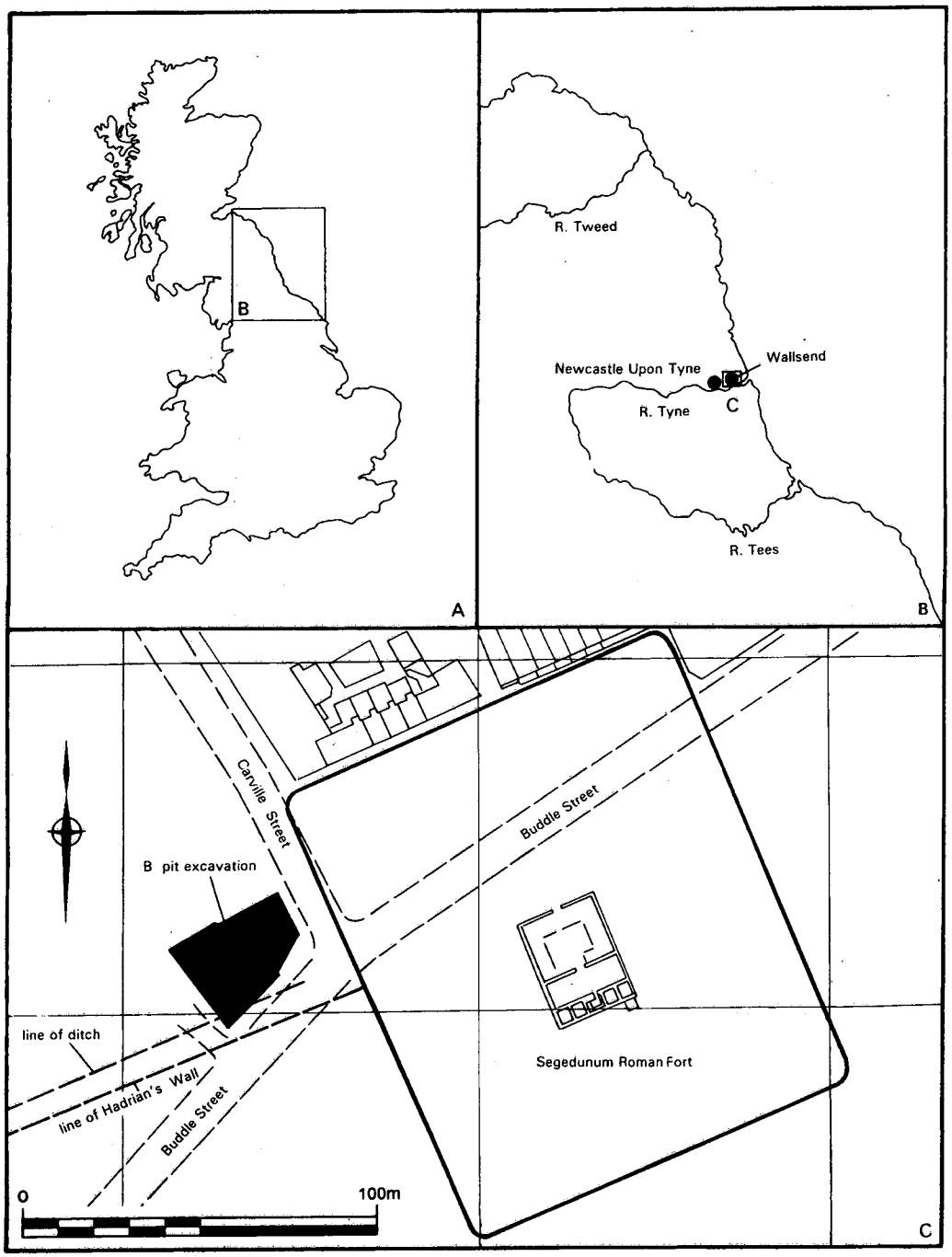


Fig. 1 Location of site.

found to have been extensively demolished, and it was assumed that this would be the case in the current excavation area.

At the commencement of the excavation the initial strategy was to machine strip the site to the level of any surviving remains of the colliery which would then be cleaned and recorded before continuing the excavations to earlier levels. However, it became clear during the initial cleaning that the colliery structures were in a much better state of preservation than had been anticipated (figs 5, 7) and a decision was taken simply to reveal and investigate the structures and to consolidate parts of them for permanent display.

It should be remembered that only limited excavation of the B Pit remains took place. The work consisted mainly of removing demolition material with some limited excavation to elucidate the structural sequence. The primary aim of the work was to conserve the colliery remains, so in places the interpretation and phasing offered below is provisional. The activity of the colliery has been divided into four broad periods based on the stratigraphic relationships of the visible features. As the excavation work was essentially involved with the removal of demolition debris almost no archaeological dating evidence for the separate periods of activity was recovered from the site. To some extent, however, the structural sequence can be linked to elements of the historically recorded development of the pit. A description of the remains in each archaeological period, with technological explanation where necessary, will be followed by a general discussion which attempts, where possible, to date the various elements recovered in 1997 and to set them in the context of developments in mining technology in the north-east coalfield.

ROMAN OCCUPATION

Ditches belonging to the western defences of the fort were located; these will be fully reported upon in a forthcoming publication. The ditch of Hadrian's Wall was not seen in the excavations, its site being completely obscured by remains of the colliery period.

THE PRE-COLLIERY LANDSCAPE

On the areas not occupied by colliery structures, the ground-surface that preceded the colliery was exposed. In the natural yellow clay subsoil west of the cap the undulations of east–west aligned rigg and furrow (3004) (figs 2, 3) were clearly visible. The crests of the riggs were 5 m apart and from crest to furrow-base the height was 0·27 m. Over the rigg and furrow, a blue-grey clay loam (3001) 0·30 m to 0·50 m deep was found overlying the natural clay. No sign of the rigg and furrow showed in the surface of this horizon. A Period 2 clay bank (3039) (fig. 6) had been deposited directly over the loam in the area of the cap preserving a layer of vegetation. This was sampled and floatation revealed a dense mat of fine roots from grass cover. The vegetation was coated black by soot, presumably produced by the burning of coal, perhaps to heat the boiler of a steam engine working nearby before the clay bank was raised. Above the blue-grey clay loam, on areas not covered by the Period 2 clay bank (3039), was a mid brown clay loam (3003). These horizons were agricultural soil formations.

Cutting these horizons was a ditch (3252) (figs 2, 3) which ran north-east to south-west but was exposed only in the south-east corner of the site. It was 1·40 m wide across the top, narrowing to 0·20 m in the base, and 0·35 m deep. Its primary fill was an orange clay loam and the upper fill consisted of blue grey shale and sandstone rubble, up to 0·50 m by 0·30 m by 0·20 m in size, carefully packed into the ditch perhaps to replace it with a crude dry-stone wall or simply to block it. The layer above this fill was also composed of shale and sandstone (3036) 0·85 m deep, derived from the mine workings and possibly deposited during Period 2. The ditch (3252) could have been a field boundary seen on a map of 1740.[1] On

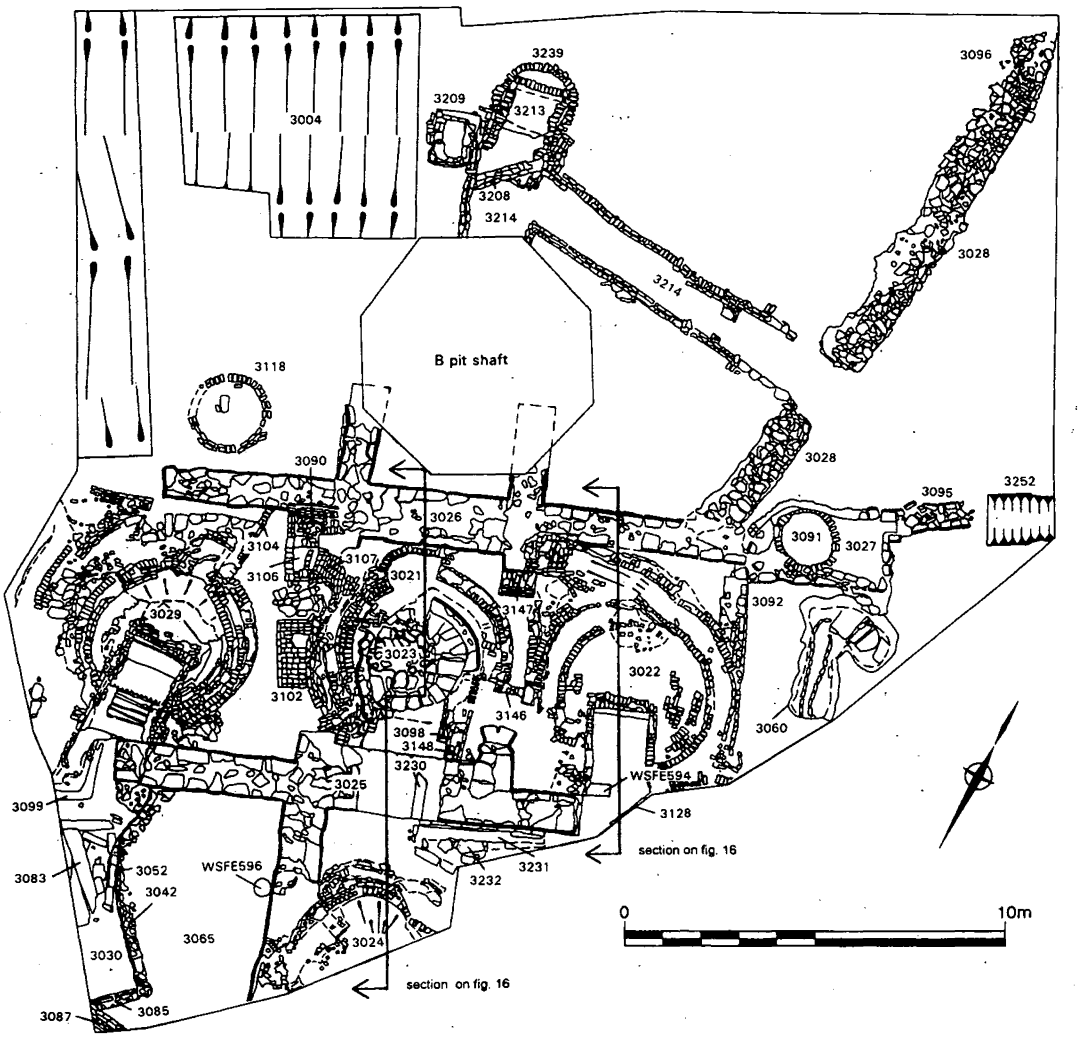


Fig. 2 General site plan. Scale: 1:200.

maps of 1781[2] and 1783[3] the shaft is shown north of this boundary and what is probably a depiction of an engine to the south, which, as we shall see, corresponds to the evidence from the site.

PERIOD 1 (FIG. 4)

This period covers the earliest colliery features observed during excavation; it is entirely possible that there may be earlier colliery features sealed below those dealt with here. Approximately 7·50 m south of the shaft a substantial,

mortared, sandstone wall (3025) (figs 2, 3, 4, 5) was constructed. 12·50 m of its length lay within the trench. The western end of this wall, partly demolished to make way for a later boiler, was visible but the eastern end was probably cut through by the ash pit of a Period 2 boiler-base and may have lain outside the south-eastern edge of the excavation. The wall was constructed from greyish-yellow dressed sandstone blocks up to 970 mm × 300 mm × 270 mm in size, with a predominantly limestone rubble core. The stone appeared to be freshly quarried and there were no Roman stones. The south face of the wall ran straight and the two lowest courses were offsets. The central section of the wall was broadened northwards to a width of 1·60 m compared to *c.*1·10 m at either end. Two buttresses flanked the north side of the central area. The east buttress was 1 m wide and projected 0·20 m north but had been extended to 0·76 m. It had been extended and ended in a wedge-shaped stone that was 1 m across at the widest part. The north side of this stone was curved with a central notch 0·12 m deep by 0·08 m wide blocked with brick and mortar. Centrally on top of this block were traces of white mortar. The west buttress was 0·80 m wide and projected north 0·20 m.

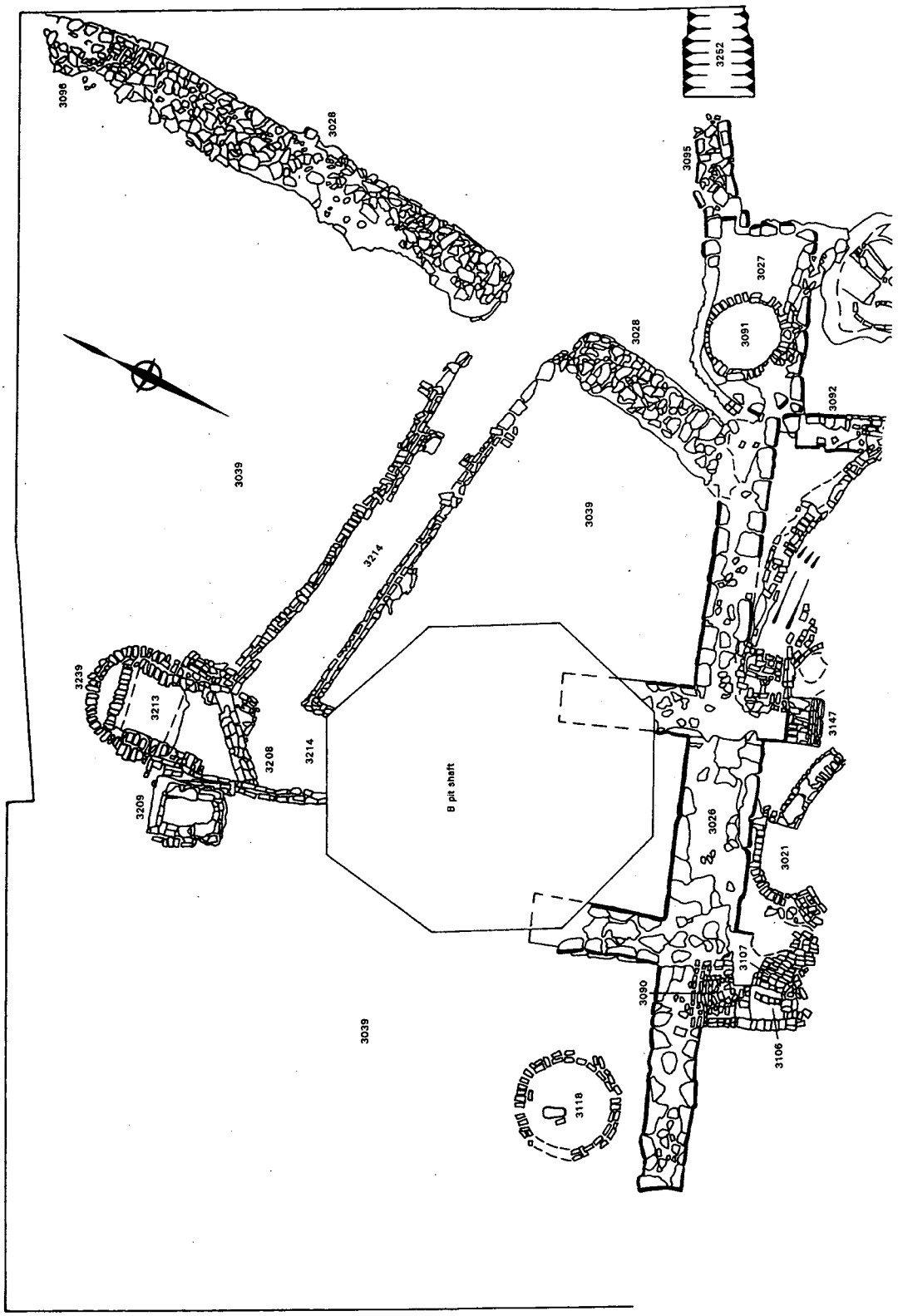
Between the buttresses the wall had been partly dismantled to provide access to the stoke hole of a Period 2 boiler. The east and west sides in the north half of this passage had been roughly faced at this time but the southern end had tooled blocks like those of the primary wall-faces suggesting that there had been a primary recess in the wall 0·70 m deep and approximately 2·02 m wide which was deepened later to penetrate the wall when the boiler-base to the north was built. The recess may have been the area from where the controls of a beam-engine were operated (Farey 1827, 139).

At the west end of the wider part of the wall, at 1·55 m, was the highest surviving vis ible section. Opposite the western buttress a wall 1·20 m wide of one build with the main wall projected 5·50 m southward to the edge of excavation, where it disappeared beneath later features. There was no trace of a similar wall to the east and the offset courses showed that none was ever intended.

It is suggested that the central, buttressed part of the main wall (3025), which was stratigraphically the earliest structure on the site, was a "lever wall", in the upper part of which the beam or "lever" of a beam engine pivoted (figs 19, 20). Elevations of engine houses in contemporary sources usually show a ground floor for the boilers, a floor above this where the brakeman attends the machinery and where the cylinder is situated, and above this a storey where the beam is inserted through the wall. The wall may have been set at such a distance from the shaft because the engine was used for raising coals, and the space between would be required for the headgear (as illustrated in fig. 19). There are, however, problems in determining what lay between this lever wall and the shaft; these are discussed further in the interpretative section of this paper. The lever wall was designed to support the weight of the beam and to resist and absorb any dynamic loading or vibration during the working cycle of the engine. It must have been dismantled to its present height when a series of boiler ash pits were cut through it in Period 2 as this action would surely have made it unstable. The less substantial lengths of wall to either side of the lever wall may have formed parts of ancillary structures, housing boilers, as suggested by the similar Period 2 wall to the north.

To the south of the eastern section of the wall an area of paving (3232) was located (figs 2, 3). Only a part of the paved area, measuring 3·50 m east-west by a 0·30 m north–south lay within the excavation. The subrectangular broken slabs were an average of 0·80 m long east-west by 0·30 m wide and 150 mm thick. They may have originally been laid up to the south face of the lever wall but a later drain (3231) destroyed the relationship. No traces of boiler-bases or engine house side walls contemporary with this earliest lever wall were found.

In the north-east corner of the site was a stone and brick wall (3096) (figs 2, 3, 4) which


3252
3098
3028
3095
3027
3091
3092
3039
3214
3239
3213
3208
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B pit shaft
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3147
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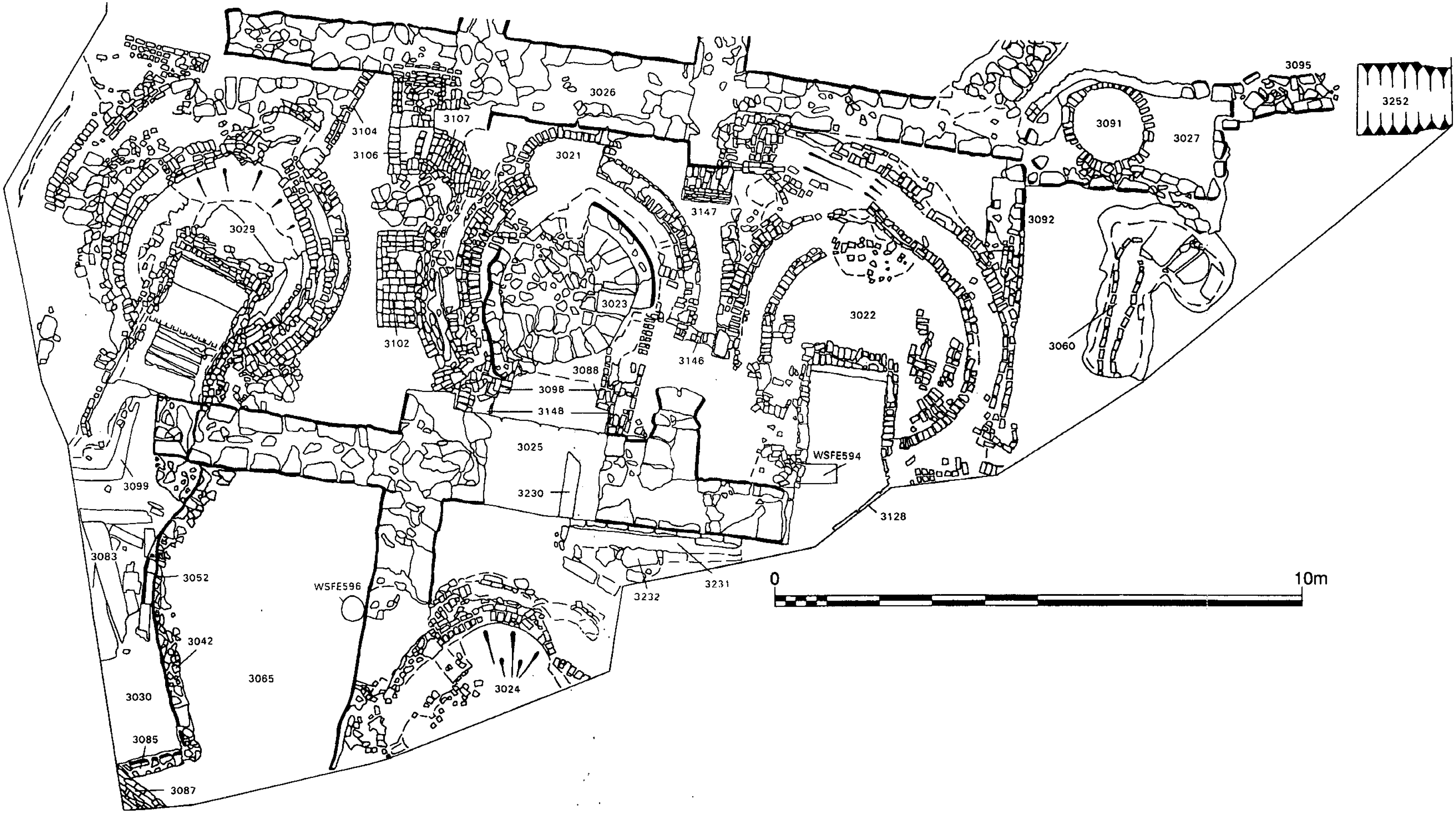

Fig. 3 Detailed site plan. Scale: 1:125 [continued on facing page].

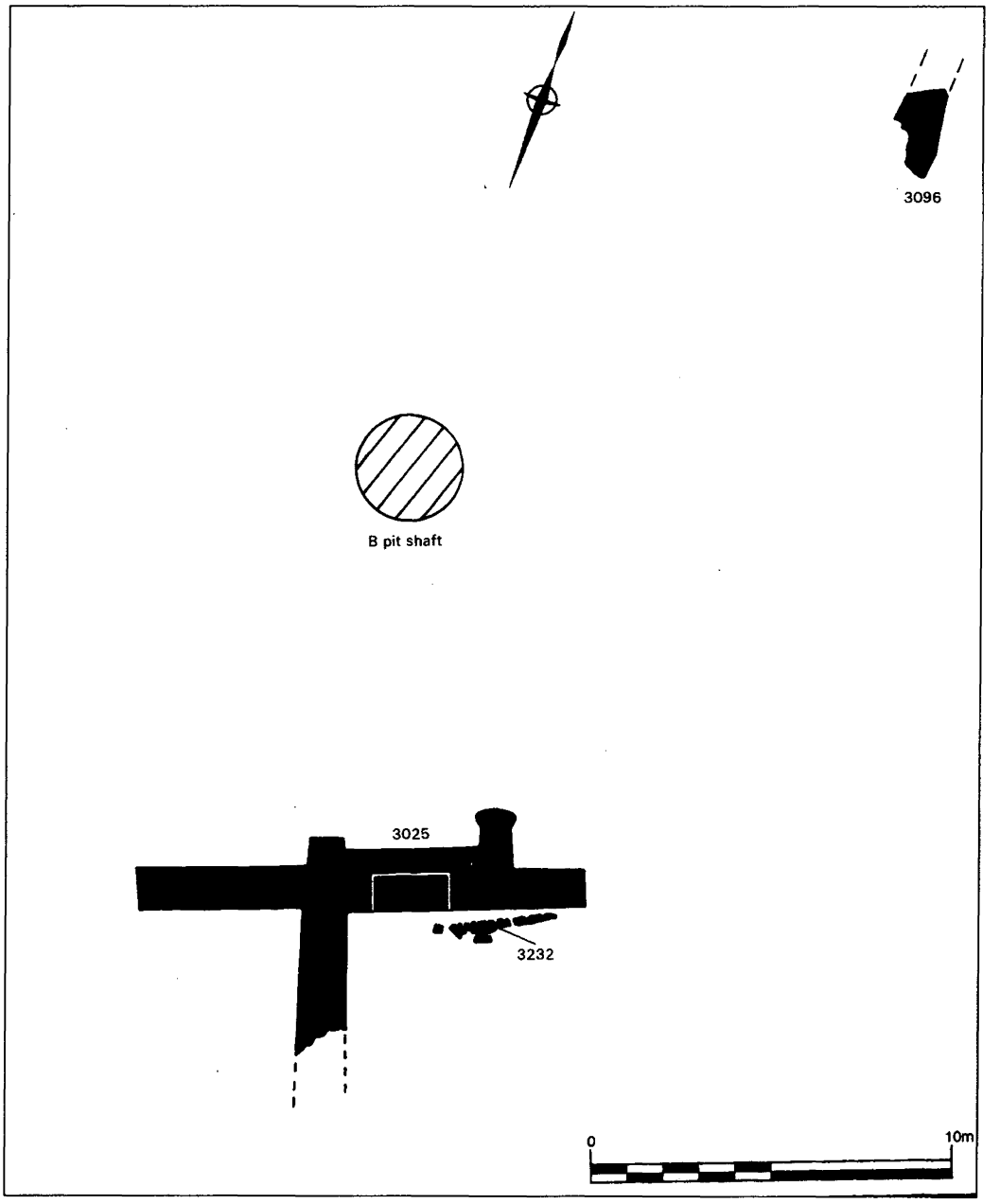

Fig. 4 Simplified plan of site in Period 1. Scale: 1:200.

Fig. 5 General view of site with overburden removed, looking north-east. 2 m scales.

was built in Period 1. Only its southern end lay within the trench. Its lower courses were of neatly squared yellow-brown sandstone blocks, 0·30 m by 0·23 m by 0·20 m in average size with five courses visible. It ran straight north-south for 1.70 m. South of this the wall turned slightly more to the south-west and continued on the new line, built in brick, for 0·80 m. There was a string course of 30 mm thick sandstone slabs above the third course and above this were several courses of brick in mixed bond and golden-yellow mortar forming the substantial east face of a core of sandstone rubble in white mortar.

It is suggested that this structure formed an abutment where waggons could draw up at the foot of the screens (a timber building containing a series of sloping screens which separated small coal and down which larger coals ran to waggons waiting below). Possibly the upper brickwork supported the foot of the screens. The area to the east, which seems to have been open ground, may have been a gathering area for waggons. The map of 1783 shows a waggonway originating in the area of this platform and running south-east. The open area to the east was later buried under colliery waste, shale and coal-dust.

SUMMARY OF PERIOD 1

A lever wall (3025) with lesser flanking walls were erected at a distance of 7·50 m from the B Pit shaft. The intervening space may have been

occupied by a mechanism which raised the coals. It possessed a paved area to the south and a recess in the centre of its southern face which was probably where the "brakeman" stood to operate the controls of the beam engine. A substantial ancillary wall was built southward which was as thick as the end parts of the lever wall itself and which would have isolated the central area from the west end of the wall. This could have been an engine house side wall, but there is the difficulty that no wall survived on the eastern side—unless the rest of the engine house was of timber construction. Perhaps the south projecting stone wall was to prevent subsidence into the ditch of Hadrian's Wall below. No other traces of an engine-house were found but this could have been a flimsy timber structure such as that shown in the illustration from Hair (1844), of the "Air Shaft Wallsend", probably the A Pit (fig. 21). The Period 1 levels to the north and south of the lever wall were not accessible during the excavation. North-east of the shaft a stone abutment may represent the position of a wagon-loading area at the screens, confirming that coal was being raised at B Pit in this structural period. It was incorporated into a clay bank and rubble wall in Period 2.

PERIOD 2 (FIG. 6)

At this time the Period 1 wall (3025) was largely dismantled, and a successor (3026) (fig. 2, 3) built 1·50 m south of the shaft. It was very similar in construction to its predecessor and ran parallel to it at a distance of 6 m, with a maximum visible height of 1·80 m. The overall length east-west of the wall was 15 m. A construction trench 120 mm wide was visible cut into the pre-colliery ground surface (3001), on the north side of the wall. In plan it was almost a mirror image of the Period 1 wall with a central area broadened southward, flanked by buttresses, to function as a lever wall. On the north face opposite the buttresses were a pair of projecting walls, one on each side of the shaft.

The wider part of the wall between the buttresses was 3·80 m long and 1·50 m wide. The eastern buttress was 0·80 m wide and 0·90 m long on its east side, 0·40 m long on the west. The west buttress was 0·90 m wide. Its east side was 0·30 m long and its west side, *c.*0·90 m long. The eastern arm of the wall had a 150 mm wide offset on the south face and like the western arm was 1 m wide. The two northward projecting walls were each 1 m wide, and ran below the concrete cap of the B shaft. The full length of the west one could be seen; it was 2·60 m long.

South of the Period 2 wall, foundations for three haystack boiler-bases were built. Limited excavation around the remains of the boiler-bases encountered dumps of clay and rubble, used to level up the area prior to the construction of the boilers. Two of the boilers were contemporary, with a western one added later, possibly within Period 2, although possibly not until Period 3.

Haystack boilers (see fig. 20 for an illustrated example) were used to produce steam for beam engines. These boilers were usually made of narrow riveted wrought iron plates, corrosion resistant and cheaper than copper or lead. The lower half of the boiler was cylindrical with a concave or flat base and the upper half was hemispherical. A haystack type boiler was located directly below the cylinder of the early Newcomen engines, but after the improvements introduced by James Watt in the 1770s, ranges of such boilers might be placed separate from, but close to, the steam engine. The haystack boiler was used almost exclusively in the Tyne and Wear coalpits illustrated by Hair in the 1830s (Hair 1844).

The cylindrical lower part of the boiler was embedded in a round or rectangular brick base. All bricks on the site except those specifically described as firebricks were "commons", or seconds, red in colour. A rectangular ash-pit projected from below the base. There was an iron grate over the ash pit below the boiler and small-coal fuel was shovelled through a door above the ash pit onto the grate. (Farey 1827, 134–5). Built into the brickwork around the boiler there was in most cases a flue *c.*0·30 m

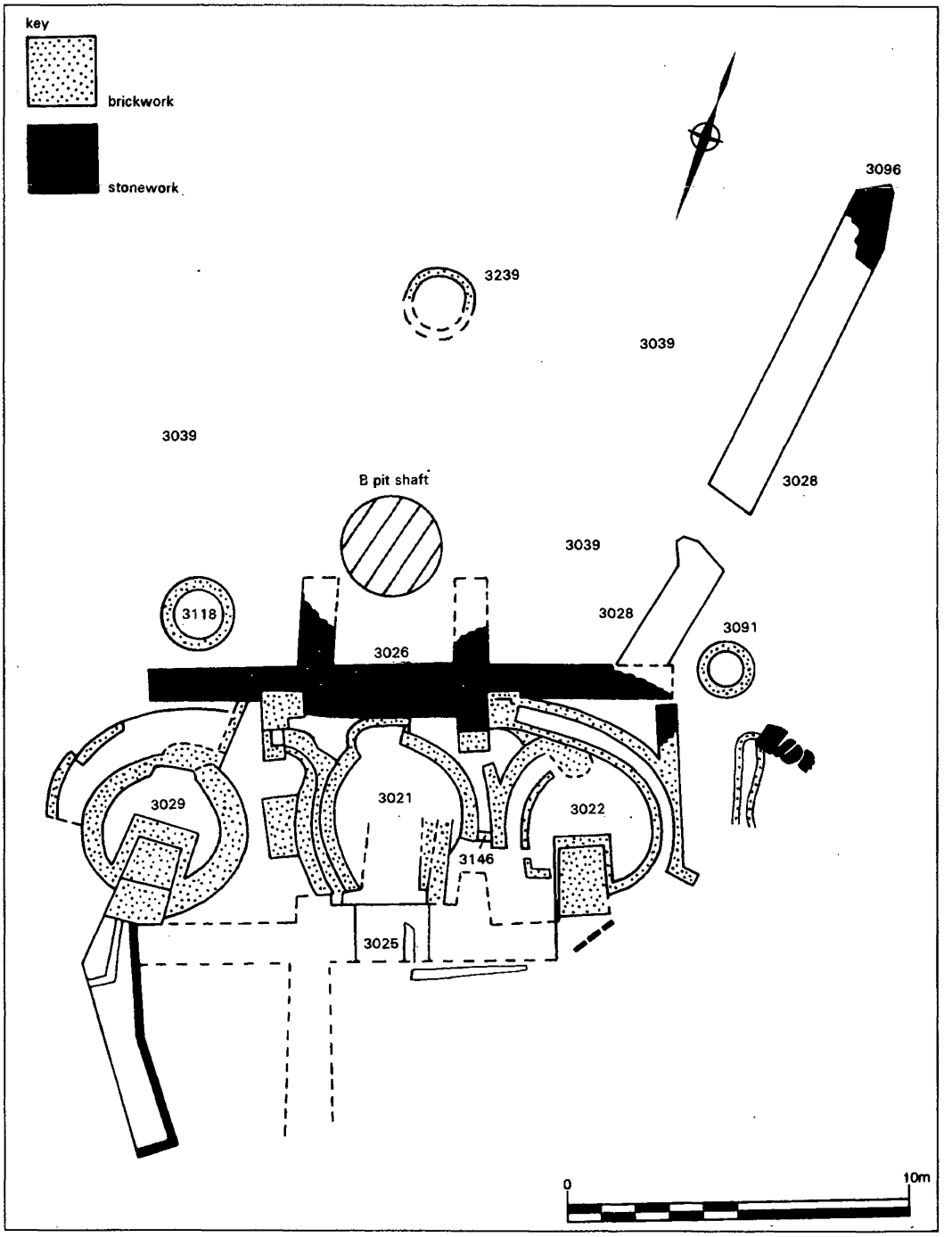

Fig. 6 Simplified plan of site in Period 2. Scale: 1:200.

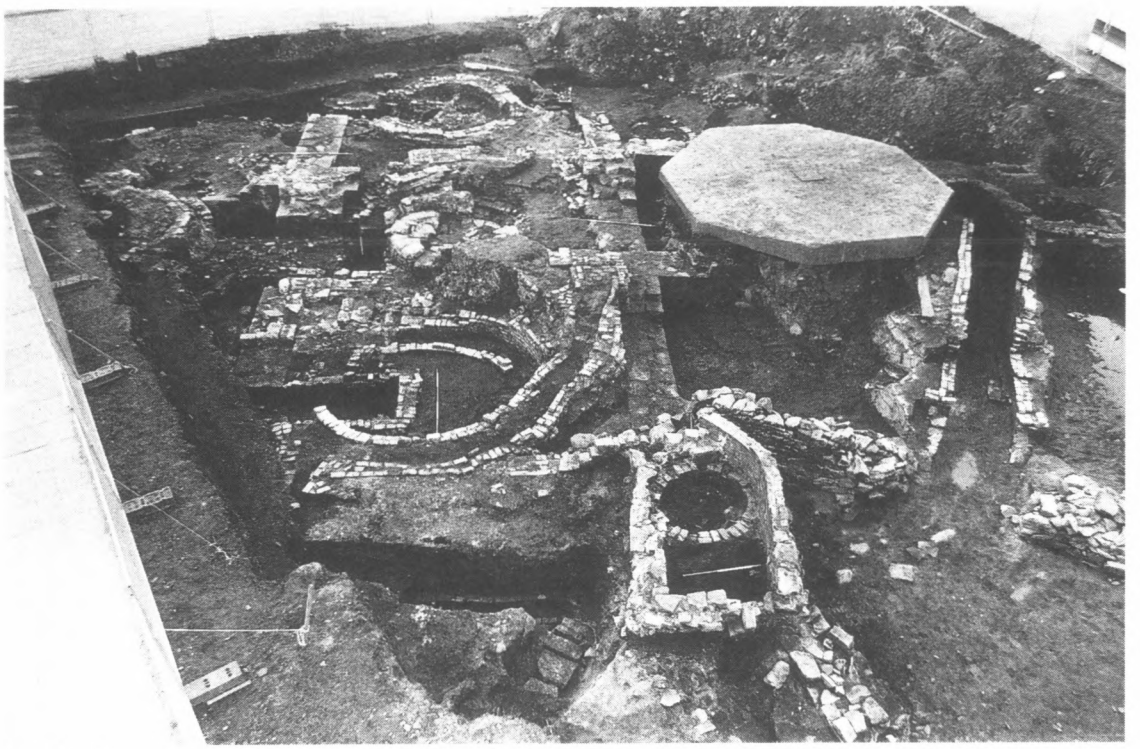

Fig. 7 General view of site with overburden removed, looking west. Scales with 0.50 m divisions.

wide, against the iron sides of the boiler. The flue-mouth lay inside the base opposite the grate. From here the flue curved around one side of the boiler, passed over the stoke hole, circled the other side of the boiler and then, at a point on the exterior of the base, usually opposite the stoking area, it continued upward as a high tapering chimney. The purpose of this so-called "wheel-draught" was to circulate heat in such a way as to raise the water temperature in the boiler evenly.

All three boiler-bases south of the Period 2 lever wall had their ash pits to the south, each cutting through the reduced Period 1 lever wall. The chimney bases were built in brick and recessed into the south face of the Period 2 lever wall, probably contemporaneously with its construction. All the bases were circular (actually, spiral) in plan. Much of their superstructure was damaged during the extraction of the iron boilers and preservation of the wheel-draughts of the individual boilers was quite varied, but exceptionally good when compared to the usual preservation of monuments of this type. The eastern and central boilers were constructed on a layer of voided grey sandstone rubble (3113) of unknown depth and extent.

THE EASTERN BOILER-BASE (3022)

The most easterly boiler-base (3022) (figs 8, 9, 10) was 5·50 m (18 ft) east–west by 6 m

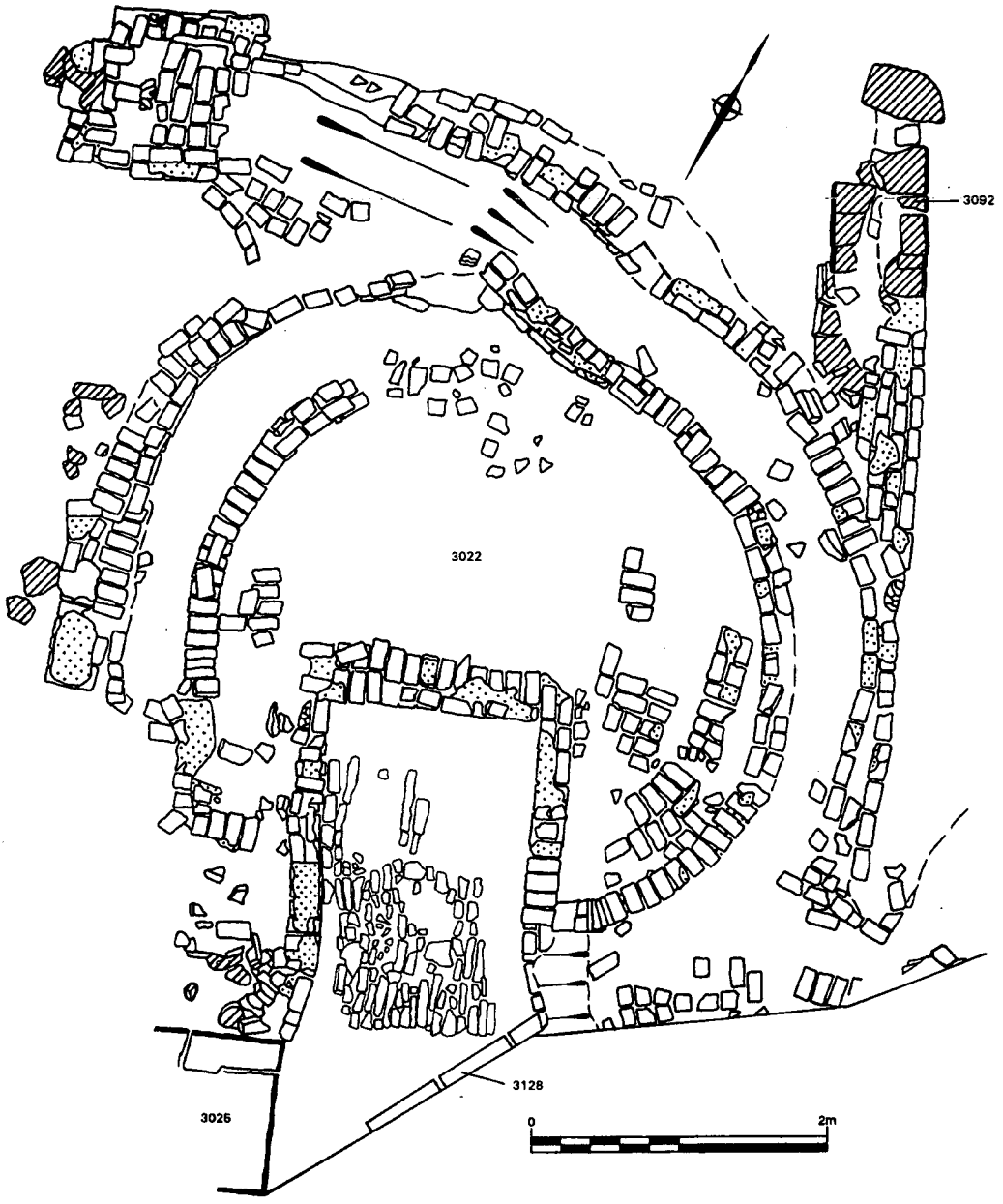

Fig. 8 Plan of eastern boiler-base (3022). 1:50.

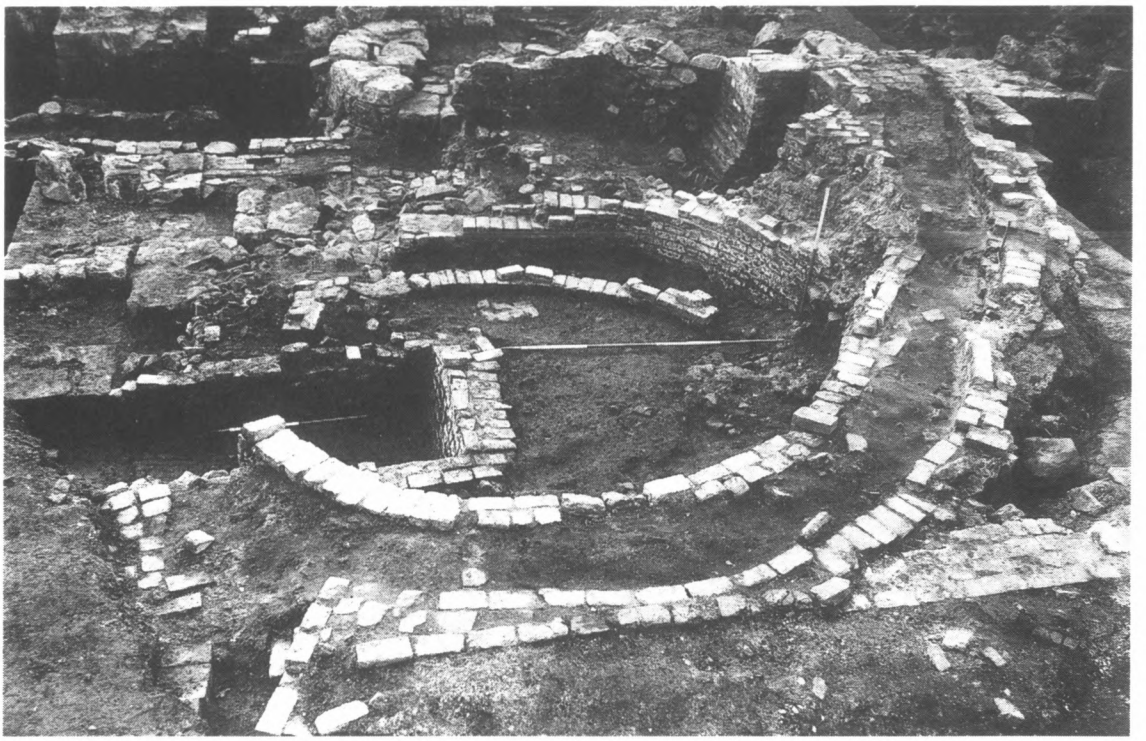

Fig. 9 View of eastern boiler-base looking west. Scales with 0.50 m divisions.

(19 ft 6 in) north–south in external diameter. The outer wheel-draught wall on its west side was of one build with the central boiler-base (3021). The floor of the ash pit was of worn brick setts. The ash pit walls survived 1 m high below the remainder of the base. Its northern wall sloped to aid raking out the ash. The floor was covered in a 100 mm deep layer of red ash (3035) (fig. 16) and on the south-west edge of this lay a folded iron plate (fig. 23, no. 2) which probably came from the bottom of a haystack boiler (pers. comm. J. Rees). Inside the base lay a 100 mm deep layer of red ash (3151) (fig. 16). In places brickwork showed which lay below this deposit and may have been the remnants of earlier structures, but without further excavation it is impossible to be certain of their function.

The entrance to the wheel-draught was north of the ash pit; it ran anticlockwise round the boiler-base with an average width of 0·50 m. On the east side, where the preservation was best, it gradually rose to the chimney base to the north. The west side was poorly preserved, the inner wall here standing to a maximum of 0·30 m in height, and the outer wall 0·40 m high. Slight remains survived where it turned to cross the ash pit. On the east side, the wheel-draught survived to a maximum height of 1·35 m near the chimney base. The area between its inner and outer walls was filled with red ash and bricks. This was not

Fig. 10 View of eastern boiler-base looking east. Scales with 0.50 m divisions.

choking of the flue but part of the initial construction. Such was evident from the presence, at the northern end of the flue, of a brick floor within the wheel-draught overlying the ash. The flue terminated at the base of a square brick-built chimney foundation 1·06 m north–south by 1·18 m east–west, to the north-west of the boiler, in the angle between the eastern buttress and the south-eastern face of the Period 2 lever wall (3026). The north-eastern corner of the flue inside the stack survived as a ridge of baked clay 60 mm thick set in 210 mm from the outside faces of the stack. The internal size of the flue, based on these measurements, would have been *c.*0·70 m square.

The external face of the curved wall on the east side of the base bonded into a straight north-south brick wall two bricks thick which may represent the east wall of a building which encased the boilers. The north end of the straight wall was built onto the stub of a wall (3092) (fig. 8) made of three courses of crudely squared yellow sandstone blocks in grey mortar, 1·60 m long north-south by 0·77 m wide and visible 0·50 m high. The stone wall abutted the south-east corner of the Period 2 lever wall (3026), the straight joint being filled in with brick fragments and mortar. The south end of the brick wall finished in a stopped joint at a 1 m long east-west row of bricks, creating an opening in the wheel-draught of the boiler

which was filled with the red ash; scattered patches of bricks laid to bed on it were perhaps the traces of a floor. This may have been the site of a service entry into the flue for maintenance and cleaning.

THE CENTRAL BOILER-BASE (3021)

The interior of the central boiler-base (3021) (figs 2, 3, 11) was not accessible as it was concealed below a Period 3 stone structure (3023).

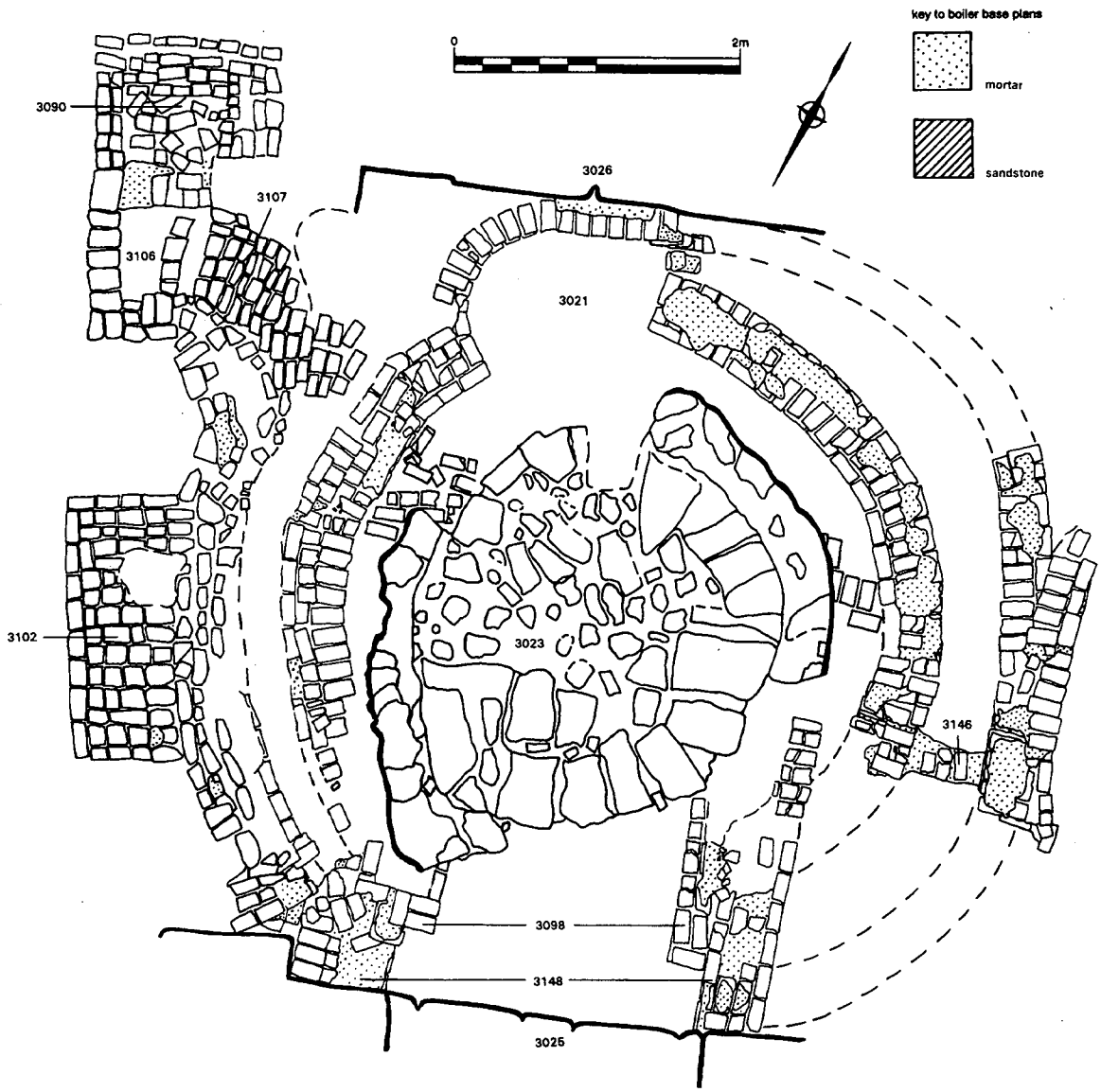

Fig. 11 Plan of central boiler-case (3021) and stone base (3023). 1:50.

Enough of its construction could be seen to give the following information. The base was of 6 m (19 ft 8 in) east–west by 5·20 m (17 ft) north–south external diameter. The ash pit, which was partly hidden by the later stone structure (3023), had two phases of east and west walls (fig. 11) and a neatly laid brick sett floor. The southern ends of the primary walls (3148) abutted each side of the access cut through the lever wall (3025) to the south (see below). The overall length of the ash pit in this phase was 2·60 m long north–south by 2·18 m wide east west. The ash pit had later been narrowed with the construction of new east and west walls (3098) (fig. 11) built against the internal faces of the primary ones. The new walls were one brick thick and this ash pit would have been 1·50 m wide east–west. These ash pit walls were 0·45 m shorter in length than their predecessors, keeping the primary width of the ash pit where it met the face the Period 1 lever wall (3025). The ash pit may have been narrowed to improve the draw through the grate.

To give access to the ash pit of the central boiler, the recess in the Period 1 lever wall (3025) was deepened to make a passage through the remains of the wall. Some 0·38 m from the east side of this access through the Period 1 lever wall (3025) a drain channel (3230) (figs 2, 3) was cut 0·26 m wide and 11 mm deep into the passage floor. It was open-ended at the south face of the lever wall. Remains of a wooden lining survived on the west side and base. The drain was filled with brown ash which spilled out of the open end and down a 0·14 m drop onto a clay surface at the end of the channel of an east-west drain (3231) (figs 2, 3) which was 3·50 m long, a maximum of 0·30 m wide and 0·15 m deep. This drain ran along the south face of the lever wall. Remains of a 7 mm thick wooden lining were found over its eastern 0·90 m. Within the drain channel, the face of the lever wall was extremely smooth, perhaps water-worn. The fall of the drain was to the east. The function of the drain in the passage was probably to run off water from the working of the central boiler (3021) when this area was part of its ash pit. A similar arrangement was observed at the ash pit of the western boiler.

The flue-mouth on the north side of the central boiler-base was neatly built and survived 0·40 m high, 1·10 m long, east–west and 0·70 m wide north–south. Its west side was semicircular, 0·50 m in diameter changing to a north wall which continued eastward bonded onto the south face of the Period 2 lever wall (3026) for a distance of 1·20 m. From here the wheel-draught ran clockwise around the boiler. The removal of the walls of the base in the north-east corner obscured the details of the flue but it was only 0·20 m wide at its start and had been narrowed with bricks in white mortar, perhaps to increase the draw on the fire.

The surviving south-east section end of the flue was crossed by an 80 mm thick bed of brownish grey mortar in which three bricks were embedded (3146) (fig. 11). This would seem to have been the slight remains of a blocking or narrowing of the flue perhaps to increase the through-draught.

On the west side of the ash pit the wheel-draught could be seen as a mass of brickwork 0·60 m wide east–west overlying the later ash pit wall, and therefore indicating a substantial rebuild of the boiler-base at some time. The inner part of the wheel-draught wall had been truncated probably to extract an iron boiler. It survived 0·56 m high above the ash pit floor. The flue passage was probably *c.*0·30 m wide. The outer wall survived 1·35 m high above the ash pit floor, its external face mostly buried in ash deposits. The brickwork lining the west side of the flue was severely damaged by heat.

At the widest point on the west side of the base, the wall was built or cut into a rectangular brick platform (3102) (figs 2, 3, 11) 1·80 m long north-south by 0·75 m wide east–west with a visible height of 0·50 m. North of this the wheel-draught curved out from the base to the north-west and here had a brick floor (3107) (figs 2, 3, 11) 1·40 m long east–west by a surviving maximum width of 1·40 m wide, its north side missing. The floor sloped up gently westward to a rectangular brick structure (3106) (figs 2, 3, 11) which was 0·60 m wide east–west by 0·90 m long north–south. This

structure connected the flue floor to a chimney base (3090) (figs 2, 3, 11) and may perhaps represent the site of a damper (a door built into the flue near the chimney which could be raised or lowered to regulate the through-draught; if shut it would extinguish the fire under the boiler). This structure may not be primary to the construction of the boiler-base as an earlier curved wall (3117) (not illustrated) seen near the stack base (3090) was covered by a layer on which the damper was constructed. The rectangular chimney base (3090) was set into the angle between the west buttress and the south face of the Period 2 lever wall (3026). It was a solid block of brickwork with a heat-damaged central area and was 1·18 m long east–west by 1·20 m wide north–south and its visible height was 0·50 m. The lower section was buried in the same ash deposits as the boiler-base (3021) and platform (3102).

THE WESTERN BOILER-BASE (3029)

The most westerly boiler-base (3029) (figs 2, 3, 12, 13) was built on deep brick and ash layers that were deposited against the side of the central boiler-base (3021). This showed that the western base was built after the others. A layer of intensely burnt brick rubble (3105) (not illustrated) was then deposited against the east wall of the western base and the possible damper (3106) and chimney flue floor (3107) which served the central boiler were constructed on this material, indicating that they may have been rebuilt at this time. The chimney (3090) associated with the central boiler may also have served the western boiler, but no structures were found which definitely linked the two (see 3104 below).

The area around the western base consisted of deposits of burnt brick, ash, burnt sandstone and semicircular fragments of walling which were suggestive of much replacement of structures, probably boiler-bases, but these remains were not excavated. The western base survived to a height of 0·50 m, with an external diameter of 4·80 m (15 ft 8 in).

The ash pit of the base cut away the west end of the Period 1 lever wall, and was orientated south-west to north-east, rather than north-south like the ash pits of the two other bases. The floor was of brick laid on bed across the northern 1·50 m and the southern 1·20 m was made of re-used broken iron firebars (fig. 12), perhaps from a grate which once stood over this ash pit. The firebars had one straight long side and the other long edge was straight at each end but arched inwards to the centre. They were laid so that the arched parts fitted into each other and were set in a fused black bituminous substance. Overlying this was a secondary surface 100 mm thick of a similar but softer black substance. The bottom course of each side wall was undermined by heat damage. The southern 0·60 m of the east wall swung eastward to join the shortened west end of the Period 1 lever wall (3025). The west side wall continued south retaining a clay bank before turning west, and running beyond the edge of excavation. Here it formed the north edge of the fuel pit (3030) of this boiler. A drain (3099) (figs 2, 3, 12) with traces of a wooden lining emerged from below the west side of the ash pit floor at the northern end of the pit and ran southward for 2 m where it turned west to run beyond the edge of excavation. The drain was square in section, 0·20 m wide and 80 mm deep.

The north wall of the ash pit was supported behind by a mass of broken brick walling, some fragments several courses thick. The south face of the north end wall had a 150 mm wide ledge 180 mm below the top, which perhaps supported the grate. The flue-mouth north of the ash pit was not excavated but inside the walls of the base stopped joints could be seen forming a mouth 1·10 m wide. Heat damage outside this area showed that very hot gasses were passing through but also obscured the structural details. A brick wall or lining (3104) (fig. 12) one brick wide and 0·30 m high seemed to be bonded into the east side of the flue-mouth with a passage through at the junction. The brick wall (3104) ran north to a point 0·40 m west of the chimney base (3090) in the Period 2 lever wall; it may be that the western boiler-base used this chimney. No evidence of a wheel-draught was seen con-

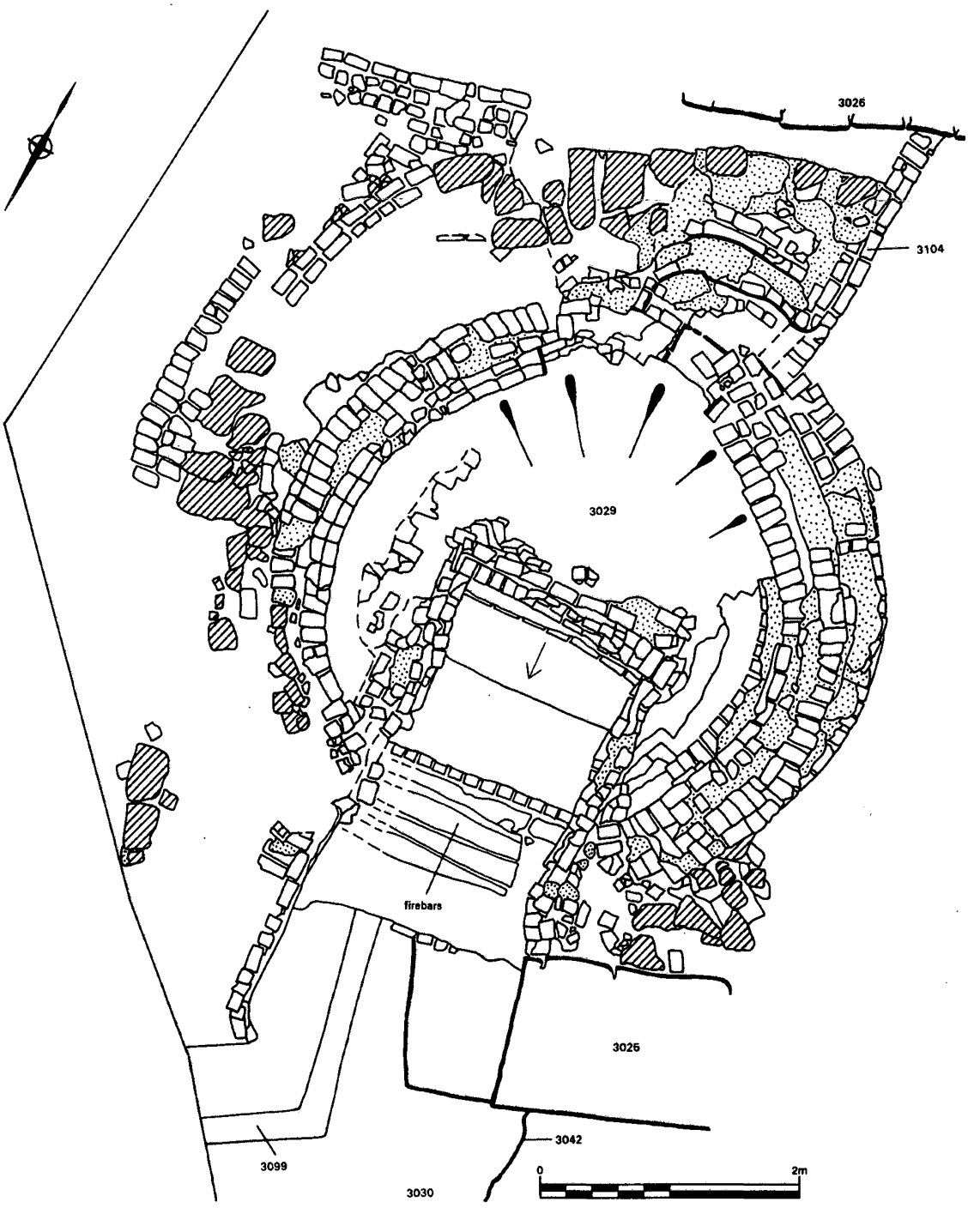

Fig. 12 Plan of western boiler-base (3029). 1:50.

Fig. 13 View of western boiler-base, looking north. Scales with 0.50 m divisions.

nected with this base. It may be that a type of haystack boiler was in use here that had iron pipes inside it to heat the water (Farey 1827, 146). This difference in construction technique may be a further indicator that, although no doubt replacing a sequence of earlier boilers, the visible structure may not have originated until Period 3.

The south end of the ash pit opened into a large pit (3030) (figs 2, 3, 12, 13) 0·90 m deep and 6 m long north-east to south-west with uncoursed sandstone rubble walls on the east and south sides. Only the eastern part of the pit lay within the excavation area. It was set into a dump of clay, mixed ash, grey loam, mortar and brick rubble (3065) (figs 2, 3) of unknown depth which had been deposited against the south west end of the Period 1 lever wall. This dump formed a rough surface on which lay an iron hoop (fig. 23, no. 2). The base of the pit was covered with planking (3083) ranging in size from 2·66 m by 0·36 m, to small polygonal fragments fitted together to prevent the underlying clay being churned about. The planked area ended 2·50 m south of the ash pit floor and 2 m north of the southern end of the pit. Set on one of the planks was a dressed sandstone block (3052) (figs 2, 3) 1·10 m long north-south by 0·25 m high with a smaller dressed block forming a second course mortared to its northern end. It was in turn overlain by a rubble wall (3042) (figs 2, 3)

forming the east side of the pit and a stone wall (3085) (figs 2, 3) defining its southern end. The blocks may represent an earlier lining of the pit. The pit (3030) was probably a fuel store for the furnace of the western boiler (3029).

ACTIVITY NORTH OF THE LEVER WALL

After the Period 2 lever wall (3026) was built, an extensive bank of brown clay was deposited against its northern face, sealing its construction cut. The clay (3039) (fig. 6) was a maximum of 1·30 m deep and filled the whole area of excavation west and north of the shaft.

In the north-east corner of the site at the edge of the clay bank was the Period 1 brick and masonry abutment (3096). To this was now added a drystone wall of grey sandstone rubble (3028) (figs 2, 3, 6) revetting the eastern boundary of the clay. The wall ran from the north-east corner of the Period 2 lever wall (which it abutted) 12·80 m northward to overlie the south end of the abutment. It was 1 m high and 0·84 m thick. In places a construction trench could be seen on the east side, cut into the tail of the clay bank.

In the south-eastern corner of the site a wall (3095) (figs 2, 3) of grey sandstone was constructed on a layer of small coal (3037) (not illustrated). Its west end lay below a later enclosure (3027). The east end of the wall was ragged as if incomplete. The function of this wall is not clear unless it was concerned with retaining heaps of colliery waste which were accumulating in this area.

FURNACE FLUE SHAFTS

Three brick lined shafts were located to the north, east and west of the main shaft. As their depth was unknown and the stability of their infilling uncertain no excavation was conducted within these features. One shaft (3118) (figs 2, 3) lay 3·50 m west of the main shaft. It was built with hand-moulded bricks, one brick thick and was 2 m in diameter. Coating the sides of the shaft was a grey laminated concretion probably deposited by fumes. The shaft was built after the clay bank (3039) had been deposited, therefore after Period 1.

The eastern shaft (3091) (figs 2, 3) was 1·90 m in diameter; it lay 6·50 m east of the main shaft and was made of hand-moulded bricks; no concretion was present. At 0·40 m intervals around the top of the shaft pairs of bricks had been omitted to create dovetail slots. They may have held a frame or grille covering the shaft. The shaft was found within an enclosure (3027) (figs 2, 3) formed by a wall of hand made bricks to the north, and other walls of sandstone blocks. The west and north sides of this enclosure overlay the wall of the shaft but did not block the slots below them. The overall dimensions of this enclosure were 3·90 m east–west and 2·20 m north–south.

A third brick-lined shaft (3239) (figs 2, 3) was cut through the clay bank (3039) 5·50 m to the north of the main shaft. Its internal diameter was 1·70 m and the lining was of hand moulded brick. The north side was visible to a depth of 0·84 m.The south side was removed by the insertion of a Period 4 ash pit (3213).

These shafts were probably flues from underground furnaces used to ventilate the mine. Their methods of working and probable place in the history of the mine are discussed in the final section.

DRAINAGE

In the south section of the trench was a south-west to north-east running drain (3128) (figs 2, 3, 8) with brick side walls capped by grey-green sandstone slabs on average 800 mm long by 50 mm thick, which had been built across the eastern boiler ash pit. South of the enclosure (3027) around the furnace shaft a drain (3060) (figs 2, 3) entered the trench running northward for 3 m before turning back eastward to leave the excavation area, south of the furnace shaft enclosure(3027). These drains cannot be assigned to any period with confidence but, as the drain in the ash pit (3128) does not cut the east side of the adjacent boiler-base (3022) it must fall within Period 2. Its alignment suggests that it could connect with the easterly drain (3060) making this

Period 2 also. In the south-west corner of the trench a deep deposit of brown clay (3086) was partly removed to reveal a vault (not illustrated) which was probably a culvert running east-west made of hand-moulded bricks on edge. It was not possible to discover its dimensions or fall.

SUMMARY OF PERIOD 2

Most of the structures on the site were built in Period 2. A lever wall near the mouth of the shaft was probably for a pumping engine, presumably of the Newcomen type, with boiler beneath the cylinder, as suggested by the position of the central boiler base with respect to the lever wall. Two boilers encased in a brick block served the engine and later a third boiler was added to the west. The western boiler may have been of different design to the others. A flimsy wooden shed may have enclosed the beam engine but no traces of this survived. A high bank of clay surrounded the B shaft (perhaps to support the heapstead—all those structures such as screens and platforms around the head of the shaft). A rubble wall protected the edge of the bank where it met a lower area. At the north end of the lower area the bank incorporated a stone abutment probably built in Period 1 to protect the foot of the screens from waggons coming to load coal. To improve ventilation in the mine three flues were built from an underground furnace or furnaces.

PERIOD 3 (FIG. 14)

Period 3 saw extensive alterations to the Period 2 layout, including the demolition of the central and eastern boilers and their replacement with a stone base and a new boiler-base built to the south. The Period 2 lever wall was dismantled and rubble from it used to level up the area over the central boiler for the Period 3 structures.

THE STONE BASE (3023) (FIGS 11, 15)

The construction dump (3046 and its equivalent 3088) (fig. 16) on which the Period 3 boiler-base (3024) and the stone base (3023) were built filled the ash pit of the Period 2 central boiler and the access through the Period 1 lever wall except on the east side where a channel was left formed by the east side of the access and a lining (3045) (fig. 14) one brick thick along the east face of the construction dumps. The lining stopped at the north face of the Period 1 lever wall. The channel was 2·06 m long north–south, 0·40 m wide and 0·36 m deep. The south end of the brick lining was butted onto the most north-westerly of two large slightly wedge-shaped sandstone blocks, which were built into the foundations of the southern boiler-base (3024). These blocks changed the course of the channel from south to east, around the side of the southern boiler-base. Such a brick-lined channel may have run off water which resulted from activity connected with the two latest boilers and the contemporary stone base (3023) above it to the north-west. The construction dump (3046) may have been covered with a brick floor (3047) (figs 14, 16), a remnant of which survived on the north-west corner of the access through the Period 1 lever wall.

The Period 2 lever wall must have been demolished at this time as the construction dumps of the stone base (3219, 3220, 3226) (fig. 16) covered the jagged remnants of the south face of the lever wall, which had been robbed out. Sandstone rubble (3013) (fig. 16) from the lever wall was piled against the sides of the stone base, and filled a vertical sided robber trench up to 0·40 m deep which ran from the western buttress to the eastern extent of the lever wall. The eastern boiler-base (3022) was filled with a layer of bricks and a layer of mortary sandstone rubble (3126) (fig. 16). It is suggested that the rubble came from the demolition of the Period 2 lever wall (3026), while the bricks derived from the superstructure of this and the central boiler-base. The sequence of the layers would suggest that the boilers were dismantled first and then the lever wall taken down.

The ash pit of the central boiler-base (3021) was filled in with rubble (3088) (fig. 16) which was equivalent to the dumps (3046) over the

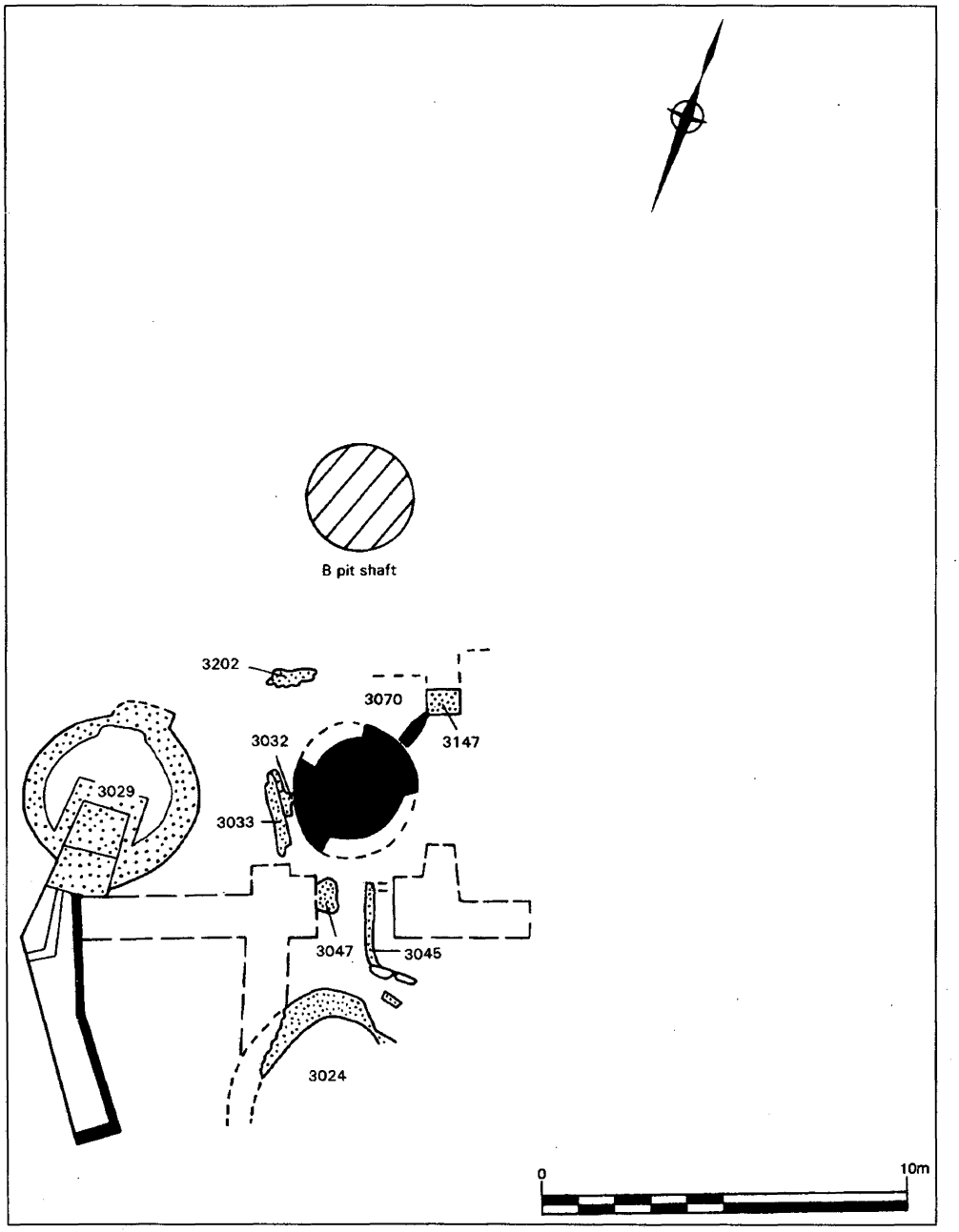

Fig. 14 Simplified plan of site in Period 3. Scale: 1:200.

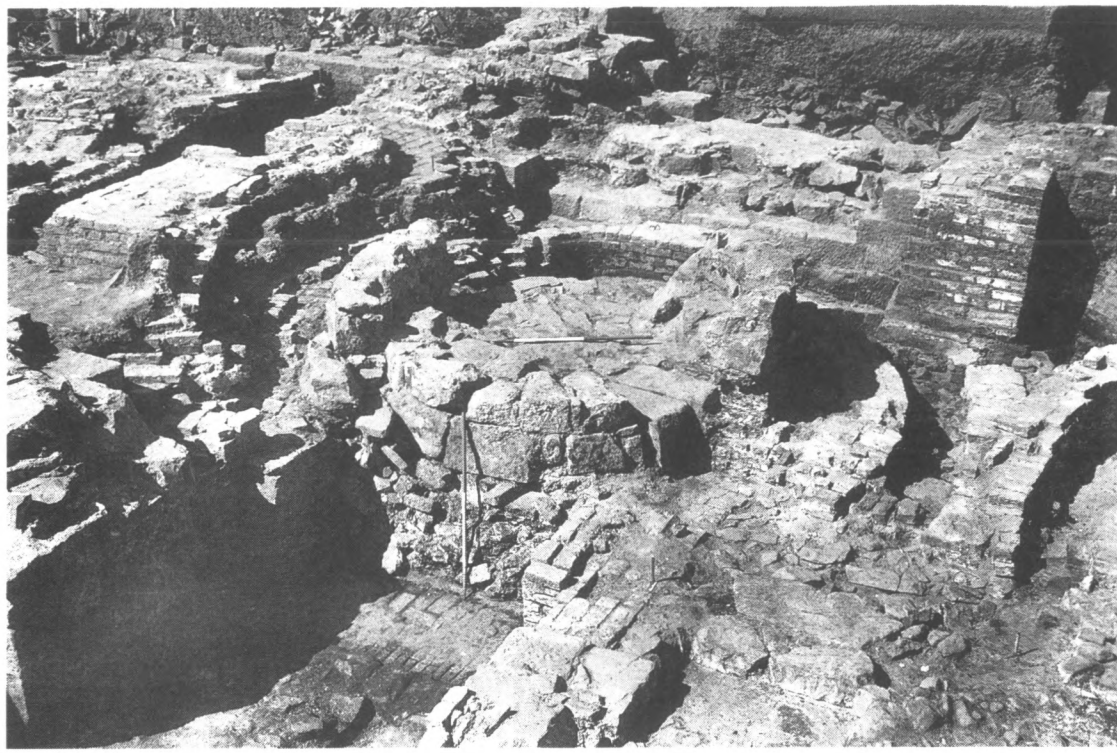

Fig. 15 View of stone base, central boiler and northern lever wall, looking north-west. Scales with 0.50 m divisions.

Period 1 lever wall. Over the centre of the demolished base a sub-oval stone structure (3023) (figs 2, 3, 11, 15, 16) was built. A foundation of crudely squared and mortared sandstone was laid with very unevenly applied grey mortar. A sub-oval platform of crudely squared sandstone blocks 500 mm by 300 mm by 250 mm in average size with a core of small sandstone rubble was built on this and a second bed of blocks was then laid which survived only on the south-west quarter and along the north-east edge of the platform. The faces of the platform were then buried 0·35 m deep in ash and brick, covering the remains of the central boiler-base (3021) and a wall enclosing the whole platform was raised on this layer. Fragments of the enclosing wall survived as almost straight lengths along the south-west and north-east perimeters of the base, 0·60 m high and 0·20 m to 0·40 m wide. The walling was of coursed sandstone rubble with much uncoursed hand-moulded brick in the lower part and it was bonded in brownish grey mortar, much spilled onto the faces of the walls.

To the north-east of the stone base the outer wheel-flue wall of the centre boiler-base (3021) was removed and a brick buttress (3147) (figs 2, 3) with substantial mortared sandstone foundations was built onto the south end of the eastern stone buttress of the Period 2 lever

wall. It was 1·10 m high, 0·90 m wide and 0·40 m thick on a stepped brick plinth. It was built neatly and strongly in narrow hand-moulded brick, probably to support machinery (pers. comm. J. Rees).

A crude sandstone rubble and brick wall (3070) (not illustrated) 0·90 m high, ran from the south-west corner of the brick buttress to the face of the stone base, to retain the infill around the stone base. South of the wall was a 1·12 m deep layer of bricks (3049) (not illustrated) which filled the angle between the buttress, the stack-base and the wheel-draught of the eastern boiler-base (3022).

The stone base was thus buried to its top on its north, east and west sides. On the west side of the infill a thick layer of white mortar (3020) was laid on which the remnant of a brick floor survived (not illustrated). On the west side of the same mortar were traces of a north–south wall (3108) (not illustrated). Over these structures a later wall (3033) (fig. 14) was built on a slightly more north-west to south-easterly line. A maximum of three courses survived. Against the east face of this wall a brick floor (3032) (fig. 14) was laid which was bonded onto the top of the structure. Near the west buttress of the Period 2 lever wall another remnant of a brick floor (3202) (figs 14, 16) was discovered which was laid on the sandstone rubble infill (3013). It would thus appear that the stone base had been surrounded by a brick floor which was replaced on at least one occasion.

Whatever mechanism was encased in the stone base was removed by lifting brick floors associated with the base and smashing through its north-west and south-east quadrants. It required steam from one or perhaps two boilers and was placed 6 m south of the shaft. It was not built strongly enough to be a cylinder base and besides no lever wall was standing when the base was built. A function connected with pumping is possible; or it may perhaps have been the base of a crab (a kind of winch).

THE SOUTHERN BOILER-BASE (3024) (FIGS 2, 3, 16)

Much of this boiler lay beyond the limit of excavation. What could be seen survived to a height of 1 m. It consisted of two concentric touching walls, the inner one 0·30 m thick and the outer 0·50 m thick. This thickness may have been to insulate the wheel-draught.

The interior of the base was filled with dark red ash. Concentric to and inside the north-west part of the base was a heat-damaged brick wall visible 0·20 m high and one brick thick which created a flue 0·60 m (2 ft) wide and was the start of an anti-clockwise wheel-draught. A fork in the brickwork on the east side of this boiler-base probably indicates the site of its chimney.

SUMMARY OF PERIOD 3

Construction dumps on which the stone base was built filled the access through the Period 1 lever wall (3025) and merged into the layers on which the southern boiler-base (3024) was built. It is suggested that the stone base and the southern boiler-base were contemporary. There is no evidence to suggest that the western boiler-base (3029) was out of commission at this time so that whatever stood on the base was associated with one or possibly two boilers, probably with a brick wall or platform between the base and the western boiler. At the time of construction of the stone base the northern wall (3026) was partly dismantled and can no longer have served as a lever wall.

ABANDONMENT

The end of Period 3 marks the abandonment of B Pit as anything other than an air shaft, and the demolition of all remaining structures south of the shaft. When the pithead structures went out of use the boilers were removed. The coal storage pit (3030) for the western boiler was left filled with small coal which became mixed during the demolition of the colliery with brick rubble, ash and mortar and a concentration of domestic refuse, pottery, meat bones and clay pipes (3014). This represents the only stratified dating evidence (indicating a mid-nineteenth century date) for the demolition of this boiler and, probably, the abandonment of B Pit. This infill was closely connected

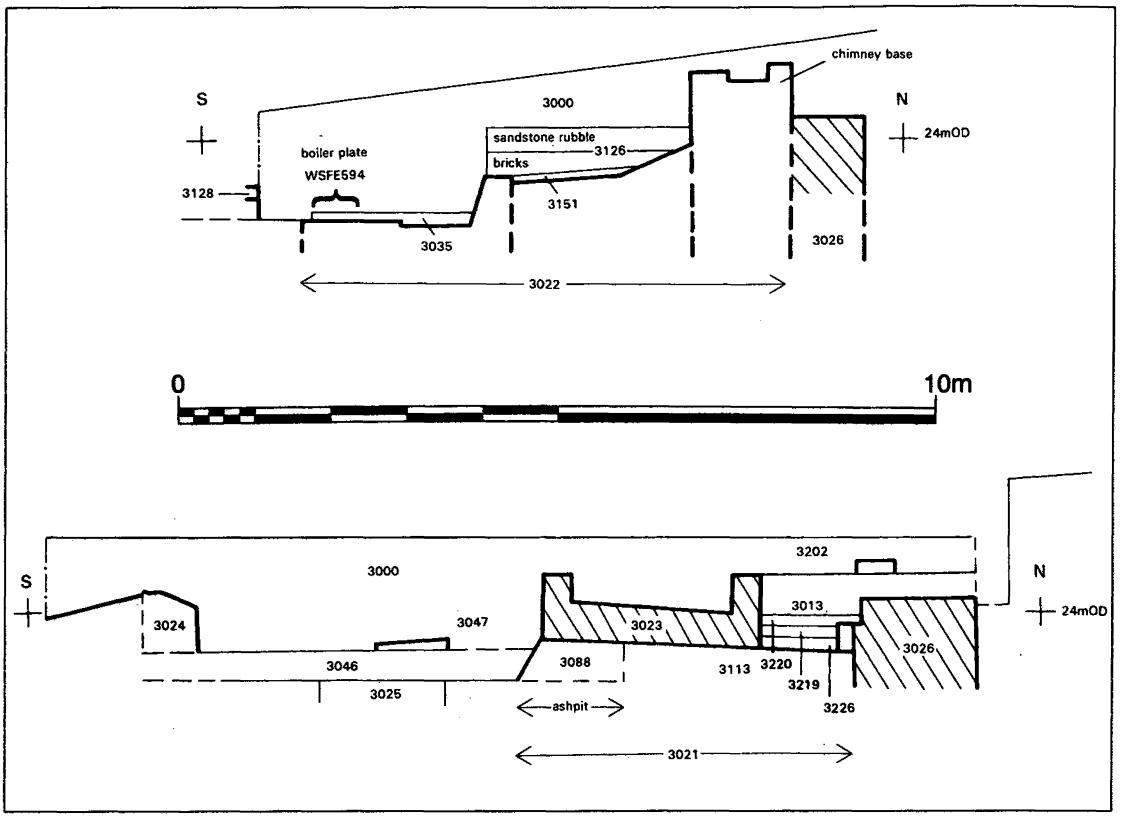

Fig. 16 Diagrammatic cross-sections. Above: boiler-base 3022. Below: through the area of the central boiler-base 3021, stone base 3023 and boiler-base 3024. Scale 1:100.

with the deposition of a 0·50 m deep layer (3000) of dark red and grey ash, grey loam, mortar and brick, stone rubble with wood fragments, slates and many pantiles which blanketed the whole area south of the cap. Elsewhere, the clay bank (3039) surrounding the B Pit shaft was covered only by topsoil *c.*0·20 m thick. The brick furnace shafts were blocked with coal waste, brick and sandstone. The general deposition of demolition material up to the height of the clay bank was responsible for the extraordinary preservation of the structures south of the shaft. Over the demolition deposits were spreads of material of twentieth century date.

PERIOD 4 (FIG. 17)

Documentary evidence makes it clear that after the mid-nineteenth century the B Pit functioned only as an air shaft for the colliery

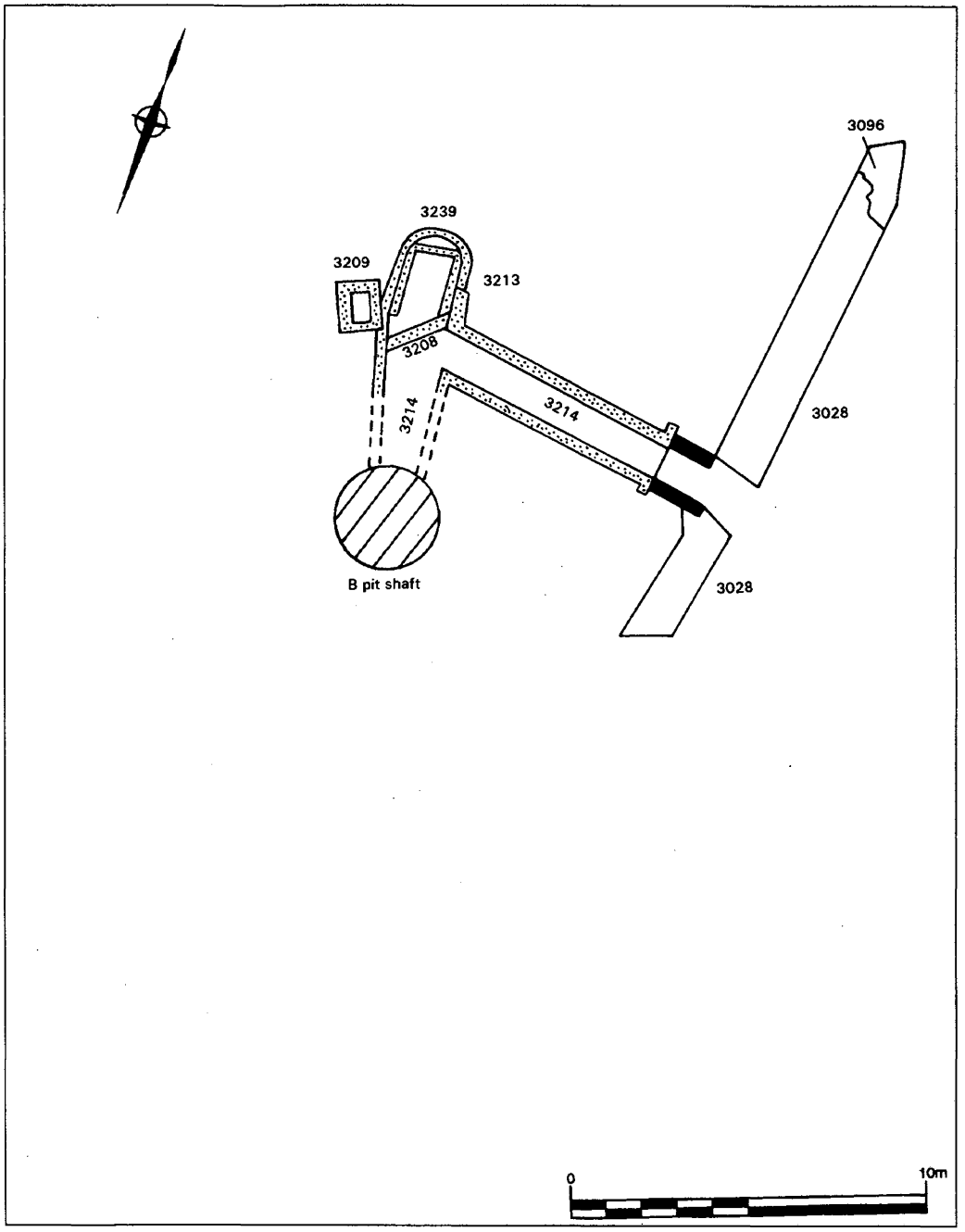

Fig. 17 Simplified plan of site in Period 4. Scale: 1:200.

workings which continued at the Wallsend G Pit (later the Rising Sun colliery) in the east of the township. Traces of structures believed to belong to the end of the nineteenth or the beginning of the twentieth century were located north of the shaft.

THE BRICK CHANNEL (3214)

A subterranean brick channel (3214), set into the surrounding clay, emerged from the north side of the shaft. Its west side (3210) (figs 2, 3, 17, 18) ran north and connected to the south side of the Period 2 furnace shaft (3239) 5·50 m distant. The east side of the channel was seen 0·70 m long before it turned through an acute angle to become the south wall of an east–west channel 6·75 m long. The north and south walls of the long east–west channel survived 1·16 m high at the west end diminishing to 0·44 m at the eastern end where they terminated in neat responds which projected to north and south, one brick square. All the brickwork of the channels was late-nineteenth century or early-twentieth century in date (pers. comm. J. Rees) in a soft white mortar jointing. All the walls were soot-blackened. The east–west channel was an average of 1 m wide. Slight remains of a mortared brick and sandstone floor laid on a bed of black ash survived along the foot of the walls. East of the responds the line of each wall was continued over 2 m by

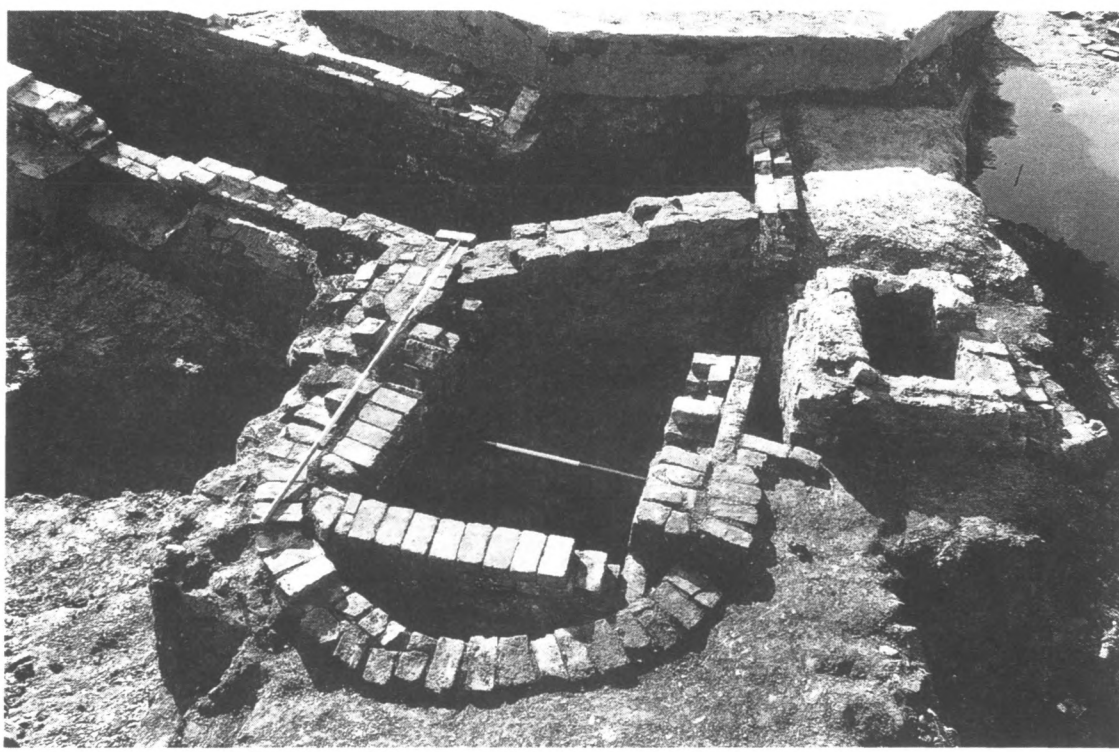

Fig. 18 View of Period 4 arrangements at shaft, looking south. Scales with 0.50 m divisions.

single courses of unmortared brown sandstone blocks. These connected the walls of the channel with a gap broken through the Period 2 rubble wall (3028).

The section of channel running below the concrete cap was 1·50 m wide and sloped gently down into the shaft. The bricks at the junction with the south wall of the long eastern channel were damaged, probably by hot fumes. Near the cap its top three courses formed the springing of a vault but no other walls retained signs of vaulting.

ASHPIT (3213)

At the north-west end of the channel (3214) a rectangular brick ash pit (3213) (figs 2, 3, 18) was constructed, partly in the top of the older furnace shaft. The brick shaft (3239) had been infilled and the ash pit walls were raised on top of this. A level floor of neat brick setts bedded in ash was laid across the ash pit interior and extended 0·50 m southwards beyond the side walls into the ventilation channel (3214). The northern 1·50 m of the floor had subsided into the fill of the brick shaft (3239) causing the lower courses of the ash pit walls to bow. The top course of the north wall and the top four courses of each side wall were of white firebrick headers. Three slots were visible in the upper course of each of the side walls that would have held the ends of bars that supported a grate. Two slots still contained iron plates on their bases. All the upper courses showed heat damage.

The ash pit was 2 m long by 1·12 m wide and survived to a maximum height of 0·62 m. A rectangular modern brick drain-inspection chamber (3029) with pipes running off to the west and north had removed the upper part of the west wall (3210) of the channel (3214) and obscured the relationships between this wall, the brick shaft (3239) and the ash pit. The ash pit was probably part of a furnace placed here to draw bad air out of the mine through the adjacent vaulted channel (3214).

At an unknown date, a rough brick wall (3208) (figs 2, 3, 18) was constructed which sealed off the ash pit from the channel (3214). It was built obliquely across the mouth of the ash pit to create a curving corner. The channel would seem to have remained in use for ventilation after the furnace served by the ash pit was walled up.

SUMMARY OF PERIOD 4

Remains of this period were confined to the channels, probably originally entirely vaulted, and associated furnace which ventilated the shaft in the 1890s or early 1900s. Most probably these structures were provided when B Pit became an air shaft of the Rising Sun colliery which began working in 1908.

THE KNOWN HISTORY OF B PIT

SOURCES

The following papers preserved in the Northumberland and Durham Record Offices were found most useful in establishing the following outline: Buddle Senior's Memorandum book of the 1790s (NRO 3410/BUD 18); John Buddle's outline account of the history of the colliery, written in the 1830s (NRO/ZAN/MIS/A/22); correspondence between Buddle and Russell (DRO/Br/B 252); a list of stock at the colliery compiled by Buddle for potential lessees in 1833 (DRO/NCB/I/JB/2340); correspondence between Buddle and a committee examining the mine after the disaster of 1835 (DRO/NCB/I/JB/2358).

The historically attested developments at the B Pit may be summarised as follows:

1756: Dean and Chapter of Durham advertise leases of the seams under their lands in the parish of Wallsend

1777: Concern leased by William Chapman

1780: After the first shaft was lost in quicksand, A Pit shaft was started and successfully reached the High Main seam. "Shortly after the Coal was sunk to, by the first pit, the original lessees sold their interest in the colliery to Mr Wm. Russell and Wade". These are Buddle's words; but this politeness conceals the

truth that Chapman's mortgagees, Russell, Allan and Wade, had foreclosed and taken possession. Chapman must have bitterly regretted that the pit had not produced its fine coal quickly enough to save his venture. B Pit opened immediately after A Pit (NRO/ZAN/MIS/A/22).

1782: A double water wheel with water supplied by a beam engine was erected at B Pit to draw coals (ibid.)

1783: Brand, describing what he had seen in a visit probably in that year, states that "the present fire engine stands 6 yards to the north of the Wall..." at B Pit (Brand 1789, vol. 1, 604).

1784: An explosion occurred in the B Pit, which set fire to the mine. The workings were filled with water to extinguish the fire (NRO/ZAN/MIS/A/22).

1792: John Buddle mentions "... at 70 fathoms a drift [from the A Pit] leading to the engine which carries [water] from above this depth to the low set at the B ... the present working engine". He is also building a tube [furnace flue shaft] for the B Pit furnace (NRO 3410/BUD 18).

1793: A new 72 inch diameter cylinder ordered for B Pit, the old one being corroded through and repaired (ibid.).

1794: The "present ... engine" cylinder is 67.5 in diameter, wrought by two boilers, one 16 ft diameter and the other 14 ft diameter. Cylinder length 10·5 ft. It draws three sets of pumps ... The B Pit engine is "supposed to have 14 or 15 hours of water to draw in the 24". A memorandum specifies materials for the new B Pit engine, including "four columns to support the cylinder" (ibid.).

1820–1: Working of Bensham seam beneath High Main seam began. The B Pit never reached the Bensham seam and became an air shaft (see Buddle's letter to Russell, D/Br/B 252).

1831: High Main seam closes (Richardson 1923, 236–7).

1832: A list of stock to which a new lessee of the mine would be entitled does not list an engine at the B Pit, though listing one at all others A, C, D, E, F and G. Instead it says that a gin and crabs at the B Pit are worth £134 (DRO/NCB I / JB / 2346).

1835: The disastrous explosion, in which 102 men and boys died, occurred. Letters from John Buddle to a committee of Newcastle men about reopening the mine, after the explosion, and relighting the furnaces and to arrange an examination to verify that the ventilation is functioning properly, mention a pipe-drift and furnace at B Pit (DRO/NCB/I/JB/2358).

1847: The colliery closed Saturday 20th November. It is leased anew in 1848, 1854 and 1864, but there are no references to the B Pit, and flooding effectively stopped the mine working in 1854 (Richardson 1923, 239–249).

1858: B Pit has disappeared except for an [air] "shaft" on the first edition Ordnance Survey of 1858

The last use of the B Pit was as an airshaft for the Rising Sun colliery which opened in 1908 (Richardson 1923, 268). The shaft was capped in the 1970s.

INTERPRETATION OF THE REMAINS IN THE CONTEXT OF DEVELOPMENTS IN MINING TECHNOLOGY AND KNOWN DEVELOPMENTS AT B PIT

ENGINES FOR COAL-RAISING AND PUMPING

Effective beam engines for pumping water and, later, driving winding gear were being produced by 1712 to Thomas Newcomen's design. These used the rod of a piston in an open-topped cylinder to move a beam. The piston was made to descend by creating a vacuum underneath it in the cylinder using the condensation of steam. The pressure of the atmosphere would then press the piston down so moving the beam. The piston was raised again by the "counter-weight" of the pump-rods attached to the other end of the beam. As

normal air pressure operated the piston this kind of machine was called an "atmospheric engine'. The first known date for the water whim (pumping engine and waterwheel winder combination) is 1767, introduced and patented by Joseph Oxley of Hartley, Northumberland.

Before the atmospheric engine, motive power for mining operations was either horse or human muscle. During this period the gin or whim developed. The gin was like a capstan which wound ropes up out of the shaft carrying self-emptying buckets each holding eighty to a hundred gallons of water or baskets (corves) of coals. As mines became deeper the cog and rung gin was invented which had a winding drum set horizontally across the shaft connected at one end with the teeth of a large horizontal gear wheel. This gear was rotated by a vertical axle which was turned via a long horizontal beam pulled round by horses. The whim gin, introduced about the beginning of the eighteenth century, was an improvement as its large vertical winding drum was set up at one side of the shaft and the rope taken over pulleys into the pit which meant that the horses were not continually circling the shaft. John Buddle states in his "Notes on the Development of the Wallsend colliery:

"... At that time, the only mode of drawing coals was by horses in a rotary machine called a 'gin'. Six or eight horses were generally attached to this machine at the same time and after working four hours, to what was called the shift, a fresh set relieved them.... The great number of horses required and the small quantity of coals that they could raise from the depth of one hundred fathoms [600 feet or 182·88 m] prevented this colliery from being in production of profit until after the introduction of water wheel machines for drawing coals. This important discovery... seems to have been adopted by the coal owners of Northumberland about the year 1780 and was introduced at Walls-end colliery in the year 1782".[4]

Newcomen engines, "fire-engines" or "whimseys" were used at this time for pumping water out of mines, a function which became more vital as the mines had to go deeper to reach the rich thick seams of the North-east. In the mid-eighteenth century the design of these engines was made much more efficient by the eminent engineer John Smeaton. Buddle, who can be regarded as a prime source, wrote: "At the period of winning Walls-end colliery ... one [Newcomen engine] of the largest dimensions then made was employed.... This engine was however only found equal to the draining of the first pit... it was found necessary to employ an engine at each pit ...".[5]

Farey (1827) states that Newcomen engines required a substantial engine-house with the lever wall, in which the beam was pivoted, strongly built so that it could absorb the powerful forces produced by the movements of the "great lever", the beam or "bob" which was set in an aperture through the wall at about third floor height (see figs 19, 20). Most but not all beam engines were enclosed in stone engine-houses but some are shown in contemporary figures either in the open or, more often with the cylinder and controls protected from the weather in a wooden casing. The Hair etching of the "Wallsend airshaft" shows the engine-house as a rather insubstantial wooden shed (fig. 21). The B Pit may have looked like this. The cylinder was bolted to massive beams which were set into the side walls of the engine-house to withstand the weight of the cylinder and the forces generated within it, especially when starting the engine. Farey (1827) shows a Newcomen engine designed by Mr Carr in 1790 secured at its central portion by beams as described above but also bolted down to other beams crossing the engine-house at first floor level by four columns attached to the bottom of the cylinder. It is known that a superior Boulton and Watt engine was installed at Wallsend in 1796.[6] In this kind of engine the cylinder was no longer placed above the boiler but was bolted very firmly onto a massive stone base below one end of the beam. The presence of a boiler directly below the beam in Period 2 seems to rule out B Pit as the recipient of a Boulton and Watt engine. The most distinctive archaeological trace of such an engine would be the massive

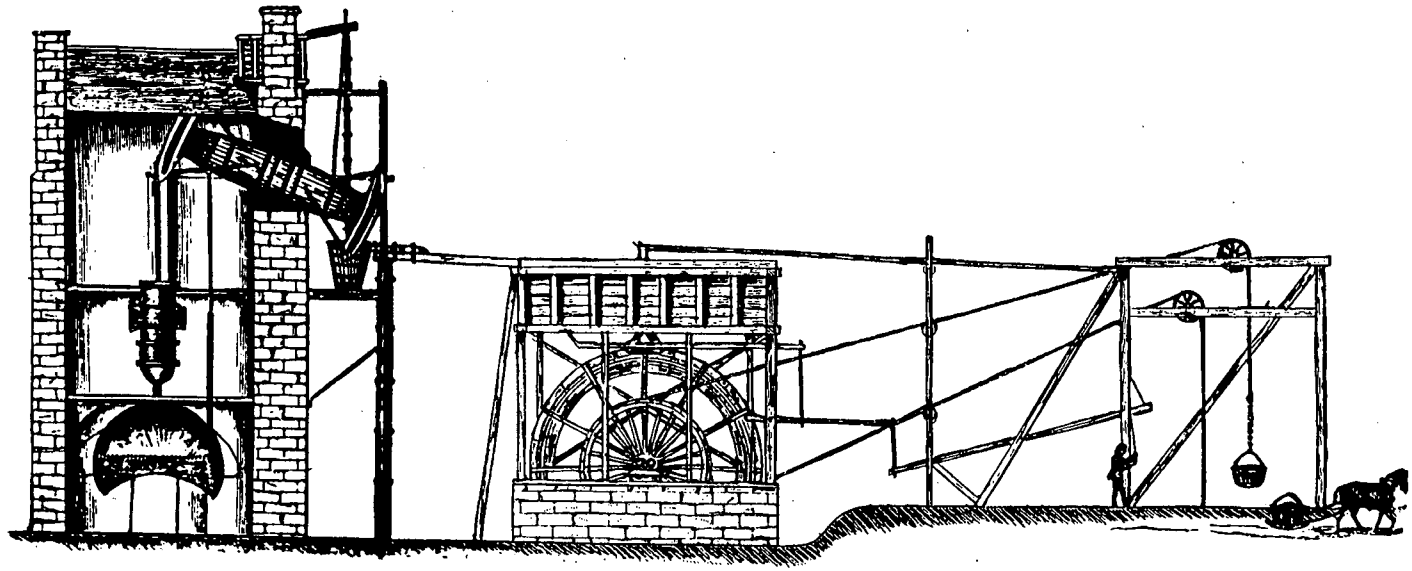

Fig. 19 A view of a double bucket wheel called a fire engine (from Boyd Nelson 1892, facing p. 35).

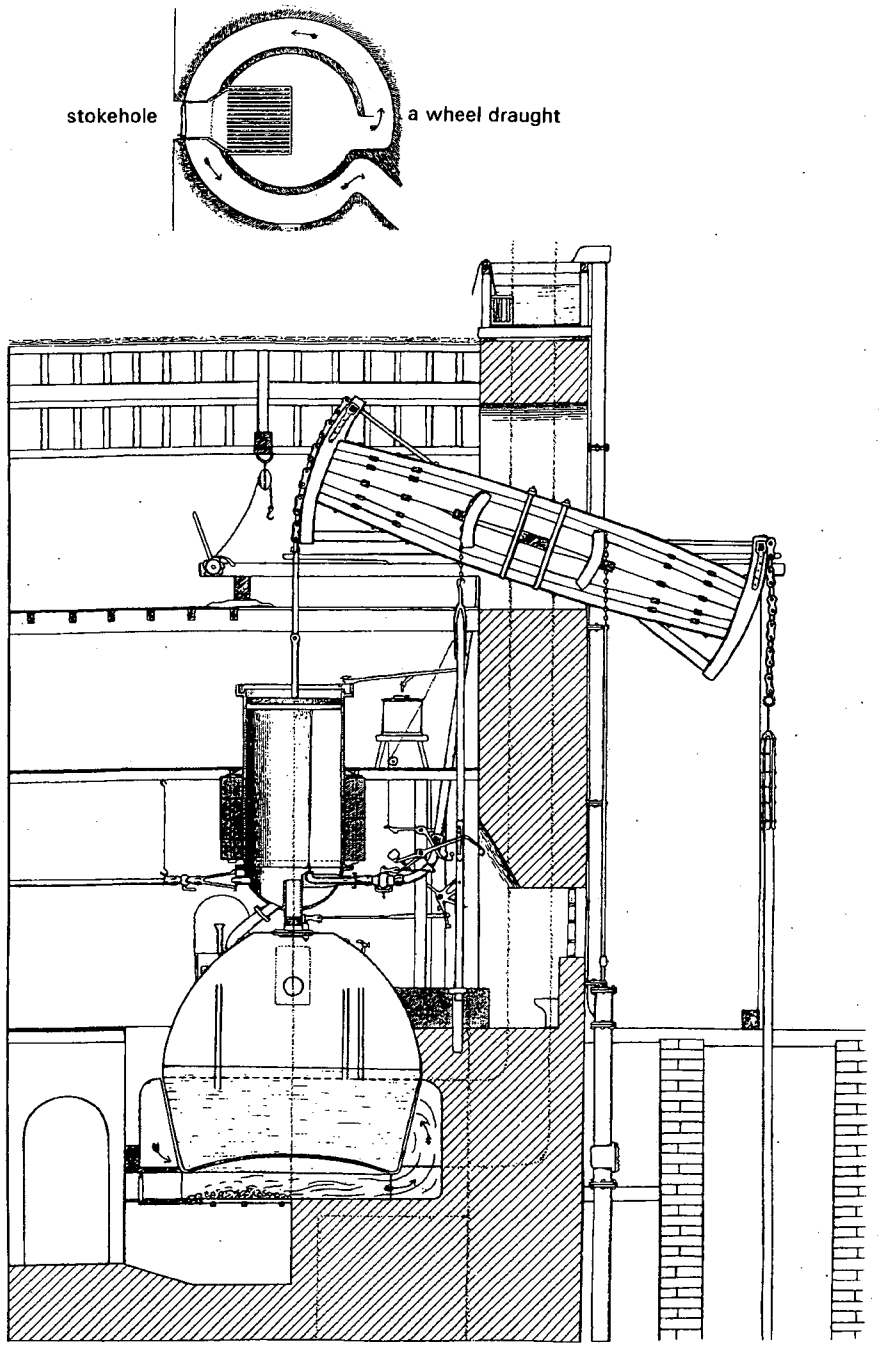

Fig. 20 Elevation of an engine-house showing the shaft, the beam, the cylinder, a haystack boiler and wheeldraught. Above: diagram of a wheel-draught. (From Farey 1827.)

stone cylinder-base, with iron studs projecting upward and nothing of this kind was seen on the site at any period. The Period 3 stone structure was not strong enough to be such a cylinder base and there was no lever wall standing in Period 3.

A Newcomen engine operating a beam is therefore the kind of machine that must be envisaged working with the lever walls of Periods 1 and 2 at Wallsend B Pit, with a cylinder on four columns directly attested at in or shortly after 1794, probably in connection with the Period 2 (northern) lever wall, which, immediately adjacent to the shaft, was mainly concerned with pumping. In speaking of "the present working engine", Buddle employs a phrase which usually means the pumping engine rather than the winding engine.

What devices were being worked by these engines? In his account of the colliery Buddle junior describes a double-bucket water-wheel at B Pit in 1782 for winding coals. The fire engine "6 yards north of Hadrian's wall ..." mentioned by Brand in *c.*1789 could refer to a Newcomen engine which might have provided water for the water wheel referred to by Buddle. If the engine stood 6 yards north of the Roman Wall this would have to refer to the position of the Period 1 lever wall as the Period 2 wall would be twice this distance from the Roman Wall. An arrangement of coal-raising gear between a lever wall and a shaft is illustrated in the example in fig. 19. Looking at this illustration, it is doubtful whether the distance between the Period 1 lever wall and the shaft is sufficient to accommodate the water-wheel described in such detail by Buddle: "Two water wheels [were] placed side by side upon the same axle as a roller upon which the ropes were wound, had their buckets placed in opposite directions. A large cistern, placed above the wheels, supplied them alternately with water, by which the two ropes were drawn up the pit alternately. A friction wheel and brake regulated the motion when the corves were drawn to the top of the pit; and a steam engine replenished the cistern with water, as it fell from the wheels; so that the same water was constantly employed ...".[7] Nevertheless it seems from the distance of the Period 1 wall from the shaft that at this period the pit was drawing coal and that some winding gear occupied the space between wall and shaft. Perhaps the excavation did not contact levels and remains connected with the water-wheel phase, after all the earliest attested at B Pit, and perhaps the Period 1 remains were associated with a replacement of the water wheel, such as a Boulton & Watt steam winder which could have been installed at B Pit, not as early as 1780, but conceivably before 1792. It was not possible in the time available to consult the Boulton & Watt papers at Birmingham library, which might in future shed light on this problem. Alternatively the water wheel may have operated with the Period 1 lever wall and taken a more compact form than that in the schematic text-book illustration. The possibility should not be ruled out that Buddle, who was writing in the 1830s, almost half a century after the event, was simply mistaken in ascribing the "water whim" to B Pit.

The historical sources therefore suggest that a coal raising device consisting of a double bucket-wheel, possibly succeeded by other arrangements, was operating at B Pit from 1782, probably replacing a horse gin. The coal raising ceased and pumping commenced or was continued by a engine powering pump rods at the B Pit before 1792. In terms of the site evidence, this change of function is almost certainly marked by the replacement of the southern lever wall by the one closer to the shaft, in other words the beginning of Period 2.

BOILERS AND THEIR BASES

Boiler-bases must have existed in connection with the Period 1 lever wall, perhaps enclosed by the wing walls to either side of the lever wall, but no trace of these was seen. The earliest boiler-bases observed on the site belonged to Period 2 and the northern complex of walls. The workings of such "haystack boilers" were described in the text of the main excavation report. Can we identify the boilers on the ground with any historically attested phase? Two boilers clearly belong together, with the

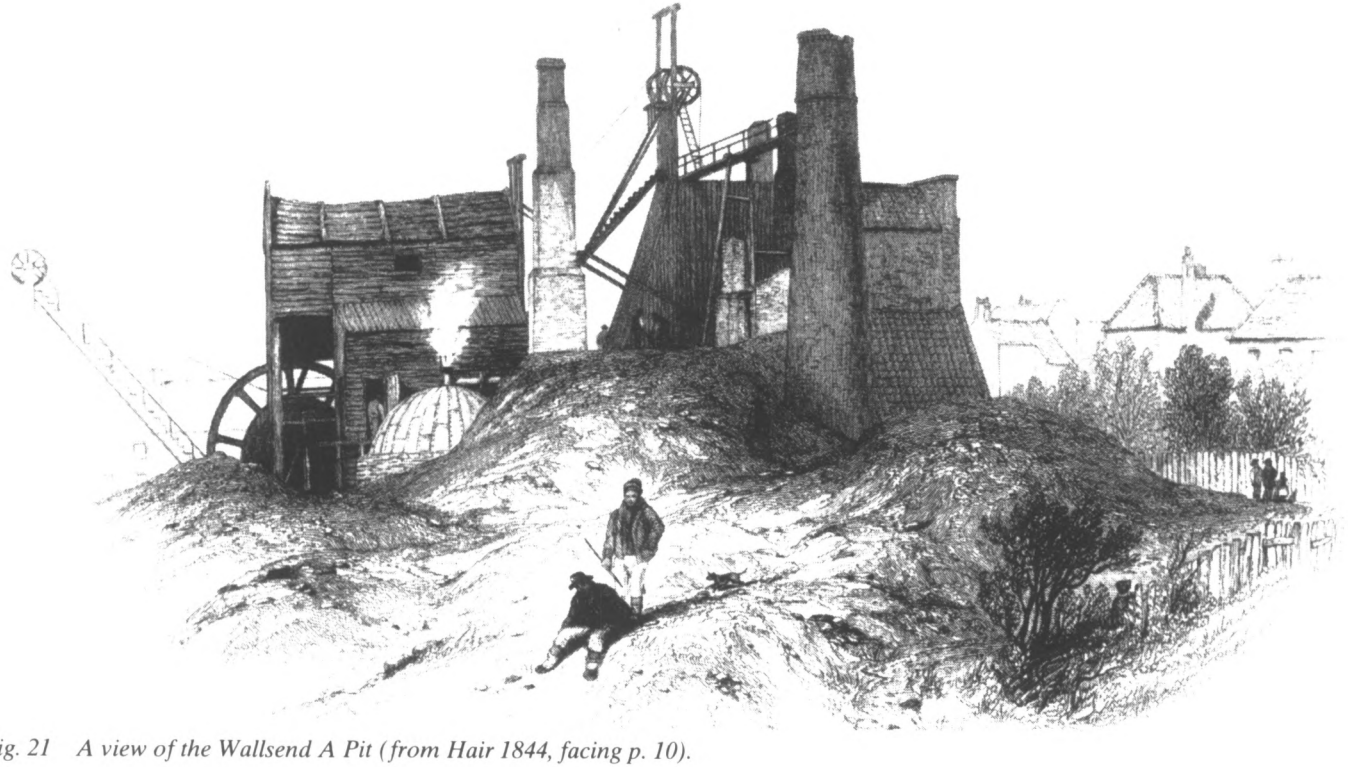

Fig. 21 A view of the Wallsend A Pit (from Hair 1844, facing p. 10).

Period 2 lever wall. The southernmost in contrast did not originate until Period 3, when the lever wall was demolished; the westernmost may also not originate until Period 3 and is of significantly different design to the earlier two. In 1794, as we have seen, the "present" B Pit engine was described as served by two boilers of 16 ft and 14 ft diameter. Boilers are described in Farey as seated on the brickwork of their bases by 4 in or 6 in of their outside edges. Measuring across the internal diameters of the two earlier boiler-bases which were recorded on the site in 1997 and allowing 8 in to 1 ft extra for the seating of the iron boilers neither of the earlier boilers on site measures anything like the sizes Buddle states. The most easterly base measured 12 ft 2 in; its western neighbour 12 ft 3 in. The third, and later, complete boiler-base was even smaller. These measurements support the view that the structures uncovered in 1997 must be of later date than 1794: presumably they must represent smaller replacements some time after 1794 but before 1831 when the pit is reported as having no engine, and probably before 1820 when the Bensham seam was commenced. Just possibly the extant bases were provided with the new engine in 1794.

It is important to be wary of simplistic equation of remains on site with historically attested developments: in a period of rapid technological change and intensive use, structures such as these may have been repaired and replaced on many occasions. Shafts changed their roles as convenient from working to laid-in (idle), ventilation, (upcast or downcast), pumping, drawing coals and/or manriding or, if the shaft was divided into two to four compartments by a vertical partition called a brattice, combinations of these roles. Engines could be moved from one site to another. The versatility of being able to remove an engine to another location when required might explain the lack of any traces of an engine-house attached to either the Period 1 or 2 lever walls at the B Pit. It is most likely that the walls at the eastern end of the Period 2 lever wall were parts of a block which encased only the central and eastern boilers. The iron boilers may have been relocated or replaced or repaired due to corrosion perhaps once a year and the construction of their bases on the B Pit site reflected their temporary status in such ways as insubstantial foundations and frequent alterations.

Farey states that all engines should have a spare boiler, so that in the case of repairs or replacements there need be no let-up in the work. Significantly, the boilers described by Buddle, the Period 2 boilers, and the boilers remaining on the site in Period 3, all occur in pairs. It is possible that the westernmost boiler was an addition to the pair already in operation within Period 2. A platform (3102) on the west side of the central boiler may have supported a hot-well (a cistern for topping up the boilers with recycled steam from the cylinder).

Although the more advanced "waggon boiler" was designed by James Watt and introduced with his engines in *c.*1770, there is no evidence of its use at the Wallsend colliery. Neither is there evidence from Wallsend for egg-ended boilers (introduced after *c.*1795), nor for Cornish boilers, associated with the higher pressure Cornish pumping engines introduced after 1806. The illustrations in Hair show only haystack boilers in position. Hair's illustrations were executed in the 1830s. Throughout his book there are very few collieries of the Tyne and Wear area shown more advanced boilers: there are two shown at Whitworth Park. The St Lawrence colliery, in the east end of Newcastle, has long rectangular boiler-bases beside the engine-house, and the etching of Willington colliery, east of Wallsend, has a haystack boiler operating and what may be a waggon boiler lying nearby, not connected to the engine. Hair's views were executed approximately sixty years after the introduction of the waggon boiler, and show the older haystack or spherical boilers still in use at the majority of collieries of the North-east coalfield. Both kinds of boilers produced steam of the same pressure. Waggon boilers were more thermally efficient, but that hardly mattered to the coal owners of the North East, who had unsaleable small coal to spare, and had no wish to invest in new technology unless it saved them money.

THE FINAL PHASE OF THE WORKING PIT

In 1834, when the mine was becoming less profitable, a valuation list shows engines with their value for sale at every pit but the B Pit where there are ... "only crabs and gins worth £134. 12. 1d". Crabs and gins would usually be used for manoeuvring equipment, especially pump elements, in the shaft. As there was no engine present these were presumably not concerned with either pumping or raising coals. Perhaps the crabs and gins were dismantling equipment in the shaft or used for man riding. Later, much activity and maintenance work at the B Pit still requiring the presence of crabs and gins is attested in connection with measures to improve ventilation following the disaster of 1835. The only structure found in excavation that could possibly be recognised as part of a crab or gin, was the Period 3 stone base (3023). This structure could have encased a capstan holding stone, an example of which has recently been found in further excavations on the site adjacent to the B Pit. It would therefore be tempting to associate Period 3 with the time after 1820/1831 and before the demolition of all structures south of the shaft, probably shortly after 1847. The major difficulty of interpretation is that the Period 3 stone base seems to be associated with the two later boiler-bases. A possible explanation would be that the base was that of a "steam-crab" or "steam-crane": such devices are mentioned in a treatise of the 1890s (Fairley 1896, 101), but may have been introduced to the North-east coalfield from the 1830s onwards (Pers. comm. J. Rees). In this case the two later boilers would have been constructed after 1834 and probably demolished just after 1847.

VENTILATION SHAFTS

Ventilation was a constant problem in the Wallsend colliery, in part due to the extensive workings, and it became a greater difficulty after 1820 when the "firey" Bensham gas coal was worked 204 ft deeper than the High Main seam which was 720 ft down at the A Pit. One method of tackling the chronic ventilation problem was the use of furnaces. A "tube" was the local term for an underground "rarefying" furnace and its flue. Underground furnaces were usually located in drifts connected to the shaft to minimise the risk of explosion. They were tunnel vaults of brick with a grate standing in one end. The heat of the fire on the grate drew in the foul air from the workings and the brick "tunnel" created a through draught to pull the air up the shaft. Pit shafts had tall tapering stacks built over them to increase this current and disperse the foul smoky air. An improvement of this system was to sink a separate shaft down to the furnace drift so that the foul air was drawn into the drift by the furnace and up the separate shaft and then a very tall stack, which increased the draw and released the fumes well above ground level. Many of the views painted by Hair show these chimneys at the pitheads. They are usually very broad and high with a conical roof or cowl provided with a slot shaped opening. A wooden vane beside the slot often swung to and fro to disperse the fumes. Not all furnace chimneys were so elaborate; many were simply square or round stacks.

West of the main shaft at B Pit, a brick-lined shaft (3118), 2 m in diameter, was discovered, but with no traces of stack foundations. The inside of the shaft was coated with a grey laminated concretion. This strongly suggests that the shaft was above an underground furnace at the B Pit with coatings of fumes baked onto its interior. Two other brick lined shafts were found and are also best explained as "tubes" rising from underground furnaces. The eastern shaft (3091) probably had a grill across its mouth at the level to which it survives today and it also had an enclosure (3027) built across its brick-lining at this level. The enclosure, like the grill was probably to prevent surrounding waste heaps from falling into the shaft. These facts suggest the possibility that this shaft had no stack above ground level; in the case of the others, stack foundations might have been robbed away.

It is uncertain to which period these shafts should be attributed, or even whether they

were in use at the same time; for convenience they are shown together on the Period 2 plan (*c.*1792–1820/31). Buddle was building a tube for a furnace at B Pit in 1792.[8] There was at least one furnace at B Pit in 1821, used to draw air down the C and G pits after the "prodigiously firey" Bensham Seam had been contacted by those shafts.[9] Again, after the disaster of 1835 the furnace of B Pit was examined and it was recommended that the A Pit furnace should be provided with a pipe-drift similar to that at B Pit.[10] Both shafts 3118 and 3239 cut a clay dump of Period 2. These shafts would therefore seem to have been variously in use during Periods 2 and 3.

In summary, the following dates and functions may be suggested for the main archaeological periods at Wallsend B Pit. It must be stressed that these are provisional conclusions based on the limited amount of excavation and documentary research that has been carried out, and that further excavation or research in the future would still find much to discover, and perhaps modify these results.

Period 1 (From 1780 to some date before 1792):
Coal raising with engine set back from shaft.

Period 2 (From before 1792 to a date between 1821 and 1832):
Pumping with engine set at edge of shaft.

Period 3 (From between 1821 and 1832 until 1847):
Air shaft; use of crabs and gins, with addition of steam power after 1832.

LATER DEVELOPMENTS

The colliery closed in 1847. The last time the colliery lease was taken up was in 1864 by Joseph Anderson. These later leasings were of short duration as flooding made the colliery impossible to re-open and the attempts each lasted only a few years. Only the G Pit was reopened successfully but this took many years of intensive investment and pumping. The demolition of the Period 3 structures at B Pit therefore probably occurred in the late 1840s or early 1850s, a dating borne out by the pottery and clay pipes recovered from the fill of the western boiler fuel pit.

From then on B Pit served only as an air-shaft: the Period 4 structures to the north of the shaft fall into place very well as a ventilation furnace and flue connected with the opening of the Rising Sun Colliery in 1908. A date close to this is indicated by the brick-types.

Many collieries which began in the era of the Wallsend colliery continued in use into the present century and so the earliest buildings have, on most sites, been swept away or buried by developing technology and architecture. Many other pits when finished have been built on by the spreading towns and villages of Northumberland and Durham. Like the major part of our industrial heritage others were removed because they were regarded as unsightly and of no historic interest. Other sites in the north-east coalfield may prove to have substantial remains from the period which concerns us here but they have yet to be uncovered, as demonstrated by the recent discovery of a contemporary timber colliery waggonway at Lambton. The Wallsend colliery site is therefore a very unusual survival from the early days of deep coal mining. It is also a fragment of a colliery which was one of the most famous in the world, with its viewers John Buddle senior and junior considered among the most eminent mining authorities of their day. It is a fortunate chance that such a rare survival was found within the limits of the archaeological park being created by the Segedunum project, and can thus be partly left on permanent display, a monument to the early development of modern Wallsend and a reminder of the central role of the town in the first industrial revolution.

THE BRICKWORK

The bricks used in all structures except the channel (3214) and furnace (3213) north of the shaft were of hand-moulded eighteenth to

mid-nineteenth century type. The mortar was white, soft and usually contained many flecks of grey and black ash. A few structures had a jointing of greenish grey mortar that was more closely related to modern cements (pers. comm. J. Rees) The bricks were "commons" or "seconds" and when exposed they exuded a distinct film of salt, a constituent of the clay that they were made from. The southern boiler-base (3024) had occasional white firebricks several courses down in its exterior wall and the possible rebuild of the western boiler flue-mouth was also of white firebricks.

Structures north of the B Pit shaft (the so-called "dumb drift") were of a much later type of machine-made brick, probably of the 1890s or1900s (pers. comm. J. Rees). Machine-made bricks were first manufactured in the 1850s. The white firebricks used in the ash pit here (3213) were of very recent origin (pers. comm. J. Rees), yellowish white and coarse-grained.

The bonds on the site were: English garden wall bond (this was the most widely used bond), stretcher bond, header bond and, in a few structures, mixed bond (perhaps for extra strength) as in the wall of the southern boiler-base and the western furnace shaft.

THE SMALL FINDS (FIG. 22)

A. T. Croom

The only context to produce any finds of interest was the pit 3030 (see p. 139). The catalogue entries give identification, dimensions and the small find number. All finds come from context 3014, the fill of the pit.

PIT 3030

The latest pottery from this pit dates from between the 1810s and about 1840, and includes creamwares, whitewares and brownwares (pers. comm. N. Dolan). The latest clay pipes are Public House pipes of the mid-nineteenth century and a pipe marked Cutty Pipe of about 1840 or shortly after. The one clay pipe dated later (1871–1906) is presumably intrusive.

SMALL FINDS

The catalogue entries contain description, dimensions, context number and small find number where relevant.

1. Copper alloy drawer handle (L:79 mm W:36 mm B:4 mm) WSCA533
Drop drawer handle, eighteenth-nineteenth century type.
Parallels: Bishops Waltham: Barton 1969, no 94, eighteenth century
South Shields: Allason-Jones and Miket 1984, 3.427

2. Copper alloy thimble (D:13 mm L:15 mm) WSCA535
Flat topped thimble, with indentations over two-thirds of the sides.
Also: WSCA534 (D:11 mm L:19 mm) Similar design.

3. Copper alloy button (D:25 mm B:10 mm) WSCA539
Flat circular button with alpha attachment loop. Traces of gilding survive. Eighteenth-nineteenth century.

4. Bone button (D:12 mm B:3 mm) WSB508
With a concave face and three holes in a line. Such utilitarian buttons appear from the late seventeenth century onwards (Margeson 1993, 22).

5. Bone disc (D:32 mm B:5 mm) WSB509
A bone disc with a flat lower surface, and a slightly domed upper surface with lathe-turned grooves and ridges. The central hole has a screw thread, and there are two surviving holes near the outer edge. This is probably an element of a needlework accessory such as a thread reel or thread waxer from a work box (Rogers 1983, pls 125–7). A similar type of tape measure (which would not need the central screw-thread) has a base with an outer circle of small holes to attach an emery cushion below (Proctor 1990, pl 30, i). There is, however, a disc from Canterbury with a central screw thread (but no outer circle of holes) that

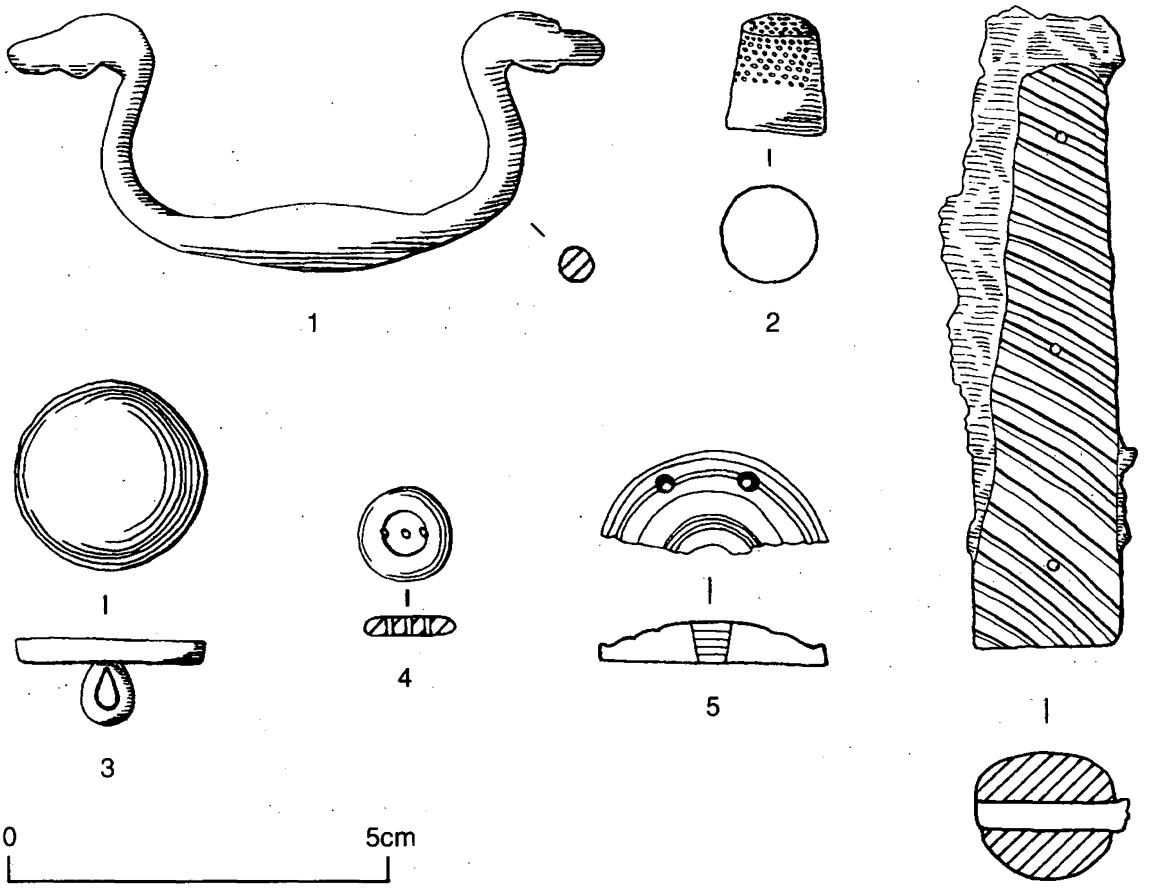

Fig. 22 Small finds. Scale: 1:1.

is the base of a three-piece chess piece (Greep 1995, fig. 505, no. 1048, post-1800). Nineteenth century.
Parallels: South Shields: Allason-Jones and Miket 1984, 2.216
Dorchester: Draper 1993, fig. 109, no. 27, from pit dated 1780s-1790s; larger central hole

6. Bone cutlery handle (scale L:77 mm W:19 mm B:6 mm handle W:16 mm) WSB507
Two bone scales with diagonal incised lines, attached to an iron tang by three iron rivets.

STRUCTURAL IRON FINDS (FIG. 23)

1. Iron hoop (L:830 mm W:48 mm B:20 mm) 3065, WSFE 596
A hoop with much corrosion concealing its exterior. The entire interior has impressions of

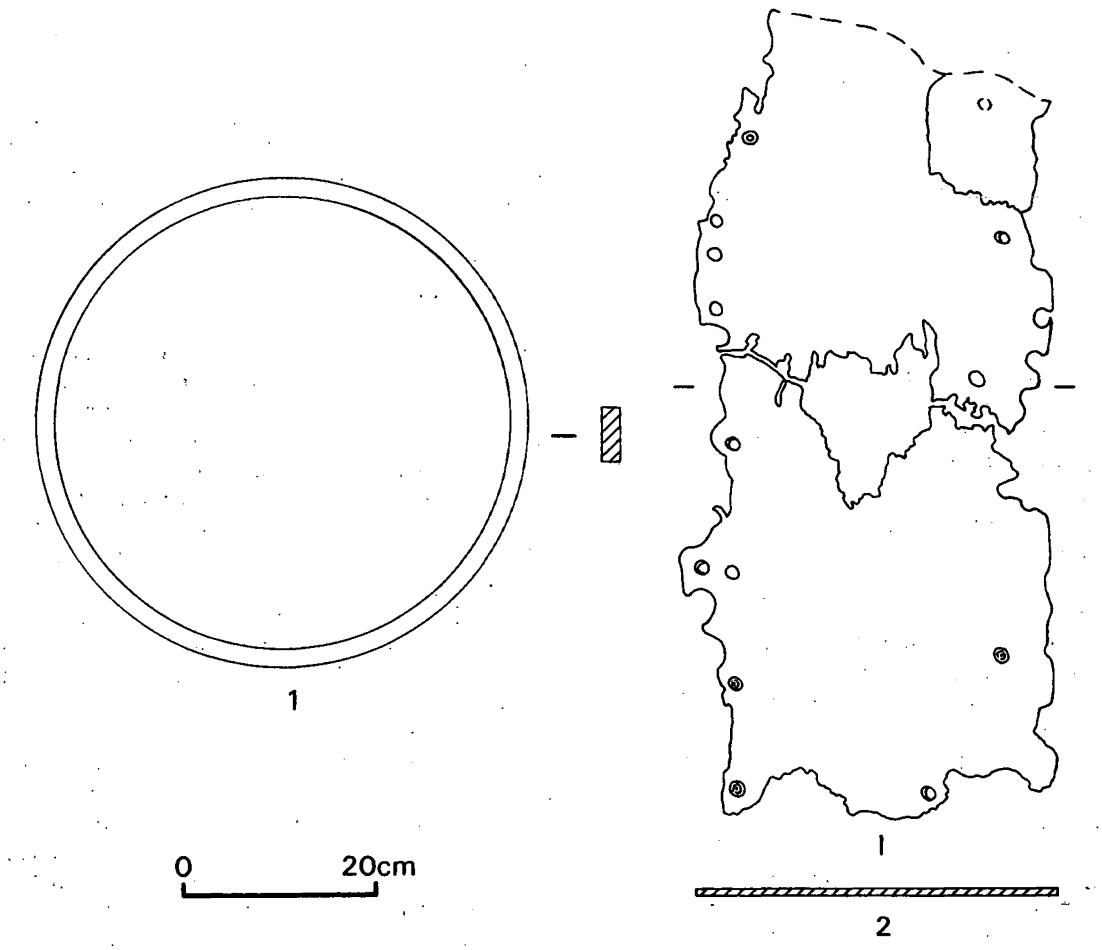

Fig. 23 Ironwork. Scale 1:8.

wood preserved in the corrosion with its grain perpendicular to the hoop. This object is probably a ferrule to prevent the end of a large timber, an axle or pivot perhaps, from splitting (pers. comm. J. Rees).

2. Boiler plate (L:805 mm W:392 mm B:5 mm) 3002, WSFE594
A flat plate found folded in half. Two lines of rivets can be seen along one side and two or perhaps three lines of rivets along the other side. A rivet hole at one end is close to the centre-line of the plate. This is probably a plate from the bottom of a haystack boiler (pers. comm. J. Rees). It was found in an ash-pit belonging to this type of boiler. On the side of the plate illustrated, no rivet heads survive. Some holes are filled by laminated metal, from the shank and the base of the head of the rivet, which in some instances

spreads up to 10 mm beyond the edges of the hole. Many of the empty holes have indented edges caused by the head of the rivet. Corrosion products fill most holes. The diameter of the holes ranges from 15 mm to 20 mm.

THE ANIMAL BONES (TABLE 1)

L. J. Gidney

INTRODUCTION

The quantity of animal bones recovered was small, much of which was poorly stratified having been found in the general overburden of demolition debris. The initial assessment indicated that preservation was excellent, with fish and bird bones being noticeably well preserved.

Methods

Since this site produced a small assemblage of comparatively recent material, only one context was selected for further analysis (3014). A restricted suite of information was recorded: fragment counts for the species present; skeletal elements; epiphysial fusion; tooth wear; measurements. Fragments were only counted as identifiable if they encompassed a discrete "zone", though the zone information was not recorded. This method helps to reduce over-recording of highly fragmented bones and reduces bias in the representation of the common domestic species.

Fragment counts for the species present

Cattle	4
Cattle size	1
Sheep	2
Sheep/goat	55
Sheep size	24
Pig	6
Fowl	3
Goose	2
Partridge	1
Oyster	3
Cockle	1
Total:	102

Species

The table lists the species present in 3014. It can readily be seen that sheep and sheep-size bones dominate this group. Cattle and pig bones are scarce but are also present. Poultry are presented by bones of domestic fowl, goose and partridge. Seafood is indicated by shells of oyster and cockle and some large fish bones.

Only the sheep bones from 3014 were sufficiently numerous to warrant further analysis. Table 1 illustrates the body part presentation of the sheep bones. The bones of the head and scrag end of neck are present but not abundant. Ribs are the most common bone, only proximal ends with the capitulum were counted. These, with the thoracic vertebrae, are the bones of the rib chop while the loin chop is indicated by the lumbar vertebrae. The shoulder bones are more numerous than those of the leg. No attempt was made to articulate the various bones but the assemblage gave the clear impression that articulating bones from joints of meat had been deposited. There is a striking absence of the bones of the lower leg and hoof, which supports the interpretation of these bones as deriving from meat originally purchased as set cuts from the butcher. There are too few measurable bones for analysis. The sheep bones were, however, noticeable large and robust, indicating the percolating to the ordinary consumer of sheep of "improved" type, originally promulgated to breeders from the late eighteenth century.

While the poultry bones are sparse, included among them is a most interesting domestic fowl skull. The protuberance on the top of the skull indicates that it is from a crested breed, and as such is rare, if not unique, in an archaeological context. The anatomy of this peculiarity of the skull, which supports the feathered crest or topknot, is illustrated by Wright (1903, 441). The most common breed with this feature is the Polish fowl, which was a particularly popular exhibition fowl from 1850 to about 1865 (Wright 1903, 442). At this time the breed was regarded as a good layer of large white eggs and producing table birds of 5–6 lbs,

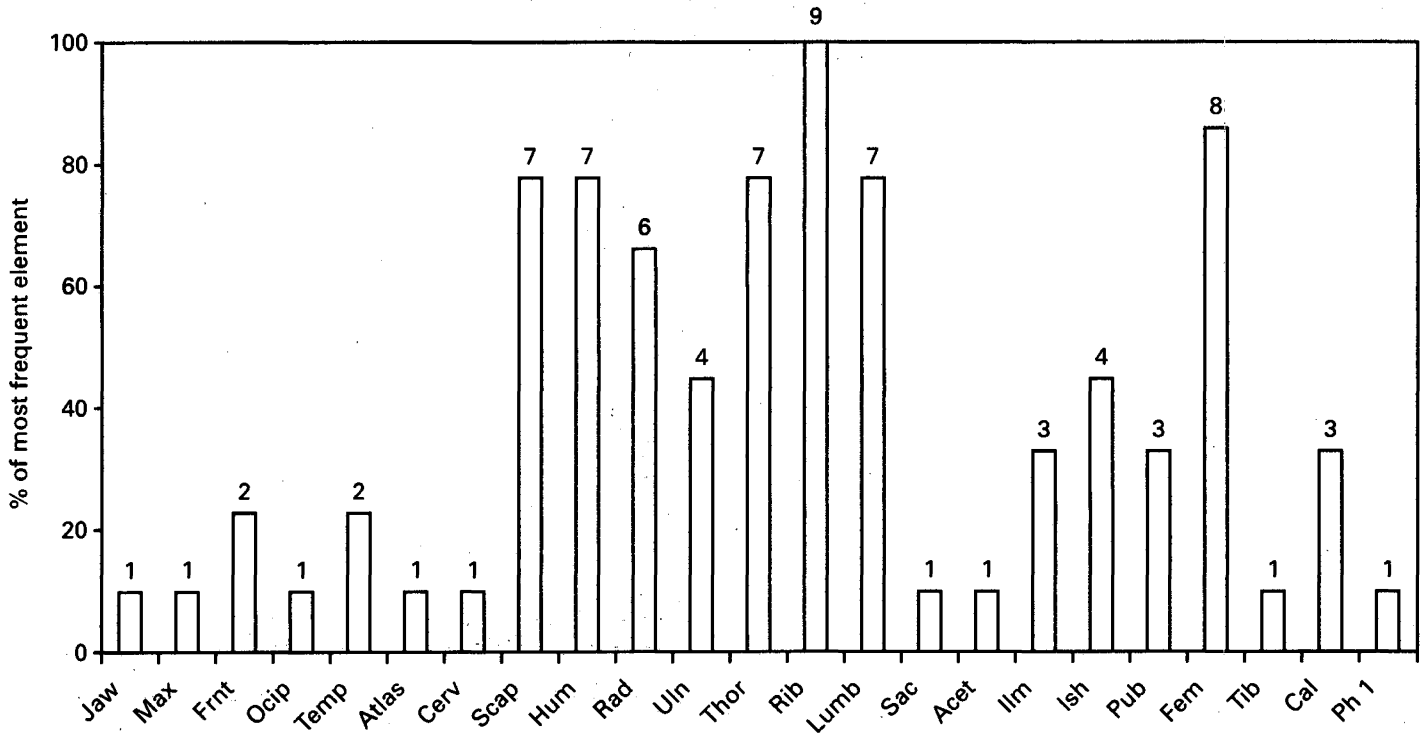

Table 1 Sheep fragments from context 3014.

Table 2 The Clay Pipers.

16th–18th century Pipemakers

Maker's name	Maker's mark	Tyneside bowl type	Tyneside stamp type	Pipe no.	Mark description	Date	Context	Small finds no.
—	—	15	—	1	Plain		3001	WSCP622
—		10	E4	2	On spur	1680–1750	3013	WSCP623
—	(?)/(?)	—	E	3	Indecipherable	1680–1750	3003	WSCP624
—	(?)/(?)	—	E2	4	Indecipherable	1680–1750	3058	WSCP625
—	—	14	—	5	Plain	1700–1780	3058	WSCP626
—	—	14	—	6	Plain	1700–1780	3000	WSCP627
—	(E or F)/B	—	E2	7	Spur mark	1680–1750	3014	WSCP516
—	? / B	—	E2	8	Spur mark	1680–1750	3014	WSCP517
—	? / E	11	E2	9	Spur mark	1680–1750	3014	WSCP522
—	(T or F)/E	Pars 13	E2	10	Fluted bowl	18th/19th C	3014	WSCP524
—	T/E	—	E2	11	Spur frag. only	1680–1906	3014	WSCP527
—	—	Pars 13		12	Bowl with mould flutes, shield and dragons	1780–1840	3014	WSCP518
—	—	Pars 13		13	Bowl with mould flutes and ribs	1780–1840	3014	WSCP532
—	—	Pars 13	E2	14	Indecipherable	*c.*1680–1750	3014	WSCP530
—	E/C		E2	15	Unknown	1680–1750	3058	WSCP543
—	—	15	—	16	Bowl with dancing figures	*c.*1700–1780	3049	WSCP555

Abbreviation: Pars = Parsons

19th century Pipemakers

Maker's name	Maker's mark	Bowl type (Parsons)	Pipe no.	Mark description	Date	Context	Small finds no.
—	—	18	17	Plain	1840+	3011	WSCP621
G Ruddick	Parsons D	—	18	(G RUD)DICK/BURN(S CUTTY)	1871–1906 or 1905–1908	3014	WSCP539
—	—	14	19	bowl with stylised shamrock decoration	1800–1850	3014	WSCP523
—		14	20	bowl with mould flutings; hen and a tankard on bowl. Public house bowl	?mid 19th C	3014	WSCP529
—		14	21	Bowl with stylised shamrock	*c.*1800–1850	3014	WSCP533
—		14	22	Bowl with stylised shamrock	*c.*1800–1850	3014	WSCP521
—	Parsons D	18	23	(C)UTTY PIPE	1840+	3014	WSCP531
—		14	24	Bowl with mould flutes, crown and anchor	mid-19th C	3014	WSCP528
—	—	14	25	Bowl with mould flutes, crown and anchor	mid-19th C	3014	WSCP520
—	—	17	26	Bowl with ribs and swags	1820–1840	3014	WSCP519
—	—	—	27	Roulette on stem	?mid-19th C	3000	WSCP551
—	-	13	28	Bowl with ribs	*c.*1800–1850	3058	WSCP544
—	-	—	29	Bowl fragment only	?1780–1840	3011	WSCP554

having tender, juicy flesh. Fancy fowl of this type were not kept on a commercial scale.

The bones from context 3014 appear to have been deposited in pristine condition with no evidence of canid gnawing or sub-aerial weathering. Many bones had scorch marks, indicating that they had been dumped together with hot ashes.

THE CLAY PIPES (TABLE 2)

S. Speak

The clays from this site came from contexts ranging from 3000–3058. Clay pipes from the pre-Colliery ploughsoils are pipe 1, of *c.*1645–1660 date and pipe 3, which, although possessing indecipherable spur marks, nevertheless is of a type dated to 1680–1750. Seventeen clays were recovered from the fill (3014) of pit 3030, a fuel pit and part of an ash pit filled at the time of the demolition at the end of Period 3. In this context, pipes 7–9, 11 and 14 are 1680–1750; pipes 12 and 13 are 1780–1840; pipes 19, 21 and 22 are 1800–1850; pipe 26 is dated 1820–1840, pipe 10 is eighteenth-nineteenth century; pipes 20 and 23–5 are mid-nineteenth century; and finally pipe 18 is a named clay manufactured by G. Ruddick (from either 1871–1906 or 1905–1908). The only pipe that need be later than the mid-nineteenth century is clay 18, but it is known that the site stood open until the twentieth century and this pipe almost certainly represents a find from the general overburden immediately overlying the fuel pit fill. In general, then, the clay pipe evidence supports a mid-nineteenth century date for the demolition of boiler 3029 and the end of Period 3. This was the only context where the clay pipes recovered were of use as dating evidence.

In other contexts the clay pipes were residual. Context 3013, representing Period 2 demolition, contained pipe 2 belonging to 1700–1780. In Period 3, context 3049 contained clay 16 (*c.*1700–1780). Period 4, probably late nineteenth or early twentieth century activity, is represented by 3058, which contained 2 clays of 1680–1750 (nos 4 and 15), the latter with an Edwards (1988) stamp type E2 spur marking E/C (maker unknown) and one of 1700–1780 (no. 5). Pipe no. 28 from the same context is a ribbed bowl *c.*1800–1850. The site overburden (3000 and 3011) contained clays 6 (1700–1780), 27 (?nineteenth century), 17 (1840+) and 29 (1780–1840).

ACKNOWLEDGEMENTS

The development at Segedunum is funded by the Heritage Lottery Fund, European Regional Development Fund, Northumbrian Water Kick-Start Fund, National Heritage Arts Sponsorship Scheme, Bellway Urban Renewal and North Tyneside City Challenge. Thanks are due to Gary Brogan, assistant supervisor, and to the specialists who contributed to the finds report: Alexandra Croom, Steve Speak, Nick Dolan (all Tyne and Wear Museums) and Ms L. J. Gidney (University of Durham). Michelle Taylor produced the drawings with contributions from Mark Jenkins and Paul Carrick. Karen Denning gave administrative assistance. Thanks must also go to the many volunteers who worked alongside staff on the site. Seminars and visits by individuals and groups from regional and national industrial archaeology organisations contributed to the site interpretation. All those who visited the site are thanked for their contributions, particularly John Clayson (Tyne and Wear Museums), who also kindly agreed to read the report in draft, Andy Guy and Jim Rees (Beamish Open Air Museum) and David Cranstone. Thanks are also due also the staff of the Durham and Northumberland County Record Offices.

NOTES

[1] Church Commission. Dean and Chapter of Durham. Plan 13675.
[2] NRO/ZAN/M17/197/a no. 60
[3] NRO/ZAN/M17/197/a no. 62
[4] NRO/ZAN/MIS/A/22
[5] NRO/ZAN/MIS/A/22)
[6] DRO (D/Br/B 178)
[7] NRO/ZAN/MIS/A/22
[8] NRO 3410/BUD 18, p.3
[9] DRO/Br/B 252
[10] DRO/NCB/I/JB/2358

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