The military bath house at the Roman fort of Chesters, Northumberland

Margaret Snape and Graeme Stobbs

SUMMARY

The well-preserved extra-mural bath house at Chesters fort on Hadrian's Wall belongs to a small group of Hadrianic bath houses along the frontier so similar in plan as to suggest the work of the same architect. Four campaigns of excavation and survey at Chesters bath house have produced a wealth of data, enabling the building's complex structural history to be deduced.

Like the other examples of this group, Chesters bath house began not as the simple row-type, but the more sophisticated ring-type in which bathers circulated through a series of rooms without retracing their steps. However a later period saw a major restructuring; the building was enlarged and new features added, but its highly unusual plan was changed to operate like a simple row-type bath. In late Roman times the building was abandoned for bathing, and used for other purposes, before succumbing to stone-robbing and decay.

INTRODUCTION

Chesters bath house lies on sloping ground *c.* 60m outside the lesser east gate of the fort, and *c.* 20m from the present river bank (fig. 1). The course of the North Tyne has moved north-westwards since Roman times (Bidwell and Holbrook 1989, Fig. 2), thus the bath house lies roughly half way between the fort and the projected former west bank of the river. The building was probably accessed by a road from the lesser east gate. The foundations at the north-east corner apparently rested on 'quicksand and deep loam' (Holmes 1886–7, 127). Subsidence and 'sponginess' of the soil are cited as evidence of a streamlet here, and subsidence is apparent at various points in the north-eastern part of the building (Macdonald 1931, 233–4, 243, 249, 253).

The bath house lies just south of the Roman bridge across the Tyne. In the 160s the Hadrianic bridge was rebuilt to carry the Military Way, the road being raised to the level of the bridge by a ramp. On the west bank the ramp passed close enough to the front of the bath house to overshadow it (for reconstruction drawings see Hodgson 2011, 21).

Operation of a military bath house would be labour-intensive, requiring provision of water and fuel, stoking of furnaces and regular maintenance. As well as providing bathing facilities, they no doubt also acted as centres of relaxation and socialising for inhabitants of fort and military *vicus*. We can imagine these buildings at the height of their popularity, noisy and crowded with bathers, some with their personal slaves, and a small army of cleaners and bathing attendants — female in the morning when women bathed, and male in the afternoon. Proof that Chesters baths were used by civilians as well as the military is shown by the items of jewellery belonging to females found in several rooms (Holmes 1886–7, 129).

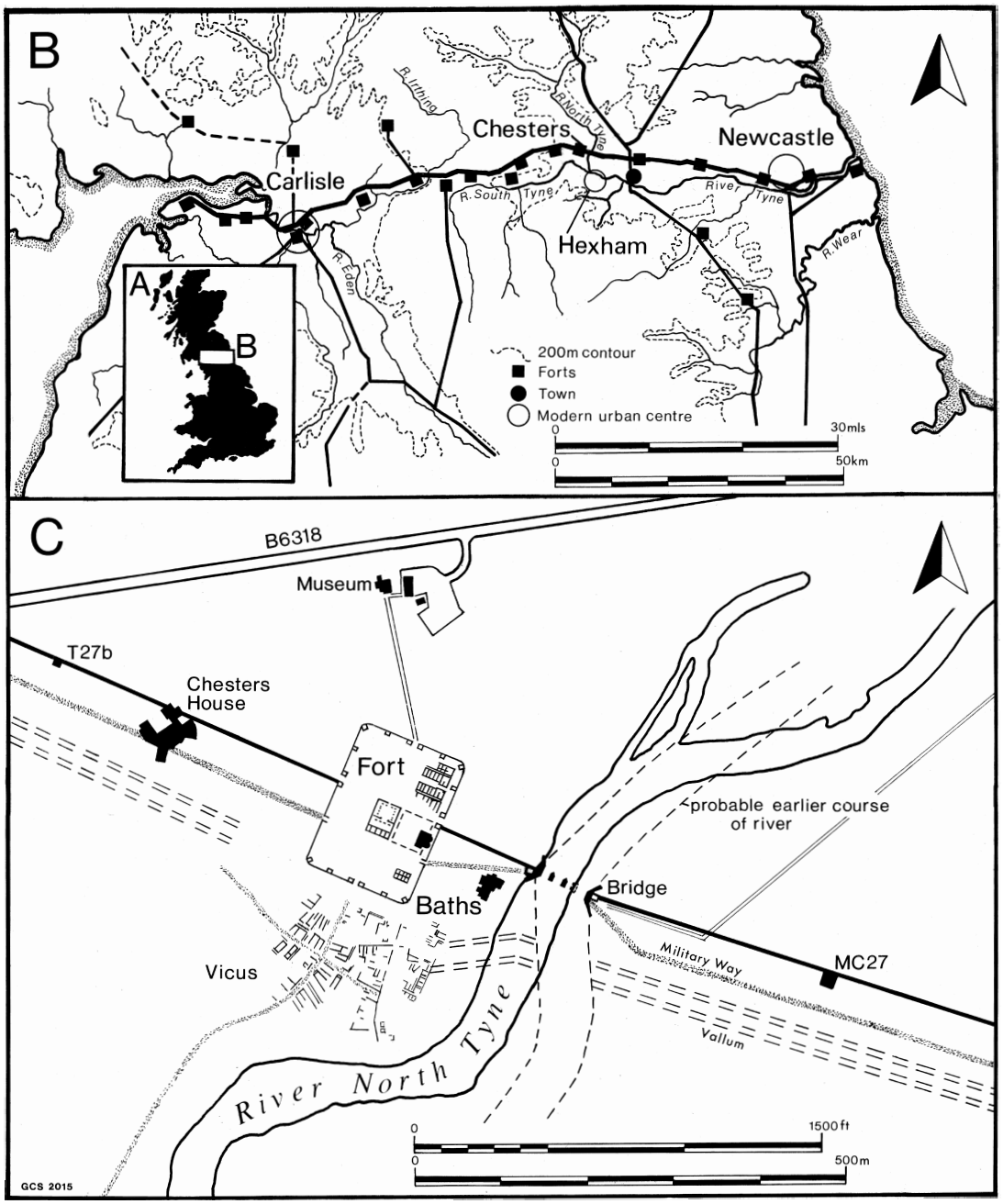


Fig. 1 Location of the Roman bath house at Chesters.

THE PLAN OF THE BUILDING

The most common form of small bath house consists of a suite of rooms arranged in a row, in which bathers passed from a cold room (*frigidarium*), through a warm room (*tepidarium*) to a hot steam room (*caldarium*), before retracing their steps. However the building at Chesters belongs to a small group of military bath houses in the Hadrian's Wall zone with an unusual and sophisticated plan (fig. 2). They are ring-type baths, having a lobby and three warm rooms as well as a *frigidarium* and *caldarium*, the suite arranged in a block around which bathers could circulate without retracing their steps. Other known examples, all of Hadrianic date, are the baths at Benwell (Brand 1789, 606 and plan following), Carrawburgh (Bruce 1874, 17–24, plan facing p. 17), Netherby (Roy 1793, 197–9; Pl. 46) and Bewcastle (Gillam *et al.* 1993). The newly-discovered bath house at Wallsend was also built to the same plan, although later rebuilt on a smaller scale after a landslip (Hodgson 2014, 9; 2015, 22–3). All these examples show great similarity of layout — some aspects being identical — suggesting the work of the same architect (Gillam *et al.* 1993, 1–3, Fig. 3). The bath house at Ravenglass is similar, though not identical (Jackson 1883, 216–24; Brann 1985); the fort of Ravenglass is probably of late Hadrianic date (Bidwell *et al.* 1999, 66).

Buttresses are a common feature on plans of the baths at Chesters, Bewcastle, Carrawburgh and Netherby, though differing slightly in number and position (Gillam *et al.* 1993, Fig. 3). None is shown on the plan of Benwell. At Bewcastle there are three buttresses along the east wall of the first *tepidarium* and another at the south-east corner. In its primary phase the east wall of Chesters baths also had three buttresses along the east wall of *tepidarium* H; the most southerly buttress shown on fig. 2 belongs to a later extension (Period 2a). Investigation of the junction between primary east wall and extension showed that there had never been a buttress there; the south wall ended in a straight joint, the external face of which had been plastered (Gillam 1956–8, 1). On the surviving portion of the equivalent *tepidarium* at Ravenglass there are two buttresses, the rest of the wall being missing (Brann 1985, Fig. 1).

Since buttresses are a common feature of this group, their arrangement is probably not related to local topography but to the design of the structure. It is possible that the need for buttressing may be connected either with the lateral thrust from the roof, or to the design of the wall itself, which could have been pierced by large window openings (Gillam *et al.* 1993, 10–11). The variations seen throughout the group may therefore indicate differences in roof design or provision of windows, or could be the result of later modifications.

Changing rooms (*apodyteria*) built of stone are found at Chesters, Bewcastle, Benwell and Carrawburgh; those at Chesters and Bewcastle are known to be secondary additions, leading to the suggestion that they replaced primary changing rooms of timber (Gillam *et al.* 1993, 22). Bath houses are subject to frequent repair and modification, and the plans of all examples in this group show evidence of modifications. However, only at Chesters, Bewcastle and Wallsend has modern excavation and survey made it possible to propose a sequence of development.

The dry heat of a *laconicum* was an integral part of the Roman bathing regime, and its provision is to be expected in baths with such a sophisticated plan (Paul Bidwell, pers. comm.). There is no evidence of a *laconicum* in the main block of any of the group in their primary phase, although a detached structure could have been provided. At Chesters and Bewcastle a *laconicum* was subsequently attached to the western side of the building, and the plan of Carrawburgh baths suggests that the same occurred there (Bruce 1874, plan facing p. 17).

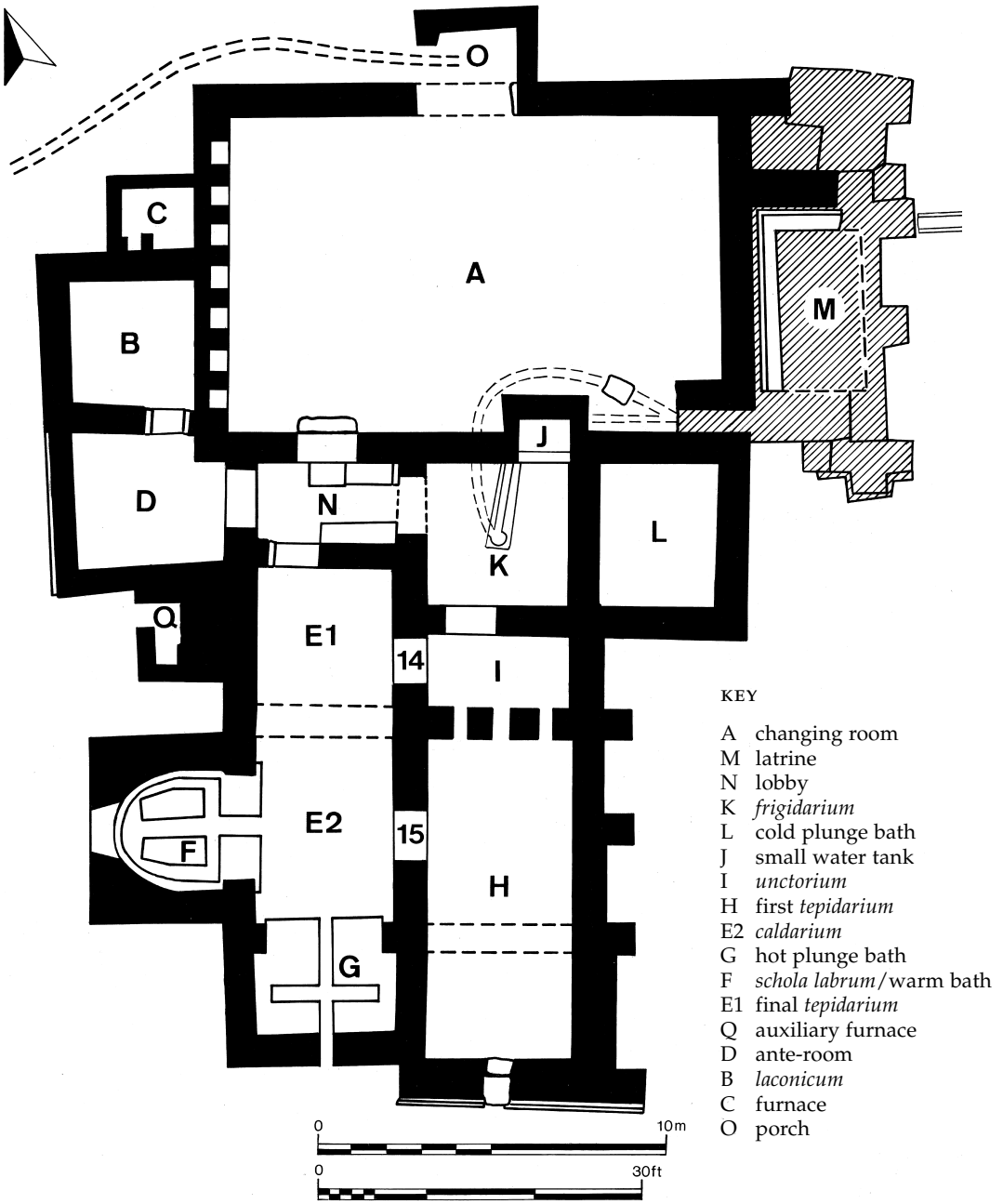


Fig. 2 Plan of the surviving remains of the bath house. (Surveyed by TWAM Archaeology Department in 1997. Lettering and numbering as plan by W. Parker Brewis in Macdonald 1931, plan facing p. 304). Masonry shown in black, foundations hatched. Dashed lines indicate demolished walls and course of drains. Scale 1:200.

A later period at Chesters was marked by extensive remodelling to produce an enlarged building with a simpler plan, which operated as a row-type baths (see below, Period 2a). There is evidence that in the late Roman period the building was abandoned as a bath house, converted for other uses and subjected to stone robbing and rubbish dumping (Period 3).

EXCAVATION AND SURVEY

EXCAVATION BY JOHN CLAYTON, 1884–6

John Clayton succeeded to the Chesters estate in 1832 and carried out excavations over a period of 50 years until his death in 1890 (Bidwell and Snape 1993, 11–17). From 1860 the work was supervised by his foreman William Tailford Jnr, a skilled excavator (Bidwell and Snape 1993, 15). Excavation was concentrated on the fort, the extra-mural buildings attracting comparatively little interest until the remains of the baths were discovered early in 1884 during an attempt to dig a drain between the fort and river (Bruce 1884, 73).

The recording of the bath house excavation was better than that of some excavations within the fort. During the campaign, progress was recorded by an award-winning photographer, John Pattison Gibson, creating an invaluable resource. Some of the photographs were published in 1931, as described below, but many were not. In the Clayton Collection at Corbridge Museum there are two albums of Gibson photographs showing different, previously unpublished, views of the baths. In the Bruce Collection at Arbeia Roman Fort, South Shields a book entitled 'Views along the Wall' contains four photographs taken by Gibson at the beginning of the excavation, only one of which is recently published, the others previously unpublished. The Gibson photographs in this paper derive from these two sources.

For some photographs the year of excavation is recorded and often the season is indicated by the scenery. It was the practice in the fort that collections of excavated finds should be laid out for display (Bruce 1885, 97), which continued in the bath house excavation; many of Gibson's photographs show groups of finds. However, not all objects are in their original findspots; it is clear that sometimes finds from various locations were grouped in prominent positions for the benefit of the camera.

William Tailford Jnr collected a small archive, now in Corbridge Museum, containing previously unpublished photographs of the excavation by James F. Robinson, and post cards of the site.

Three previously unpublished Gibson photographs reveal how the initial discovery of the baths was made and the method by which excavation began. Figure 3 shows the interior of the west wall of the changing room, lined with niches. Apparently recording the start of excavation in 1884, the shortness of the grass indicates it is early in the year, the caption written before the building was identified as a bath house. This and a subsequent photograph (fig. 4) show the portion of wall containing the northernmost niche collapsed forward, most likely caused when workmen digging the trench for the drain accidentally struck the corner of the building.

Having identified Roman remains, Clayton might have assumed that the arched niches represented windows or arcades along the outside of a building. The Victorians typically began excavation by trenching alongside the outer walls of a structure; thus a trench was dug running southwards along that wall face. Figure 3 shows how the trench soon encountered another wall to the south indicating the interior of a building; part of a layer of flagstones was

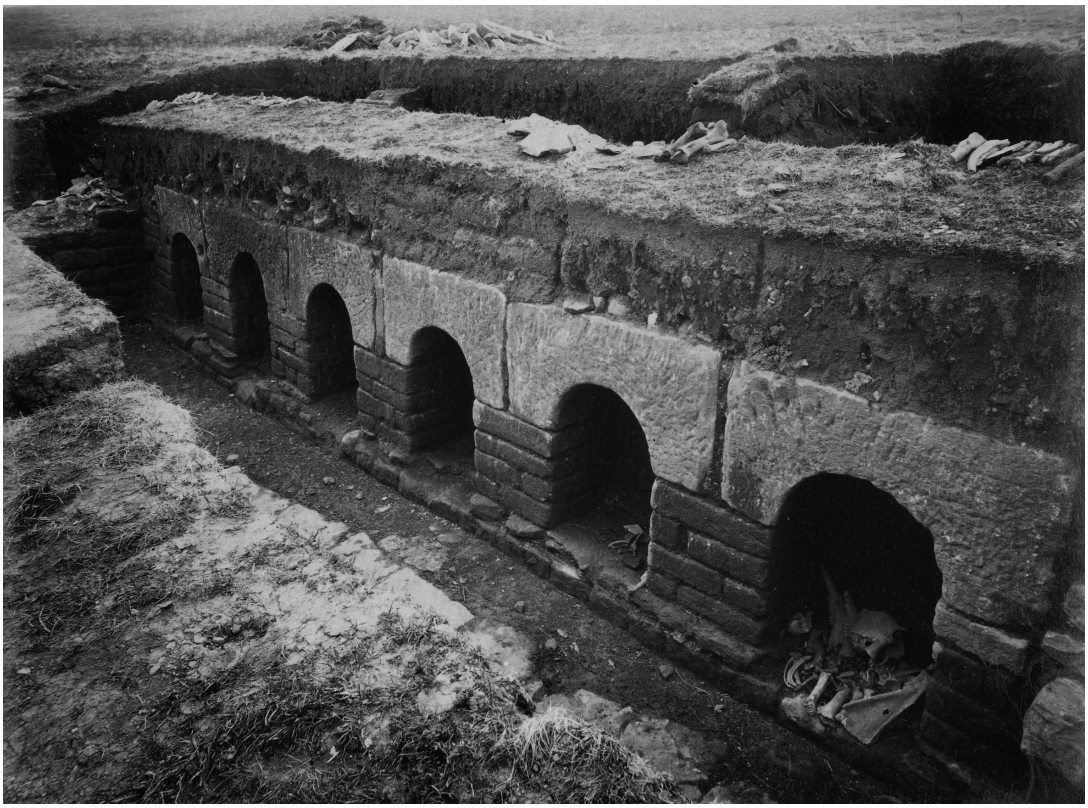


Fig. 3 Start of excavation of the bath house: trenches along the interior and exterior faces of the west wall of the changing room, viewed from the north-east. Part of the collapsed northernmost niche visible in the lower right corner. Finds of animal bones on display. Photograph by J. P. Gibson, 1884 (Copyright Tyne & Wear Archives and Museums).

also uncovered. Some flags closest to the wall were removed before being identified as possibly part of a floor, and so another exploratory trench was dug at right angles to the original. When this confirmed the presence of internal flooring, the excavators trenched along the other side of the wall, seeking the outside of the building. Instead they encountered the *laconicum* suite — the tops of two of its walls are visible in fig. 3 — and turned their attention back to the changing room.

Figure 4 shows the flagged floor revealed, but not the north wall of the room. The collapsed niche can be seen, and in the baulk of earth above it is the cut made by the drain-diggers. Enlargement of the original photograph revealed a faint trace of the top of the open drain on the ground surface running from left to right. Figure 5 shows a photograph taken in summer, with several rooms cleared. The northernmost niche has been rebuilt and the drain cut back-filled, although the grass on the baulk above it is not fully grown.

Tailford's trenches had perfectly straight edges and baulks were left on top of walls, presumably for protection against the elements. Masonry was scrupulously cleaned and as well as repair to the damaged niche, there was at least one example of reconstruction. Figure 6.i (also published in Hodgson 2011, 39) shows the apsidal recess of the *caldarium* in 1884; at

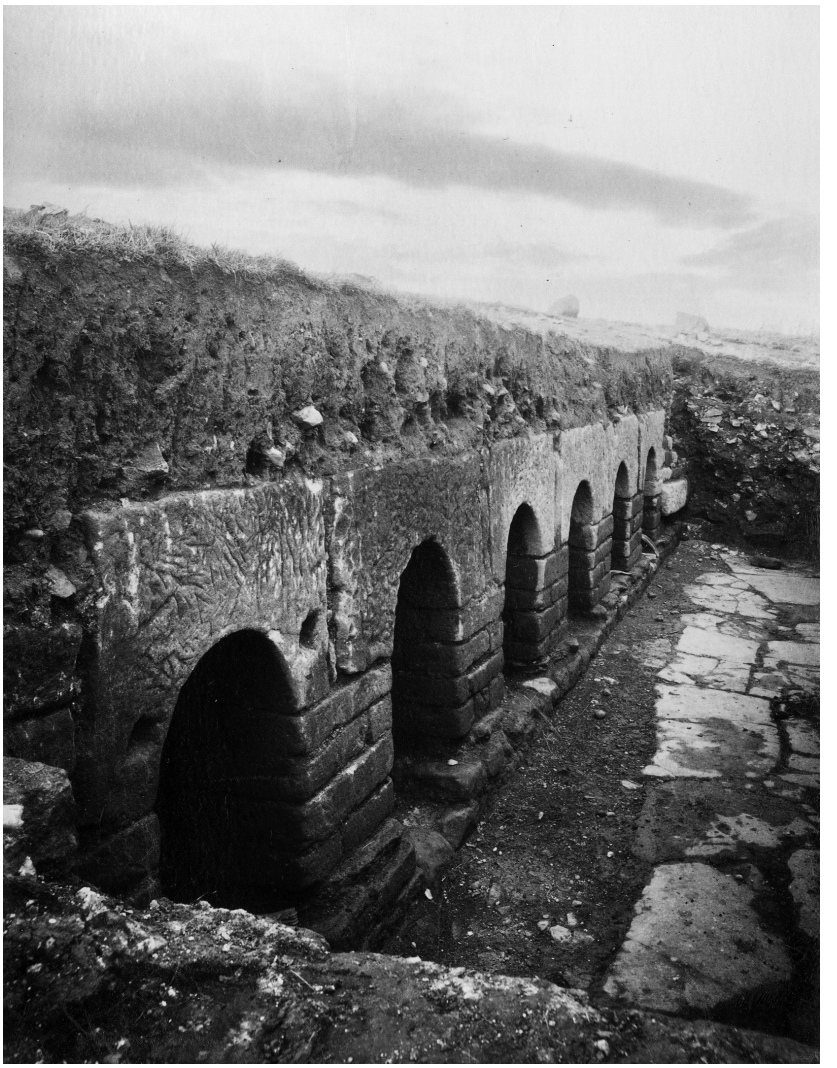


Fig. 4 Start of clearance of the interior of the changing room, viewed from the south; the arch of the northernmost niche collapsed. (The Victorian caption reads 'River-side buildings', rather than 'Baths'.) Photograph by J. P. Gibson, 1884 (Copyright Tyne & Wear Archives and Museums).

this date the building was still not identified as a bath house and the view through the window of the apse shows the vertical edge of the trench along the outer face of the wall. The wall of the apsidal recess stands 17 or 18 courses high above an offset, but slopes down steeply towards the front, being only six courses high on the north side and seven on the south. Another photograph of the apse, taken in the summer of 1886, shows the extent of reconstruction (Macdonald, 1931, Pl. LII, republished here as fig. 6.ii). By then the front walls had been built up, with two courses added on the north side and four on the south.

Excavation proceeded towards the south and east. When an interim summary of the 'large and lofty range of buildings' was published by the Rev. John Collingwood Bruce (1885, 98–105) the north-east quadrant of the building was still unexcavated (Bruce 1885, plan facing p. 98). The interim contains descriptions of structures and finds, some of the latter being

Fig. 5 Changing room, lobby and *laconicum* suite fully excavated, viewed from the south-east; northernmost niche in the changing room repaired. Finds displayed on top of baulks. (The Victorian caption reads 'River-side buildings', rather than 'Baths'.) Photograph by J. P. Gibson, 1884 (Copyright Tyne & Wear Archives and Museums).

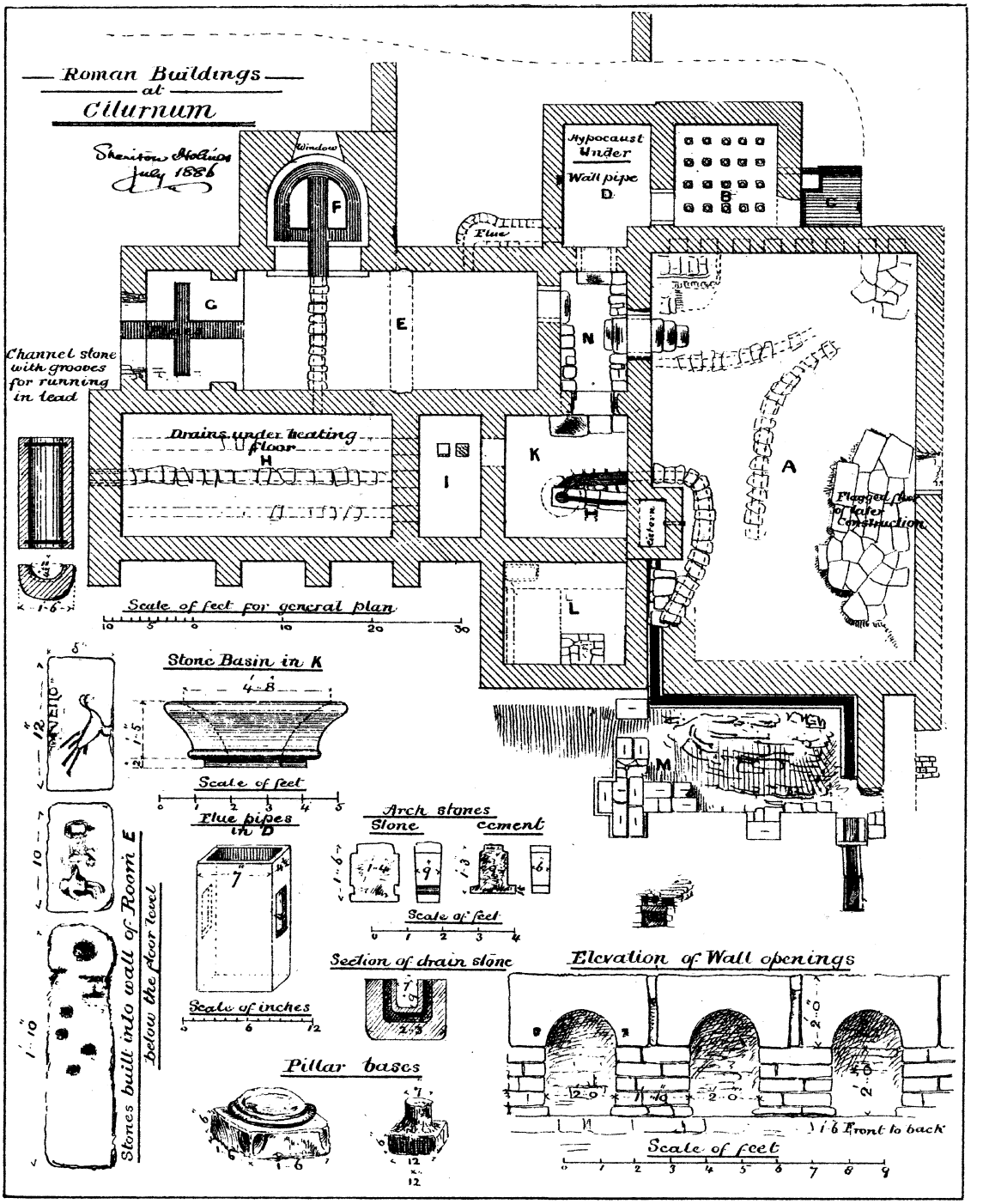
illustrated. Also included is a brief reference to the discovery of human remains; this enigmatic statement was never expanded. It was recognised that the building had undergone structural changes, as shown by differences in masonry and the absence of occupation material was noted (Bruce 1885, 102–3).

Sheriton Holmes was the first to identify the remains as those of a bath house; his paper (Holmes 1886–7) supplies details not included in the interim report. Holmes' plan was drawn in July 1886, (Holmes 1886–7, Pl. V, republished here as fig. 7) when the layout of the changing room, latrine and cold bath had been revealed and the sloping ground to the west had been landscaped. The plan shows features in the cold bath which were later removed and details such as the wear on stone steps. Also included are scale drawings of architectural fragments and a box tile. The underfloor drains in the heated rooms had not been fully uncovered, so the conjectural reconstruction is inaccurate. There is one curious inconsistency — Holmes shows eight niches in the west wall of the changing room, although in the text he accurately refers to seven (Holmes 1886–7, 125). The plan reveals how the changing room was excavated. Recognising that the flagged floor was a late feature, the excavators removed most of it to investigate what lay beneath. Two lengths of drain, converging on the north-west corner, were uncovered, and a sondage (test pit) was dug in the south-west corner to investigate the lowest layers.

Subsequently the outer face of the north wall was cleared, revealing a porch attached to the main entrance and also a small lobby to the north of the latrine. A photograph (fig. 8) in an

Fig. 6.i William Tailford Jnr standing in the excavated apse of the *caldarium* with finds including a tufa voussoir, hypocaust *pila* and animal bones on display; viewed from the east. (The Victorian caption reads 'River-side buildings', rather than 'Baths'.) Photograph by J. P. Gibson, 1884 (Copyright Tyne & Wear Archives and Museums).

Fig. 6.ii The apse of the *caldarium*, photographed by J. P. Gibson in 1886, showing that the walls on the north and south sides had been built up (Copyright Tyne & Wear Archives and Museums).



James Akerman, Photo-lith, London W.C.

Fig. 7 Plan drawn by Sheriton Holmes in July 1886 (reproduced from Holmes 1886–7, Pl. V).

Fig. 8 Photograph by J. P. Gibson of the northern part of the building, sometime after July 1886, viewed from the north-east. Part of the porch in the right foreground, a sondage dug in the south-west corner of the changing room, finds on display against the south wall (Copyright Trustees of the Clayton Collection and English Heritage).

album in the Clayton Collection in Corbridge Museum (CH5980, acc. no. 03.5066) shows part of the porch and the sondage in the changing room. The photograph must post-date the plan of July 1886, but the foliage visible in the background indicates it was still late summer or early autumn. Finds are arranged on the top of baulks, in the niches and grouped against the south wall. The stone trough is still *in situ* today.

Usefully for modern archaeologists, two upstands of late flooring and make-up material were left intact at the end of the 1886 season. Clayton did not resume work in the bath house the following year; his subsequent, and last, excavation was of the barracks in the north-east part of the fort in 1889. Throughout the 50 years of Clayton's excavation work, in which he devoted Monday of each week to archaeology, the pattern was to investigate systematically one type of structure until prompted to initiate a different campaign. This produced a pattern of six campaigns of three to six years each, separated by gaps of four or five years (Bidwell and Snape 1993, 11, 13).

Another photograph from the Clayton Collection album (fig. 9.ii) (CH16686 (96.5013A)) records the end of excavation. Taken in the autumn or winter of 1886 — trees had shed their leaves — it shows a panorama of the building from the remains of the southern hot bath, looking towards the north wall of the changing room and entrance porch. Weeds sprout

Fig. 9.i Photograph by J. P. Gibson of the baths from the south in 1885, probably in autumn/winter (Copyright Trustees of the Clayton Collection and English Heritage).

Fig. 9.ii Photograph by J. P. Gibson of the baths from the south, probably after the end of excavation in autumn/winter 1886 (Copyright Trustees of the Clayton Collection and English Heritage).

amongst the remains, but the arrangement of finds is exactly as displayed in a photograph taken late in 1885 (Macdonald 1931, Pl. XLIX, reproduced here as fig. 9.i).

SURVEY AND TEST PITTING BY SIR GEORGE MACDONALD, 1929

Sir George Macdonald was invited to describe the baths to members of the 1929 Pilgrimage of Hadrian's Wall, and in preparation carried out a thorough survey (Macdonald 1931), assisted by William Parker Brewis who produced a new plan (Macdonald 1931, plan facing p. 304). This study resulted in a major breakthrough in the interpretation of the building. Trial pits were used in an exemplary way, restricted to the minimum required to answer specific questions. Digging was carried out by the foreman of the North of England Excavation Committee, Thomas Hepple, who had valuable knowledge of the building and of previous renovation work. The results were published in a paper which Macdonald stressed was not an excavation report, but a preliminary survey, and 'its conclusions are to be regarded as tentative only'. But the paper contains a detailed analysis of the building, evidence of its structural history and the first publication of many Gibson photographs.

A huge amount of data was gathered. In his introduction Macdonald notes how he had welcomed the opportunity of examining the building afresh, adding, 'Probably I should have hesitated if I had foreseen how difficult the task of interpretation would be'. Nevertheless his discussion of how the baths were operated was wide-ranging in its scope and scholarship; though inevitably some of its ideas are now outdated, it provides an invaluable foundation for studies of Chesters bath house.

The remains surveyed by Macdonald had been open for 43 years. The ground was covered in turf, the walls still topped by the earthen baulks left by the Victorians (Macdonald 1931, 9, Pl. XLVI), and the sondage in the south-west corner of the changing room was still evident as a hollow; nevertheless the building was very much as excavated (Macdonald 1931, 256). A little reconstruction had been carried out in the intervening years. Macdonald found that the inner face of the west wall of room E1 had been restored since 1886 (Macdonald 1931, 262). Hepple reported that some stones had been placed in the wall near the apse in a 'comparatively recent restoration' (Macdonald 1931, 277). Hepple also remembered restoration of the south wall of the *laconicum* ante-room, where a chimney was built up because the wall had threatened to collapse (Macdonald 1931, 297, Pl. LVI, Fig. 1).

OBSERVATION AND TRIAL TRENCHING BY JOHN GILLAM, 1956–8

In 1956–8 a programme of consolidation was carried out by Charles Anderson of the then Ministry of Works (MoW). The baulks of earth and grass left on top of the walls by the Victorians were removed (Gillam *et al.* 1993, xiii), and the consolidated remains laid out for display. During the programme John Gillam carried out trial trenching and maintained a watching brief; plans and elevations were drawn by Gillam and Charles Daniels. Some significant new discoveries were made; the results are unpublished, but the J. P. Gillam archive in the Discovery Museum, Newcastle consists of site notes and drawings containing valuable new information (Gillam 1956–8). Further valuable information comes from a record book for Chesters Museum, in the collection at Corbridge Museum; it contains handwritten notes by Grace Simpson (Simpson 1956–77). A section on 'Objects handed over by the Ministry of Works during restorations at Chesters' contains previously unpublished details of finds made during consolidation of the extra-mural baths.

In 1985, in preparation for the publication of a new Chesters guide book (Johnson 1990), Stephen Johnson of English Heritage interviewed Gillam at the bath house about the work in 1956–8 and a transcript was made of the interview (Gillam and Johnson 1985), also in the archive at the Discovery Museum.

In 1949, 1954 and 1956 Gillam undertook excavations in the baths at Bewcastle. The published report (Gillam *et al.* 1993) sets the results in the context of data gathered from the other block-type bath houses, their metrology and methods of construction and operation, and contains much information relevant to the study of Chesters baths.

SURVEY BY TYNE AND WEAR ARCHIVES AND MUSEUMS, 1993 AND 1997

In 1993 English Heritage commissioned the Archaeology Department of the then Tyne and Wear Museums (now Tyne and Wear Archives and Museums, TWAM) to produce a documentary survey recording the extent and preservation of the archaeological deposits at Chesters fort and its environs (Bidwell and Snape 1993).

In 1997 Paul Bidwell of TWAM Archaeology Department led a project to build a reconstructed Roman bath house at Segedunum Roman fort, Wallsend. Prior to construction an extensive programme of research was carried out, during which the authors of this paper conducted a new survey of Chesters baths, the building on which the reconstruction is modelled. Data from the survey, including co-ordinates and heights of some 500 locations on the surviving masonry, was passed to the architects of the David Ash Partnership (now Tench Maddison Ash Architects LLP) who undertook the design and building of the reconstruction. In collaboration with the architects a new ground plan of the main building was produced (figs. 10.i, 14, 22). This recorded some slight irregularities and misalignments in the original layout which had been 'squared off' in Parker Brewis's plan (Macdonald 1931, plan facing p. 304). However, some of the original lettering and numbering used by Macdonald has been retained, to aid comparison.

TWAM archaeologists liaised with Graham Tench of the then David Ash Partnership to provide information on Roman baths and bathing in general. The object was to elucidate the likely design of features which have not survived at Chesters, such as the vaulted ceilings and the roof. Although the primary purpose of the survey was to provide data for the reconstruction (David Ash Partnership 2001; Griffiths 2008, 60–3), the process also gave new insights into the structure and appearance of the baths which could not have been gained from survey of the remains alone, thus clearly demonstrating the value of reconstruction and experimental archaeology. Producing the new ground plan also enabled further study of the metrology of the building.

THE STRUCTURAL HISTORY OF CHESTERS BATH HOUSE

Two conclusions are immediately apparent from the results of these studies; it is striking how little the remains have changed since 1886 and there is now a huge amount of data, that gathered through research and that still held within the building. This accumulation of evidence points more clearly at sequences of construction and modification. Always bearing in mind Sir George Macdonald's *caveat* on reaching conclusions about so complex a structure, this paper sets out one possible sequence of phases.

SUMMARY OF PROPOSED PHASING

This summary lists the major structural work that took place in each period; the many minor changes are described in the full account below. There is no clear dating evidence for any activity following the primary construction of the building; later dates suggested below are speculative.

PERIOD 1a (Hadrianic): Construction of a ring-type bath house of sophisticated plan, comprising lobby, *frigidarium*, *unctorium*, two *tepidaria* and a *caldarium*.

PERIOD 1b: (possibly Antonine): Addition of a stone-built changing room and latrine.

PERIOD 1b or 1c: An auxiliary furnace added to the final *tepidarium*. New door opened between *unctorium* and final *tepidarium* providing alternative route to ease congestion.

PERIOD 1c: Addition of a *laconicum*, attached to the west of the building. Period 1c ended with significant demolition prior to major remodelling.

PERIOD 2a (possibly early third century): Remodelling so that building operated like a row-type bath house. Furnace on west side demolished and replaced by furnaces on south side, heating east and west ranges separately. First *tepidarium* and *caldarium* enlarged, western hot bath replaced by an apse. Small water tank added in the *frigidarium*. Addition of an ante-room to the *laconicum*; auxiliary furnace out of use. Porch added to the main entrance possibly at this time.

PERIOD 2b (possibly late third century): Cold bath reduced in size. New doorway opened to incorporate *laconicum* suite into the main building.

PERIOD 3 (possibly early fourth century to late Roman period): Building out of use as baths; some areas stripped of materials for re-use elsewhere, the remainder modified for other uses; dumping of rubbish.

PERIOD 4 (very late Roman or early post-Roman to medieval): Continued stone robbing. Decay and collapse of the building, cemetery outside the east and south walls of the eastern range. Remains of building buried.

PERIOD 1A

The primary layout and metrology

Figure 10.i shows the probable plan of the primary baths at Chesters. The metrology of this group of bath houses was studied by Derek Welsby in 1993, using the remains at Chesters as a basis (Welsby in Gillam *et al.* 1993, 24–6); this showed that the buildings were laid out on a modular system. Welsby deduced that the Roman foot used at Chesters was slightly larger than the *pes Monetalis* of 295 mm. The 1997 survey by TWAM proved that the measurement was 297 mm (not 287 mm as stated incorrectly in Snape 1999, 119).

At Chesters rooms were laid out using modules of 10 or 20 Roman feet, and walls were three Roman feet thick. Consequently the internal measurement of many rooms was either 7 or 14 Roman feet (the lobby (N), *unctorium* (I) and the southern hot bath (G) are approximately 7 by 14 Roman feet; the *frigidarium* (K) and *tepidarium* (E1) are 14 Roman feet square; *tepidarium* (H), the *caldarium* (E2) and the cold plunge bath (L) each have one measurement of

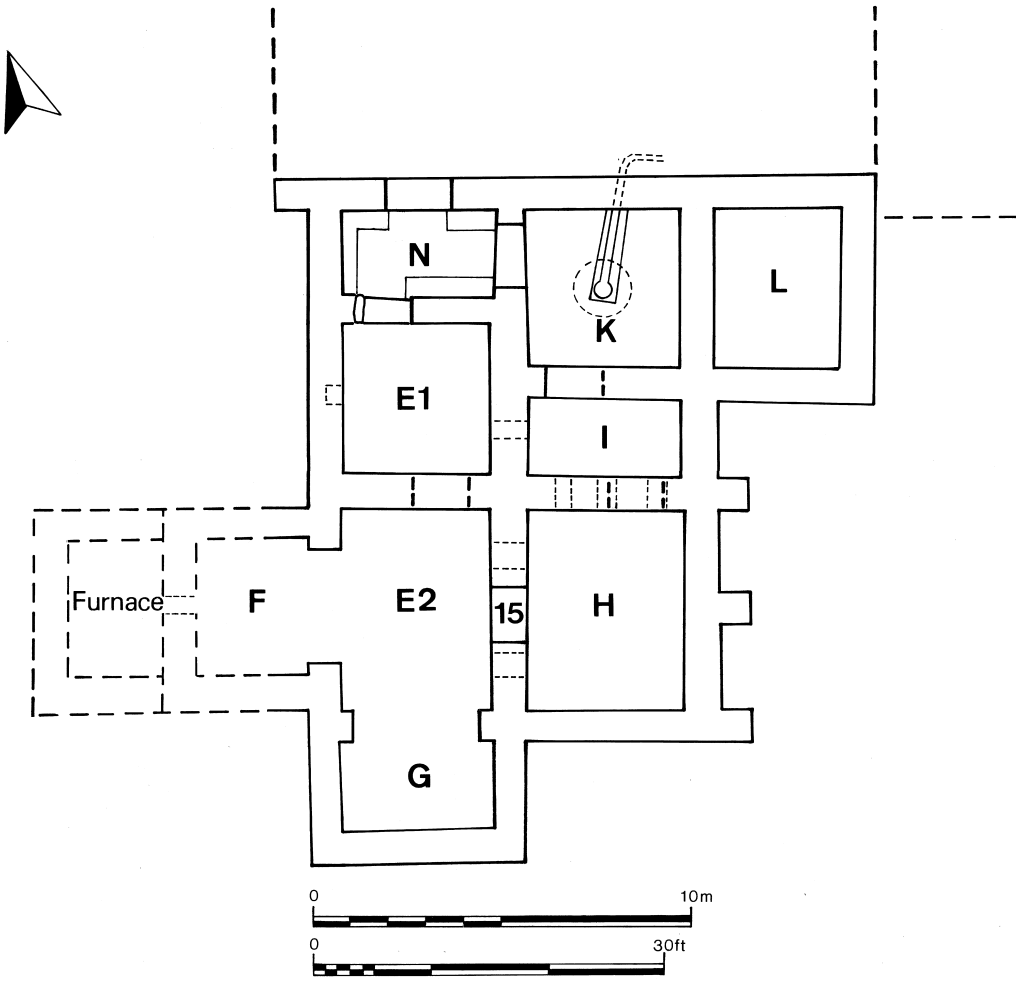


Fig. 10.i Plan of the primary baths (Period 1a). This and subsequent period plans as surveyed by TWAM Archaeology Department; lettering and numbering as Macdonald 1931, plan facing p. 304. Dashed lines indicate position of furnace room and primary western hot bath, presumed position of doorways and possible location of timber changing room and latrine. Dotted lines indicate underfloor vents and chimney. Scale 1:200.

roughly 14 Roman feet). It is impossible to say whether this repetition of seven and its multiple was accidental or a deliberate policy of the architect (see Period 2a).

Method of construction

PRELIMINARY TERRACING

At Bewcastle it is likely that the whole area to be occupied by the bath house was excavated down to the level of the hypocaust basement and the walls constructed up from that point (Gillam *et al.* 1993, 15). Basement floors were then laid. The same method at Chesters entailed

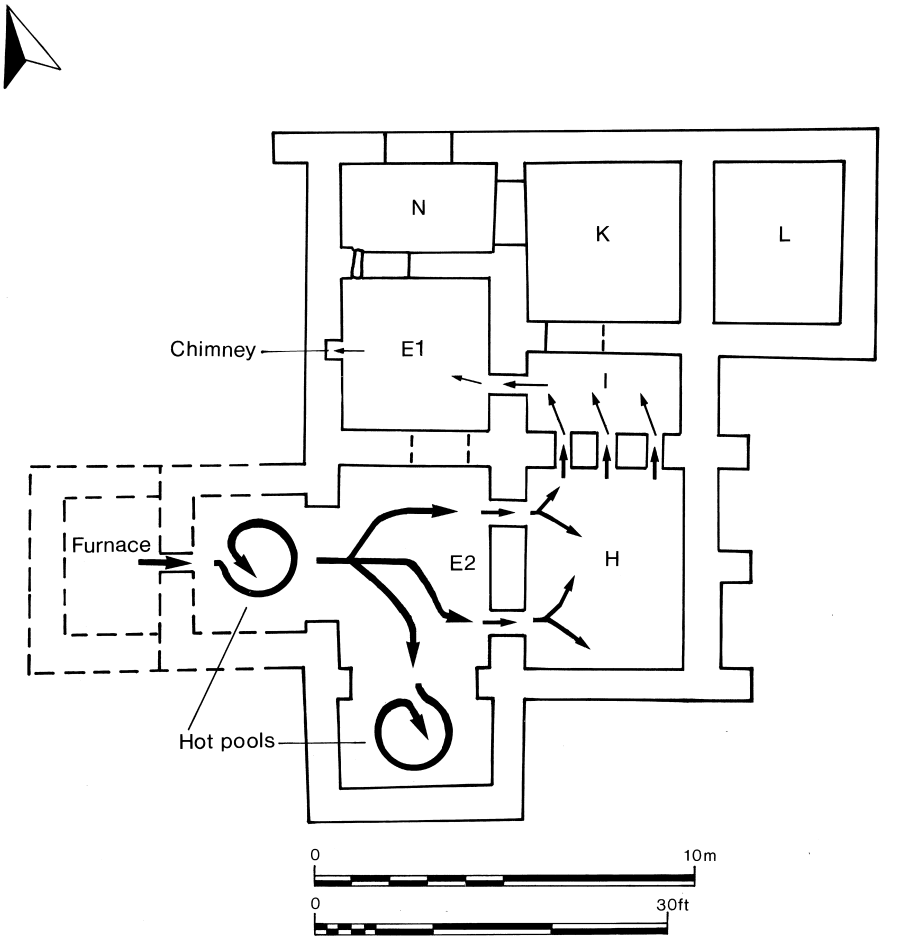


Fig. 10.ii Plan showing flow of heat in anti-clockwise direction, from furnace and through underfloor vents, spent gases discharging through chimney. Scale 1:200.

cutting a deep terrace into the slope (reconstruction drawings in Hodgson 2011, 21). Curiously the terracing was not uniform, ground being cut away more deeply beneath rooms E1 and I to the north than beneath E2 and H to the south. This seems counter-intuitive; it would seem more logical that the spongy soil and possible stream bed to the north of the site ought to have been levelled up rather than terraced down. Possible reasons are suggested below. The depth of terracing beneath the lobby and *frigidarium* is unknown, there being no record of excavation below their flagged floors.

CONSTRUCTION OF WALLS

The walls of the main block at Chesters were 3 Roman feet (0.89 m) thick. Evidence of the probable height of walls in bath houses of this type comes from Ravenglass. Although only

five rooms of that building are now standing, the walls are very well preserved; in the south-eastern corner of the probable *frigidarium* the facing masonry stands to a height of *c.* 3.50 m above the level of the door sills (Brann 1985, 83). At *c.* 3.50 m there is a roughly even ledge interpreted as a wall plate to carry roof or ceiling timbers, suggesting that the full original height of the wall survives. The Roman foot used at Ravenglass was *c.* 323 mm (Welsby in Gillam *et al.* 1993, 26), making the original height of the wall *c.* 11 Roman feet.

Observing the outer face of the western walls of Chesters baths, Macdonald noted that in 'various parts' there were small holes which did not penetrate the wall, but which had mortar inside (Macdonald 1931, 275). These are probably putlog holes in which scaffolding timbers rested during construction of the walls. The square hole seen at the extreme left of the photograph in fig. 9.ii may be a putlog hole since it is too high to be related to plumbing (this wall is not primary but belongs to a modification of Period 2a). Many regularly-spaced putlog holes survive at Ravenglass; penetrating right through the walls, they had been plugged after the scaffolding was removed, then covered with mortar render (Brann 1985, 83, Fig. 2).

The walls at Chesters rested on deep foundations. Macdonald cleared the north face of the wall between rooms H and I, revealing six courses of well-built masonry reaching a depth of 2 ft 6 ins (0.76 m) below the base of the vents in the wall, *i.e.* below the basement floor (Macdonald 1931, 267–8). The core of the primary walls was bonded with white mortar (Gillam 1956–8, 1). The outer faces were coated with lime plaster (fig. 9.i), traces of which can be seen on the wall at the south-west corner in fig. 9.ii. At Bewcastle traces of white plaster were found on the outer faces (Gillam *et al.* 1993, 10). Internal wall plaster was found only in the unheated lobby and cold bath and in the surviving western hot bath; walls in the heated rooms were covered by hollow jacketing, and it was assumed that it was the jacketing not the masonry which had been plastered (Gillam *et al.* 1993, 14). However at Ravenglass large patches of lime mortar rendering survived on both exterior and interior wall faces, the best example being on one of the interior walls of the small buttressed room likely to be the equivalent of the *unctorium* (room I) at Chesters (Brann 1985, 81–2, Figs 1 and 2). Some of the Ravenglass mortar was white, but pink mortar containing fragments of tile was found mainly on the lower part of the walls. It is likely that the wall plaster was painted (*cf.* painted wall plaster at the extra-mural baths at Binchester (Mason 2014b, 20, Fig. 13)).

THE OPERATION AND USE OF THE BUILDING

The plan of Period 1a at Chesters (fig. 10.i) illustrates how this type of bath house was operated and used. A furnace outside the *caldarium* heated water as well as providing hot gases which circulated in an anti-clockwise direction under the raised floors of the rooms by means of vents in the walls at basement level (fig. 10.ii). A system of hollow jacketing enabled walls and ceilings to be heated. As heat dissipated, the rooms furthest from the *caldarium* were progressively less warm.

At Chesters bathers moved round this main block in a clockwise direction (fig. 10.i). From the lobby (N) they progressed to a *frigidarium* (K) with a cold bath (L), then a small warm room (I) which has been interpreted as the *unctorium* where bathers anointed themselves with oils; from there they moved through a large *tepidarium* (H), a *caldarium* (E2) with hot (G) and warm (F) plunge baths, and a second *tepidarium* (E1), then through the lobby to revisit the *frigidarium* before returning through the lobby to the exit. Thus the door between lobby and *frigidarium* was the only place in the suite where bathers had to pass others moving in the opposite direction.

BASEMENT FLOORS

Where investigated the primary basement floors at Chesters were found to be of *opus signinum* (Macdonald 1931, 260; Gillam 1956–8, 3; see fig. 18). An example of *opus signinum* (concrete in which fragments of crushed tile were incorporated) was illustrated on the plan of Benwell baths (Brand 1789, second plan following p. 606).

DOORWAYS

As shown on fig. 10.i, the position of four of the primary doorways at Chesters is known and the location of two more has been conjectured, as described below. Each threshold was formed from a single sandstone slab, with slots at each side to hold massive stone jambs 0.25 m wide, some of which are still *in situ*. No lintels have survived, however they were presumably of sandstone like the fragment of lintel still *in situ* at Ravenglass (Brann 1985, 83, Fig. 2). Each door was supported on a pivot, fitted into holes in the threshold and lintel. On some of the threshold slabs there is a small hole in one corner, a shallow groove leading into it so that the pivot could be slid into position. In the TWAM survey levels were taken on all surviving thresholds; where none survived it was almost always possible to estimate the threshold level by comparison with other remains.

The doors leading into and out of the lobby were wider than the others, presumably to avoid congestion. The width of the door between *tepidarium* H and the *caldarium* (15 on Parker Brewis's plan) in the medial wall can be estimated from the surviving threshold slab. In the *tepidarium* there is a stone door jamb propped against the northern end of the west wall, close to door 15, from which it may have fallen (see Period 3 and fig. 26).

All that survives of the doorway between the *frigidarium* and *unctorium* is a ragged break in the wall on the west side and a fragment of the west side of the threshold slab still *in situ*, containing one edge of the slot for the jamb. This doorway is shown on plans by Holmes (fig. 7) and Parker Brewis (Macdonald 1931, plan facing p. 304). As drawn it is very narrow, the total width of the opening being little more than 1 m; allowing for jambs, the actual door would be only *c.* 0.50 m in width, surely implausible. Presumably the opening was narrowed or partially blocked in late Roman or early post-Roman times when the building seems to have been used for purposes other than bathing (Period 3). Therefore on fig. 10.i and subsequent illustrations, this doorway is shown as roughly the same width as door 15.

A large stone slab, 1.84 m long and at least 0.60 m wide, is set into the modern ground surface immediately adjacent to the north wall of the *unctorium*. Presumably this is a former jamb, fallen from one of the doorways in the vicinity when the building was in decay, recovered at some time during excavation or consolidation and positioned to form a firm surface. Nothing has survived of the door between the *unctorium* and the first *tepidarium*, but the western half of that wall is still *in situ* without a break, showing that the doorway must have been at the eastern side (Macdonald 1931, 266). Thus the two doors in the *unctorium* were not in line, so avoiding draughts through the room. The south wall of the second *tepidarium* was demolished in a later period, removing all trace of the doorway; on fig. 10.i this is shown at the eastern end of the room, so that it mirrors the layout in the *unctorium*.

The door between rooms I and E1, the *unctorium* and second *tepidarium*, (14 on Parker Brewis's plan, see fig. 2) is a later insertion (Period 1b/c). Though some doorways were altered or damaged in later periods, their original width can be estimated by measuring the

Table 1 Surviving doorways in the Period 1a bath house.

Doorway	Jambs or Slots	Width between Jambs	Description of Threshold Slab
Entrance into lobby (N) from the north	Traces of slots surviving on E and W sides	1.18 m	Unknown, Period 1 slab altered in later period
Between lobby (N) and *frigidarium* (K)	Probable open entrance, door inserted later	Width of Period 1 entrance unknown	No threshold slab or door jambs; plain flagstone with no pivot hole
Between first *tepidarium* (H) and *caldarium* (E2), door 15	No jambs; both slots present	0.94 m	Slab worn, pivot hole not visible
Between lobby (N) and *tepidarium* (E1)	Jamb on E side Slot on W side	1 m	Slab, pivot hole at NE corner, diameter 70 mm, depth 70 mm

distance between surviving jambs or slots (Table 1). The doorway between lobby and *frigidarium* was altered in Period 1b; however later robbing (Period 2b) has revealed the primary surface beneath. This consists of a worn and cracked flagstone, levels on which are the same as those of the primary floor of the lobby. The stone has no pivot hole or slots for jambs, so cannot be the threshold of a door. As explained above, this doorway is the only one in the primary building where bathers would cross paths moving in opposite directions, so a simple opening with no actual door would have been a practical way to avoid congestion. Also since neither room was heated, there was no need for a door to conserve warmth. It is not known if the situation at Bewcastle was similar; only the doorways in the west and south walls of the lobby were fully disengaged and the position of the doorway in the eastern wall leading into the *frigidarium* was not indicated on the extant plans (Gillam *et al.* 1993, 15).

The only possible parallel is at Ravenglass, where one of the five entrances between rooms (Brann 1985, 83, 44 on Figs 1 and 2) had no door jambs and was interpreted as a narrow archway; this opening was between two heated rooms (Jackson 1883, 216–7, plan facing p. 218).

WINDOWS

There is no direct evidence for the size and location of windows in the primary building at Chesters, but some indication comes from other bath houses of the same type. At Carrawburgh there was a window with internal splay in the centre of the rear wall of the cold bath; its exterior width was *c.* 4 ft 6 ins (1.37 m) and interior *c.* 6 ft (1.83 m) (Bruce 1874, plan facing p. 17). At Ravenglass in the probable equivalent of the Chesters *unctorium* there was a splayed window of exterior width *c.* 0.95 m and internal width *c.* 1.40 m (Brann 1985, 83, Figs 1, 2). It was relatively high off the ground, ensuring privacy, with a downward splay of 0.3 m. Traces of windows survive in the equivalent of *tepidarium* H and the probable *frigidarium*.

At Chesters there could have been windows in the cold and hot baths L and G, and between the buttresses in rooms I and H. A window in the south wall of *tepidarium* H would have let in sunlight and warmth throughout the day. Large windows might be expected in rooms where bathers would linger. In *tepidarium* E1 there could have been a small window at

a high level. The maximum surviving height of the outer wall is 1.44 m (4.8 Roman feet) above the estimated level of the suspended floor. Allowing for a downward splay of *c.* 0.3 m, the sill might be at *c.* 6 Roman feet above the floor. If there had been a window in the west wall of the lobby, the evidence was destroyed when a door was inserted in Period 2a.

ENTRANCES TO PLUNGE BATHS

The hot baths F and G were entered through archways which rested on responds which still survive; the width between the responds of the western bath was 3 m and that of the southern 3.20 m. The masonry of the entrance to the cold bath has been robbed, but the arrangement was presumably the same. At Bewcastle the width between responds was 3.40 m and 3.30 m for the two hot baths and 3.20 m for the cold bath (Gillam *et al.* 1993, 4–5, 16).

CEILING AND ROOF CONSTRUCTION

Ceilings in the main block at Chesters took the form of ribbed vaults. Evidence comes from voussoirs (wedge-shaped blocks which fit together to form an arc). Within the fill of the western range of heated rooms the Victorians found 'numerous' examples made of tufa (Bruce 1885, 99–100), which is a calcareous rock suitable for use in vaulted ceilings because it is robust but light.

A recent study includes a discussion of ribbed vaults, of which there are two types in the western Roman provinces (Bidwell 2010, 113–6). In one type voussoirs are used to form ribs, the spaces between each rib being filled with mortar, concrete, or rubble. The other type of vault employs voussoirs which have grooves, rebates or projections on their sides; Chesters examples belong to a type sometimes called 'armchair voussoirs', having ledges on both sides at top and bottom. One is displayed on the apse in fig. 6.i, two in fig. 6.ii and more in figs. 9.i and 9.ii (see also Macdonald 1931, Pls LII, Fig. 6). These have been identified at many sites in Britain, Gaul, Germany, Spain and North Africa, although it was only at Chesters that their function was recognised (Bidwell 2010, 14, Fig. 36). During Macdonald's survey, W. Parker Brewis demonstrated how these voussoirs could be joined to form ribs, spacer tiles resting on the ledges to create hollow channels between the ribs. The arched vault thus formed was illustrated by R. J. S. Bertram (Macdonald 1931, 278–83, Figs 7, 8); a new drawing of the vault, based on Bertram's illustration is shown here as fig. 11. There is no means of knowing whether the spacing between ribs and channels is roughly equal as shown in the drawing, but it is clear that tiles of two different sizes were needed, possibly of non-standard sizes. If so, they would have to be specially made for the purpose.

Another study of the vaulting demonstrates how each vault may have rested on the walls of Chesters baths (de la Bédoyère 1991, 24, Fig. 9). The drawing shows a section across one of the rooms with a vault of 59 voussoirs 0.3 m wide resting on the internal face of the inner and outer walls. Since the walls are 0.89 m thick, there is ample space for the medial wall to support the springing of the vaults over the east and west ranges. The external face of the external walls could have risen higher than the springing point of the vault in order to support a pitched roof. The total span of the vault shown on de la Bédoyère's illustration is 4.8 m. The illustration does not allow for the fact that the voussoirs are not all of a uniform size, or that they may have been covered by a thick coat of plaster. Therefore the total span may have been closer to 5 m. Roger Wilson suggested that this 'highly original design' might

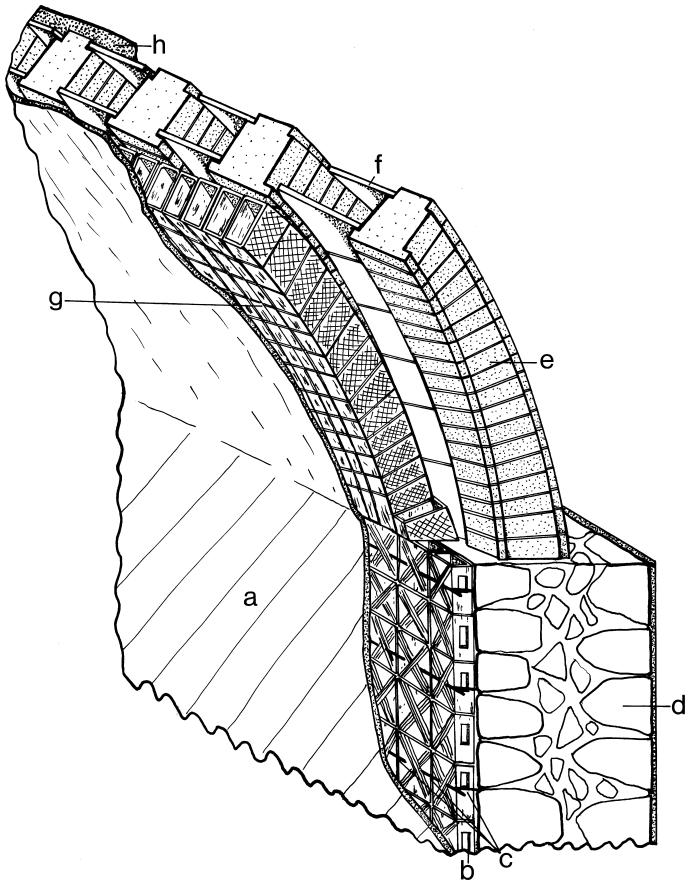


Fig. 11 Suggested reconstruction of the roof vault within the *caldarium*.

KEY

a wall plaster
b box tiles
c iron holdfasts
d exterior wall
e armchair voussoirs
f tiles/slabs
g hollow voussoirs
h concrete

be 'the work of an imported legionary architect' (Wilson 2002, 182). This implies it belonged to the sophisticated plan of the primary building, rather than later modifications. The 30–40 surviving tufa voussoirs vary enormously in form; the 'typical' example with ledges on both sides is in fact in the minority. Many have only ledges at the top and no rebate or projection at the base, although the latter could easily have broken off. Interestingly, there are a few with ledges and rebates on one side only; these presumably belonged to one of the end ribs of the arched vault, the flat side being bonded into one of the walls.

Parker Brewis pointed out that without a ceiling vault, hot air would escape through joints in the roofing, but the weight of a solid brick barrel vault would exert too strong a thrust on comparatively narrow unbuttressed walls. Thus the gaps between ribs had two purposes: added to the use of tufa, they made a very light vault, and the 'stagnant air' in them was a poor conductor of heat, thus providing insulation. It is important to go back to this original explanation, noting that nowhere does Parker Brewis suggest that the Chesters arrangement was for heating. This was first suggested in the 13th edition of the *Handbook to the Roman Wall* (Bruce 1978, 119–20) and by some subsequent authors; however this suggestion is omitted from the fourteenth edition, which reverts to the original (Bruce 2006, 208). Paul Bidwell has pointed out (pers. comm.) that it would have been difficult to connect the spaces between

the ribs with the vertical wall-jacketing; also it would not have been an efficient method as there would have been no lateral connection. He believes that where necessary to heat a ceiling it is more likely that hollow tiles were attached to the underside of the ribbed vault.

We follow the original interpretation, believing that ribbed barrel vaults with hollows between the ribs were used solely for the purpose of providing light, insulating ceilings. As such they would have been useful not only in the *caldarium*, but all the *tepidaria* at Chesters. Close examination of one of Gibson's photographs (fig. 9.i) reveals a tufa voussoir propped up in the shadow against the north wall of *tepidarium* H, between two of the underfloor vents. It seems unlikely that this object was moved far from its original findspot. Rather than being displayed in a prominent position for the benefit of the camera, it is in fact scarcely visible at the very edge of the photograph. Furthermore, if all the tufa voussoirs had been found in the *caldarium*, there is no obvious reason why one should have been moved into *tepidarium* H. This is therefore a possible piece of evidence to support the suggestion that all the heated rooms in Chesters baths were covered by the same form of hollow, ribbed barrel vault. However, only the *caldarium* ceiling would have needed an extra layer of tiles to allow for heating, as described below.

At Bewcastle tufa voussoirs were found in abundance, though to the north-west, north and east of the heated suite, *i.e.* close to the unheated rooms, rather than in the debris overlying it (Gillam *et al.* 1993, 14). None were of the 'armchair' type as at Chesters. Sections of collapsed vault were found in the cold bath; tufa voussoirs were mortared together to form ribs, and adjacent ribs fitted closely together without spaces (Gillam *et al.* 1993, 14, Pl. 8). Another section was found in the *frigidarium* (Gillam *et al.* 1993, Fig. 5, section 7). Possibly all the ceiling vaults were constructed in this way, without the added refinement of spaces. However this does not rule out the possibility that the heated rooms were vaulted in the same way as at Chesters; the evidence could have been destroyed by later stone-robbing (Gillam *et al.* 1993, 23–4).

The various ways in which ceiling vaults might have been constructed at Bewcastle have been described by Derek Welsby (Gillam *et al.* 1993, 10–11). We suggest that the main block at Chesters was covered by two continuous ribbed barrel vaults, both running north/south, one covering the west range of *caldarium*, *tepidarium* E1 and lobby, the other the east range of *tepidarium* H, *unctorium* and *frigidarium* (Gillam *et al.* 1993, 11, note ii). In this simple and efficient construction, the vaults would sit at equal height on the wallplates of the external east and west walls and the internal medial wall. The dimensions of the surviving tufa voussoirs are variable, but nevertheless indicate a vault a little over 400 mm thick. The walls were 890 mm thick, thus providing sufficient space for both vaults to share the medial wall. Wallplates for the east and west sides of the vaults would rest on the inner part of the external walls. The hot and cold baths presumably had separate barrel vaults; however the southern hot bath could have been covered by an extension of the vault over the *caldarium*.

The Victorian excavators of Chesters also found a number of sandstone 'armchair voussoirs'. These are slightly larger than the tufa examples, less markedly wedge-shaped, and the distance between ledges is greater, so the two types could not have been used in conjunction in the same vault. We suggest that the sandstone voussoirs belong to a later modification (Period 2a).

There are two ways in which a bath house might be roofed. In Mediterranean countries with low rainfall, vaulted roofs are practical, and roofs of this type are often shown in reconstruction drawings of baths in Roman Britain, e.g. a drawing by Alan Sorrell (Johnson 1990, 13). However in northern climates it would be more practical for vaulted ceilings to be

covered by pitched roofs to shed rainwater and protect the concrete, as at Bewcastle. The portion of collapsed ceiling found in the *frigidarium* at Bewcastle comprised a mass of mutually adhering voussoirs forming the curve of the vault. On the outer side of the curve was a mass of regularly-shaped white concrete, which ended in a straight plane surface, tangential to the ribs. Adhering to the outer surface of the concrete were sandstone roofing slates; this method would make for a roof of low pitch (Gillam *et al.* 1993, 14). A reconstruction drawing (Gillam *et al.* 1993, Fig. 6, reproduced here as fig. 12) shows the suggested arrangement of ceiling vaults and roofs.

At Chesters there are no surviving tiles, roof slates or voussoirs with concrete adhering to indicate how roofs were constructed. However there is some indirect evidence of an eaves-drip gutter below pitched roofs. The Victorians found several large stone gutter blocks, no longer *in situ* but scattered in various locations, mainly outside the building (Macdonald 1931, 243–5, Pls XLII, Fig. 1, XlIX, L, LI, LIII). The blocks, joined together by strips of lead and including an example shaped to go round a corner, were interpreted as a gutter running around the west, south and east sides of the building collecting water dripping from the eaves (Macdonald 1931, 243–5).

Whatever the exact method of roofing, a configuration with separate roofs over east and west ranges is likely. This configuration would explain the later developments described in Period 3, in which rooms I and H were treated differently from the rest of the building.

There is one further complication. As mentioned above, the preliminary terracing of the Chesters site was not uniform, with the result that floors were at three different levels, stepping up from north to south. The variation in floor levels introduces a complication when considering how these rooms were roofed. Barrel vaults running at a constant level along the whole length of the west and east ranges would have produced rooms of three different heights. However, rooms of the same height could only have been produced if each had its own individual barrel vault, each at a different level; but this in turn would present problems in roofing. Reference to the suggested reconstruction of Bewcastle baths (fig. 12) shows that to bed pitched roofs directly onto these separate vaults would have produced a cluster of roofs at different heights. It might have been feasible to construct pitched roofs entirely of timber and structurally independent of the vaults (*cf.* discussion in Gillam *et al.* 1993, 14). These solutions seem clumsy and unnecessarily complex for Chesters. It is more likely that the level of ceiling vaults was uniform, producing a suite of rooms of three different heights. There would have been an advantage in lessening the height of the heated rooms to conserve heat and increase temperature. From an impressively tall entrance lobby and an airy *frigidarium*, the architecture itself would aid the creation of progressively hotter rooms, before bathers returned to the final, least warm *tepidarium*, then the lobby and *frigidarium*. Thus the apparently counter-intuitive way in which the site was terraced may have been a refinement intended to increase efficiency. Alternatively it could have been a mistake which subsequently caused problems when constructing ceiling vaults and roofs.

FLOORS

The suspended floors in the heated rooms at Chesters would have been of flagstones or large tiles (*bipedales*), the upper surface covered by a layer of *opus signinum*. None of the suspended floors in the main block survive, but good indirect evidence of their height comes from the doorways. The top of the threshold slab of the door in the north wall of *tepidarium* E1 is at a

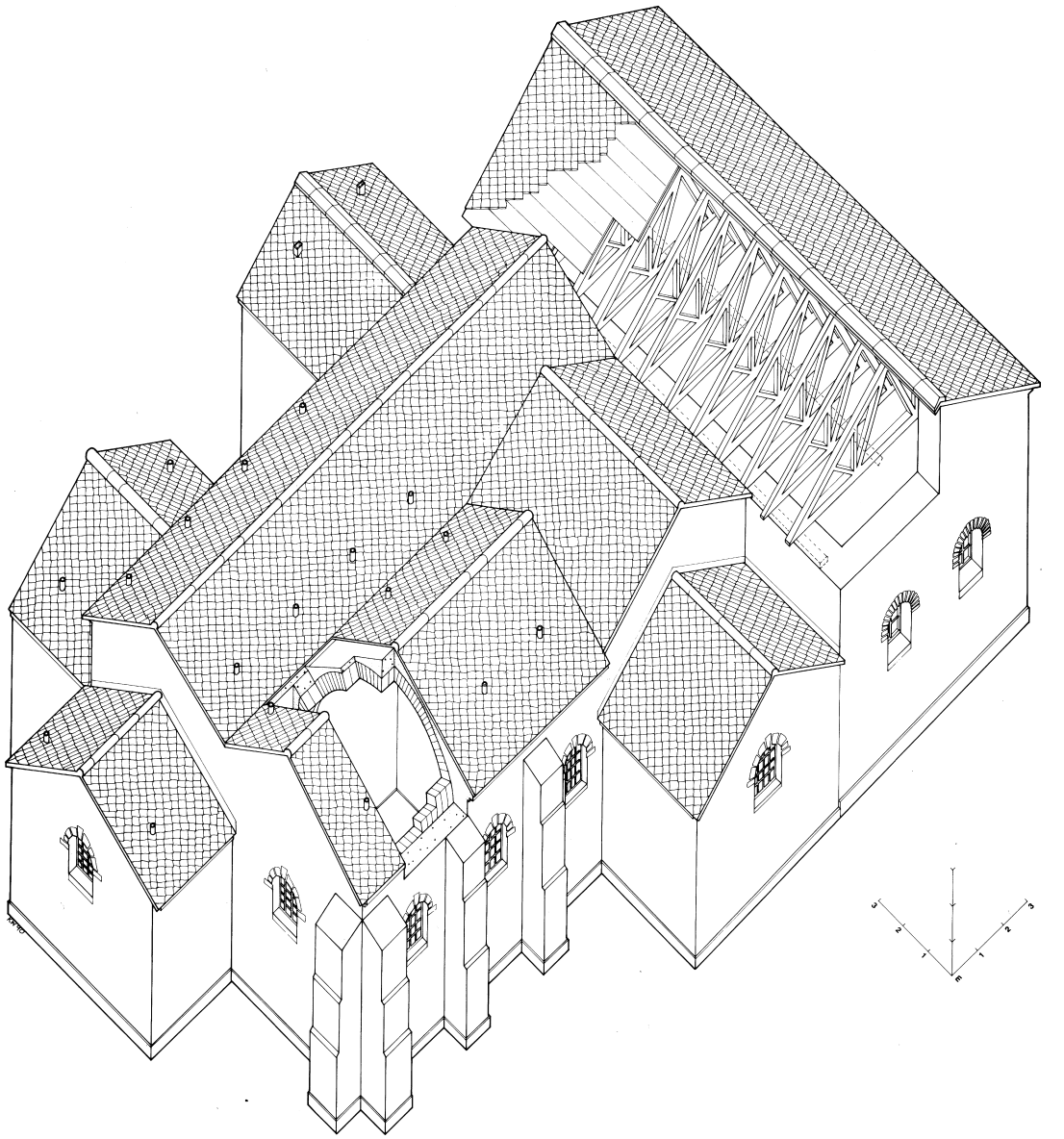


Fig. 12 Suggested reconstruction of the bath house at Bewcastle (reproduced from Gillam *et al*. 1993, Fig. 6, drawn by Kate Wilson; reproduced by kind permission of Derek Welsby, Kate Wilson and the Council of the Cumberland and Westmorland Antiquarian and Archaeological Society).

level of 56.46 mOD (metres above Ordnance Datum). Also at the same level is the threshold in the Period 1b/c door 14 between *tepidarium* E1 and *unctorium* (figs. 18, 19). Therefore rooms E1 and I appear to have had suspended floors at a uniform level of 56.46 mOD.

The average level of the threshold slab of door 15 between rooms E2 and H is 56.80 mOD. Further evidence comes from the remains of the block of masonry which supported the

Table 2 Summary of floor levels found in TWAM survey.

Level of suspended floors in first *tepidarium* (H) and *caldarium* (E2)	56.80 mOD
Level of suspended floors in *unctorium* (I) and second *tepidarium* (E1)	56.46 mOD
Difference in level of floors	340 mm

southern hot bath in *caldarium* E2; though damaged, it is topped by some surviving flagstones, the maximum levels of which are 56.79 mOD and 56.81 mOD. These results correspond well with Macdonald's finding that the suspended floors of rooms I and E1 were 1 ft 2 ins (356 mm) lower than the floors of H and E2 (Macdonald 1931, 258–9) (see Table 2).

HYPOCAUST *PILAE*

The suspended floors rested on *pilae* which stood on the basement floor. Almost all traces of the primary arrangement were removed in Period 2a, when remodelling extended down to basement level. Just two pieces of evidence suggest that the primary *pilae* were composed of tiles stacked one upon another. The Victorian excavations probed to the lowest surviving level in the *unctorium*, revealing two tiles (Holmes 1886–7, 126); shown on plan (fig. 7) these can reasonably be interpreted as the base of *pilae* still attached to the basement floor. Also, Macdonald (1931, 275–6) found a 'large portion of red brick' embedded in the primary basement floor beneath the rebuilt western hot bath.

At Ravenglass baths, possibly of late Hadrianic date, all the *pilae* uncovered were of tile (Jackson 1883, 216–9), but only portions of three heated rooms were explored — probably the equivalent of rooms H, E2 and E1 at Chesters. The evidence from other bath houses in the group is not straightforward. The intense heat to which hypocaust *pilae* were exposed over long periods would have reduced them to a very friable condition, necessitating repairs (Welsby 1980, 89–90); thus the replacements might take several different forms. This is clearly seen at Bewcastle where four different types of *pila* were found. Monolithic stone pillars were the most common, and therefore considered to be primary; others were composed of flat stone slabs or tiles and combinations of materials and assumed to be later repairs (Gillam *et al.* 1993, 8, 51). The plan of Netherby baths shows closely-set stone pillars in the presumed *unctorium* and the final *tepidarium* and widely-spaced *pilae* of square tiles in the *caldarium* and its adjacent *tepidarium*, rooms which were subjected to higher temperatures, and presumably more likely to have been repaired (Roy 1793, Pl. 46). The plan of Benwell baths shows *pilae* of different sizes; annotations state they were all of stone, those in the *caldarium* and *unctorium* being monolithic pillars, but appear to suggest that others consisted of stacks of smaller stones bonded together (Brand 1789, 607, plan following p. 606).

In conclusion, the primary *pilae* at Chesters seem to be of tile, but may have been replaced by others of different composition when repairs were needed.

BASEMENT FLOORS, UNDERFLOOR VENTS AND DEPTH OF BASEMENT

One of the most significant pieces of work carried out by Gillam and Daniels in 1956–8 was exploration and recording of the medial wall running north/south between the heated rooms. A trench dug along the west-facing side was carried down to basement floor level in the

caldarium; a sondage located the basement floor in *tepidarium* E1. The elevation was drawn; this and other drawings in the archive were provided with copious annotations describing features and materials and listing dimensions. The results are shown schematically on fig. 13.i (full elevation drawings reproduced as figs. 18, 19).

This work revealed the position and width of underfloor vents hidden below the modern ground surface, and also valuable details of later features, but an important discovery relates to the basement floor level. The Victorian excavators stated that the basement floor of room I was lower than that in room H (Bruce 1885, 101). Gillam's annotated elevation drawing (fig. 18) shows that the basement floor of rooms E1 and I was 9 ins (0.23 m) lower than the basement floor of E2 and H. However, because of the difference in level of the suspended floors (as shown by the threshold slabs of doors 14 and 15), the height of the basement space was the same in all rooms, *c.* 1.20 m.

The level of basement floors can now be estimated. An annotation by Gillam gives the distance between the top of the threshold slab of door 14 (of Period 1b or 1c) and the basement floor of room E1 as 52 ins (1.32 m) (figs. 13.i, 18). The TWAM survey measured the threshold level as 56.46 mOD. Therefore the basement floor in rooms E1 and I should be at a level of 55.14 mOD. Adding 9 ins (0.23 m) to this value produces a level of 55.37 mOD for the higher basement floor of rooms E2 and H. However a slight discrepancy creeps in when calculating this level by another method. A further annotation by Gillam gives the distance between the top of the threshold of door 15 and the basement floor of E2 as 54 ins (1.37 m), and this seems to be borne out by the elevation drawing. As measured by TWAM, the level of this threshold is 56.80 mOD. Subtracting a distance of 1.37 m from this produces a level of 55.43 mOD. The difference between the two values is 60 mm (just under 2½ ins) — not too great a discrepancy considering that these calculations are made using two sets of measurements collected 40 years apart, with masonry consolidated in the intervening period. However, the true levels can only be clarified by excavation (see Table 3).

Table 3 Estimated levels of primary basement floors in the heated rooms.

Estimated level of primary basement floor in in first *tepidarium* (H) and *caldarium* (E2)	55.37 or 55.43 mOD
Estimated level of primary basement floor in *unctorium* (I) and second *tepidarium* (E1)	55.14 mOD

The heating system

THE FURNACE AND OPERATION OF THE HYPOCAUST

Later modifications have removed much of the evidence of how the primary hypocaust at Chesters was fired, and a question arises of whether four heated rooms could be served effectively by a single furnace. However evidence does survive at Bewcastle (Gillam *et al.* 1993, 4–5); in the west wall of the western hot bath there was an arched opening, 1.75 m wide and 2.3 m high above basement level, clearly the flue for a furnace room (*praefurnium*) outside the western hot bath. The furnace which fired the hypocaust also heated water for the plunge baths, supplied from a boiler suspended above the furnace. Hot combustion gases from the

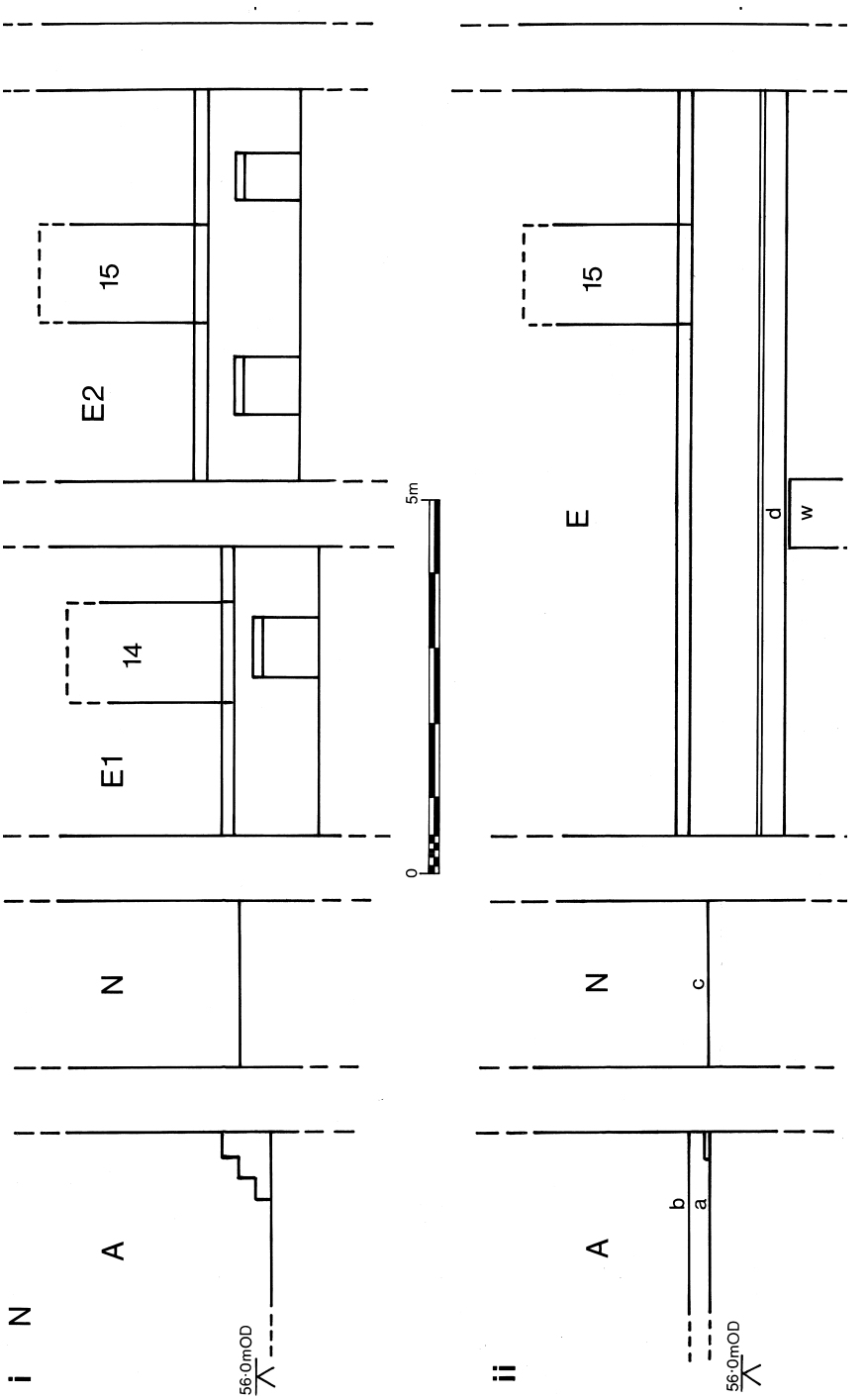


Fig. 13.i (top) Elevation through the centre of the western range of rooms in Period 1, showing basement floor and suspended floors in E1and E2, underfloor vents in medial wall, doors 14 and 15 (heights unknown). Also shown, upper surface of primary floors in lobby N and changing room A (area beneath unexcavated). Scale 1:100.

Fig. 13.ii (bottom) Elevation in Period 2a. Door 14 and underfloor vents in medial wall blocked, crosswall demolished (w) and *caldarium* extended, drain (d) inserted, secondary floor in lobby (c) and in changing room (a). Also shown, tertiary floor (b) in changing room (Period 2b or 3). Scale 1:100.

fire were drawn though the arched opening of the flue and into the underfloor space. The top of the arch was high enough to accommodate a *testudo*, a cylindrical copper heat exchanger, which sat above the flue and opened into the rear of the bath at its base, maintaining the high temperature of water (see also Bidwell 1979, Fig. 9). In contrast, there was no such arrangement at the southern hot bath, where the south wall survives to a height of *c.* 1.5 m, with no opening for a flue. Thus the primary bath house at Bewcastle was constructed with only one main furnace.

In view of the close similarity of plan in all baths of this group, it is reasonable to assume that the primary building at Chesters was equipped with only one furnace, situated outside the western hot bath. The only visible evidence is a fragment of its north wall; however a block plan drawn by Gillam (copy in Bidwell *et al.* 1997) shows walls on the northern and southern sides, and Gillam's notes refer to 'projecting walls' (1956–8, 3). Water in the western bath would be very hot; that piped to the southern bath would still be warm.

Hot gases circulated through the underfloor spaces of the *caldarium* and *tepidaria* through vents in the walls of these rooms (fig. 10.ii). The direction of heat flow was anti-clockwise as at Bewcastle (Gillam *et al.* 1993, 4). There were two vents in the medial wall between the *caldarium* and *tepidarium* H. Although blocked in a later period, their positions were established by Gillam (figs. 13.i, 18). The southerly vent was 0.60 m wide and the northerly 0.70 m. The three vents in the wall between rooms H and I were narrower — the central one 0.50 m wide, the outer two 0.40 m — their combined width being equal to the combined widths of the two vents between E2 and H. Beneath rooms I and E1 was a single vent, *c.* 0.80 m wide (figs. 13.i, 18, 19). E1 was therefore the least warm room in the heated suite.

The crosswall between E1 and *caldarium* E2 was later completely demolished (Period 2a), but evidence suggests that there had never been any underfloor communication between the two rooms. In 1956–8 Gillam examined the remains of the crosswall and found masonry on the south face reddened by heat, while that on the north side was unburnt and there were 'enormous' quantities of soot in the hypocaust basement of E1, deposited by the cooling gases (Gillam and Johnson 1985, 3). There were no vents in the equivalent wall at Bewcastle and some hypocaust *pilae* in the final *tepidarium* were buried almost to their full height in soot (Gillam *et al.* 1993, 3–4).

The primary bath house at Chesters was apparently equipped with only one furnace, and this arrangement did in fact prove to be insufficient to serve four heated rooms. Early in the building's history an auxiliary furnace was added to heat *tepidarium* E1 (see Period 1b or 1c).

WALL JACKETING

A cavity wall system linked to the hypocaust enabled wall surfaces to emit radiant heat. Hot gases from the underfloor space were drawn up through the hollow wall jacketing before being discharged through chimneys. The side of the jacketing facing the room would have been coated with plaster. Jacketing could be constructed in several ways (Brodribb 1987, 63–77; Yegül 2010, 87–9). A layer of flat tiles could be mounted on the wall, separated from it by a variety of devices, or *tubuli* (box-tiles) could be used. The latter are hollow, rectangular tiles which can be stacked together to cover the wall; holes in the sides of the boxes allowed heat to flow between vertical stacks as well as upwards.

At Bewcastle there is abundant evidence of jacketing consisting of small flat tiles, held in place by T-shaped iron spikes (or holdfasts); ceramic cylinders (variously referred to as

chaplets or spacer bobbins) were slipped over the shafts of the holdfasts (Gillam *et al.* 1993, 13, 50–1; Yegül 2010, Fig. 38d). However some fragmentary *tubuli* were also found, two of which were associated with the demolition of the southern bath in the *caldarium* (Gillam *et al.* 1993, 51–2). How the two methods were combined is not known. *Tubuli* could have been used in repairs or modifications or in forming a chimney. Flat tiles were also used at Ravenglass. In the large *tepidarium* (probably equivalent to *tepidarium* H at Chesters) a mass of tiles and corroded iron, clogged with soot, was found in the gap between the outer wall and nearest row of *pilae* (Jackson 1883, 219, plan facing p. 218). Fragments of *tubuli* have been found at Wallsend (Hodgson 2014, 9).

At Chesters the evidence is inconclusive. The entire heating system in rooms I and H was dismantled in late Roman times (Macdonald 1931, 278; and see Period 3) removing all evidence of wall jacketing. In the western range no tiles are recorded, but iron holdfasts were found embedded in the masonry, although Holmes refers only to 'room E', not distinguishing between E1 and E2 (Holmes 1886–7, 128–9; Macdonald 1931, 277–8). Parallels with Bewcastle and Ravenglass suggest the use of flat tiles with iron holdfasts and ceramic spacers. Twenty-one ceramic spacers are recorded from Chesters (Brodribb 1987, 69; Budge 1907, 375, items 629–49), of roughly the same dimensions as the Bewcastle examples (Gillam *et al.* 1993, 13). However, without an exact provenance, these could have derived from baths within Chesters fort. Also one should not rule out the possibility that *tubuli* were used. These were normally mortared to the wall, but occasionally iron holdfasts were used (Yegül 2010, 87; Brodribb 1987, Fig. 31). A single *tubulus* is shown on Holmes' plan (fig. 7), without an indication of its findspot.

Gillam's observations of the MoW work found evidence of how spent gases left *tepidarium* E1. The west wall had been altered by modifications throughout the Roman period, and has been the subject of repair and consolidation, making interpretation difficult. However Gillam (1956–8, 1, 3) stated that on the inner face of the wall there was a chimney (figs. 10.i, 10.ii). This may be identified as an 'evacuation duct'; these features are defined as 'vents running up through the walls at intervals and acting as chimneys for the hypocaust. Their presence usually indicates the absence of hollow walls' (Bidwell 1979, 32–3, n. 4). An example was embedded in the south wall of the Period 1c *laconicum* ante-room, which had no wall jacketing; the chimney was formed of hollow box tiles which had broken to leave a narrow slit in the wall face (Macdonald 1931, 297, Pl. LVI, 1). Another northern example was found in the late first-century baths at Corbridge Red House (Daniels 1959, 128–9). Gillam's identification seems vindicated by one of Gibson's photographs taken in 1885, showing the whole building viewed from the south (fig. 9.i). Halfway along the inner face of the west wall of room E1 is a narrow gap, beginning roughly at the level of the suspended floor and extending up the wall in a straight line for a short distance. There is no gap in the wall in the photograph taken at the end of excavation in 1886 (fig. 9.ii); evidently a repair had been carried out.

If the use of a chimney or evacuation duct meant that wall jacketing was not initially provided in *tepidarium* E1, the only source of warmth would have been underfloor heating — probably sufficient in a room whose purpose was merely to aid the process of cooling for bathers en route between *caldarium* and *frigidarium*.

CEILING HEATING

In rooms containing hot plunge baths it was important that the ceiling was heated to prevent the formation of condensation which would drip down into the room (Paul Bidwell, pers.

comm.). As the *tepidaria* at Chesters contained no plunge baths, only the *caldarium* would have needed a heated ceiling. Hot gases from the wall jacketing could have passed into a hollow layer attached to the base of the ribbed ceiling vault (fig. 11). How the latter was constructed is unknown, but it could have been formed of hollow ceramic voussoirs (*tubulus cuneatus*) (Brodribb 1987, 79–81).

The unheated rooms

As in all the bath houses of this group there was a small lobby N and a *frigidarium* K with a large cold plunge bath L (fig. 10.i). At Bewcastle, where the basement floor was constructed at the same level throughout the building, the basement space of the unheated rooms was filled with clean sand upon which the floor was laid (Gillam *et al.* 1993, 15–16). At Chesters the space beneath the primary floor of the lobby has not been explored, but a flagstone in the doorway between it and the *frigidarium* and another immediately inside the *frigidarium* rest on a rubble foundation.

LOBBY

Some of the flagstones of the primary floor are visible amongst the modern gravel surface. Levels on the flags at the north-east and south-east corners of the room are 56.20 mOD and 56.23 mOD. The western end of the room has been affected by later modifications and consolidation (Periods 1b and 2a).

At an early stage of the excavation Clayton's men found features alongside the north and south walls of the room, which Bruce described as 'low walls … intended, perhaps, for seats' (Bruce 1885, 99). On his plan (Bruce 1885, plan facing p. 98) they are shown as simple shaded areas. Holmes' more detailed plan (fig. 7) shows three rows of large masonry blocks — two respecting the centrally-placed northern doorway, and one to the east of the door in the south wall. There is none in the south-west corner, an area too cramped for seating. Macdonald rejected the suggestion that the 'low walls' were seats, giving several reasons (Macdonald 1931, 247–8). One objection was that the maximum height of the surviving masonry above the floor was only 1 ft 4 ins (0.41 m). However, features like these are best interpreted as the remains of bench foundations from which the upper stone slabs have been removed (Paul Bidwell, pers. comm.). The addition of a stone slab *c.* 0.10 m thick would have created benches at a practical height of 0.51 m (1 ft 8 ins). This would closely resemble a bench abutting the north wall of the changing room in the baths at Bewcastle (Gillam *et al.* 1993, 21, Pl. 10). This was 0.50 m high, topped with thick, medium-sized stone flags, and the front composed of larger flags; it was not dismantled so the interior construction is unknown. Similar masonry bench foundations have been found in the changing room of an extra-mural bath house at Binchester (Mason 2014b, 23–4, Figs 8, 10, 11, 14; 2015, 22–3, Figs 8–12). Macdonald also thought there would be no room for seating in a lobby crowded with bathers passing through three doorways, and too small in comparison with the spacious changing room. But these objections are not valid for Period 1a; at that time there was no entrance into the *laconicum* through the western wall, and the entrance to the *frigidarium* may have been through a simple arched opening without a door. More importantly, the stone-built changing room did not exist and we do not know the size of the supposed timber predecessor, or whether it was equipped with seating. Finally Macdonald noted that the southern dwarf wall was topped by a layer of

tufa voussoirs and suggested '... it may have been built up, under a misapprehension, in 1884 or 1885 ...'. That is of course possible. However, the build-up of tufa voussoirs could have happened in the Roman period. Macdonald himself noted that one or two tufa voussoirs had been incorporated into the walls of the building at a low level. He said that these could most simply be explained as wasters — blocks damaged in quarrying or in transit (Macdonald 1931, 283–4)

There have been changes since Macdonald's time. Now the bench foundations have a maximum height of only 0.27 m (10½ ins) above the floor. The southern dwarf wall has been consolidated as uniform masonry extending across the whole of the south side, with no tufa voussoirs.

FRIGIDARIUM

As described above, there may have been no threshold slab in the opening between the lobby and *frigidarium* in its primary phase. There is only a plain flagstone, levels on which are 56.20 mOD and 56.23 mOD, identical with the surviving flagstones in the lobby, suggesting a continuous flagged surface running between the two rooms. Later robbing of the *frigidarium* floor left only a single flagstone *in situ*, lying immediately inside the opening from the lobby. It has been worn down to a level of 56.16 mOD, only slightly lower than the surrounding surfaces, and is therefore probably the remains of that continuous flagged floor.

In the centre of the *frigidarium* was a feature used as a shower or douche. The underfloor emplacement survives, consisting of a stone block with a circular depression cut in it. Gutter blocks to carry away waste water run northwards (fig. 10.i; Macdonald 1931, Pl. XLVIII, plan facing p. 304). At first sight the evidence of levels seems to contradict the idea that water drained to the north — the southern end of the stone block is *c.* 200 mm lower than the northern end. Holmes (1886, 126) found the system difficult to explain, however Macdonald argued convincingly that subsidence had occurred (Macdonald 1931, 253–4). The gutter blocks can only be traced as far as the north wall of the room, where their course is interrupted by a later feature. However they presumably connected with a drain which ran eastwards along the north wall to join the drain which flushed the latrine trenches. A close parallel comes from the first-century baths at the fort of Castleford, West Yorkshire, where there was a circular emplacement and drain in the *frigidarium* (Bidwell and Hodgson 2009, 37–8, Fig. 12).

The Victorians found two portions of a large, elegantly-shaped stone basin, the flanged base of which would have fitted the circular depression in the stone block. The basin was illustrated by Holmes (fig. 7), who estimated it had been 4 ft 8 ins (1.42 m) in diameter and 1 ft 5 ins (0.43 m) in height (1886–7, 126). He noted that the pattern of wear on the flagstone adjacent to the west door showed that on entering the *frigidarium* bathers turned sharply to the right, to walk around the basin (Holmes 1886–7, 127; and see fig. 7). The basin fragments were in the *frigidarium* in 1929 (Macdonald 1931, 252), but were missing in 1959 (Daniels 1959, 115, n. 43); neither fragment can be located now. A stone fragment found in the north-east corner of the *frigidarium* at Bewcastle was thought to be 'from the corner of a laver or basin', the shape of its half-round moulding suggesting it was octagonal (Gillam *et al.* 1993, 16).

There must have been a hole in the bottom of the Chesters basin to allow waste water to discharge into the drain, so the basin itself could not hold water. It was however large enough for one person to stand in it, while someone — a fellow bather, a servant or a bathing

attendant — fetched water to pour over the bather. The sides of the basin were high enough to prevent water spilling over the floor. All that was needed for the system to function efficiently was a storage tank or trough from which water could be scooped. Evidence of the provision of a free-standing water tank is described below in Period 1b.

Though no trace of *opus signinum* flooring survives, a protective layer of it must have been provided in the *frigidarium* to prevent water seeping down between flagstones into the rubble packing below. This raises the question of how the flagstone at the entrance to the *frigidarium* became worn in spite of its protective coating. Perhaps heavy usage over a long period wore away the *opus signinum* as well as some of the stone before repairs were carried out. At Bewcastle the *frigidarium* floor was covered with 'white lime concrete', the lobby floor with white or pink concrete (Gillam *et al.* 1993, 15–6), and repairs were carried out; the *frigidarium* floor received a fresh surface at least once, the aggregate thickness of concrete being more than 200 mm, and the lobby floor was also resurfaced at least once, probably in the second half of the third century (Gillam *et al.* 1993, 15–6).

The walls of the cold bath at Chesters do not survive above modern ground level. Thomas Hepple considered that the outer wall of the bath had collapsed when uncovered in the nineteenth century and had been rebuilt then (Macdonald 1931, 249). Macdonald observed that in the intervening 34 years the wall had sagged outwards to leave a gap of 6 ins (152 mm) at the top, caused by the softness of the ground on which the wall was built and the pressure of earth behind it (Macdonald 1931, 249). The floor of the bath was of reddish concrete, at least 1 ft (0.30 m) thick; enough of the quarter-round moulding at the edges survived to show that the walls had been lined. The bath was entered by steps, one flagstone of which remained *in situ* in the north-west corner (Macdonald 1931, 249); on the plan by Holmes (fig. 7) a dotted line down the west side of the bath probably indicates the position of the steps. The remains of a similar set of steps were found in the same position in the cold bath at Bewcastle, where the depth of the bath from threshold to floor was *c.* 1 m (Gillam *et al.* 1993, 16–18, Pl. 6).

The Bewcastle cold bath had a drain hole in the south-west corner (Gillam *et al.* 1993, Pls 6 and 7). In this area of the bath at Chesters an oblong hollow 6 ins (152 mm) deep had been cut through the concrete floor in late Roman times (fig. 7), thus destroying evidence of the outlet for waste water for which Macdonald searched unsuccessfully (Macdonald 1931, 249). On Parker Brewis's plan (Macdonald 1931, facing p. 304) a short length of drain is shown outside the south-west corner of the bath.

A possible changing room and latrine

The possible position of a timber changing room and primary latrine is indicated on Figure 10.i. The existence of a primary latrine is conjectural, however the optimum position for it would be to the east of the changing room, where its trenches would be flushed by water from the *frigidarium*, and the outflow drain could discharge down the slope into the river. Macdonald thought that the solidly built platform supporting the visible remains of the latrine was primary (Macdonald 1931, 23–2).

Water supply and fuel storage

Water may have been diverted from the river upstream through an aqueduct, traces of which are likely to have been eroded away by the westward movement of the river since Roman

times (Hodgson 2011, 17). Macdonald noted that the suggested eavesdrip gully running round the building could also have collected waste water from the baths, all then used to flush the latrine (Macdonald 1931, 243–5). Fuel for the furnace had to be stored in dry conditions; pitched roofs with overhanging eaves would provide shelter for wood stacked against the walls of the building.

Summary: the bathing regime

Though heat flow through the baths was anti-clockwise, bathers moved around the building in a clockwise direction (figs. 10.i and 10.ii). In the postulated timber changing room they disrobed and collected wooden-soled sandals which protected feet from the high temperatures of the heated floors — as well as wearing away floor surfaces and sending noise echoing through the high-ceilinged rooms. Bathers passed through the lobby into the *frigidarium* to rinse away the dust and dirt of work, exercise or travel. From there they passed into the small *unctorium* to anoint themselves with perfumed oil, then stepped up into the first *tepidarium*. After relaxing there they passed into the *caldarium*, to scrape away oil, sweat and dirt, then make a choice of plunge baths, the hotter being the western one next to the furnace. A step down led from the fierce steamy heat of the *caldarium* into the second *tepidarium*, providing an opportunity for gentle cooling. From the second *tepidarium* bathers moved back into the small lobby and through the probably crowded entrance to the *frigidarium* for a dip in the cold plunge bath before returning to the changing room.

A possible detached laconicum

As there is no evidence of a *laconicum* attached to the primary bath house, the question of a possible detached structure arises. It is doubtful whether detached *laconica* were ever truly free-standing; examples at Hardknott, Corbridge and Templeborough were probably accessed through a timber changing room (Bidwell *et al.* 1999, 62–4), and this could have been the case at Chesters.

In the Gillam archive there is reference to a wall visible in the slope to the west of the main building (Gillam 1956–8, 1). Describing it as 'curved masonry showing up through the turf', Gillam suggested it could be part of a circular *laconicum* (Gillam and Johnson 1985, 4). The concept of a circular, domed *laconicum* was originally designed as the ideal shape for the propagation of and conservation of heat, but with the introduction of advanced heating methods the shape of the room was no longer critical (Yegül 1992, 385). Circular *laconica* were passing out of fashion towards the end of the first century, and occur only rarely in association with the baths of auxiliary forts (Bidwell *et al.* 1999, 63). Examples on the northern frontier are either undated or known to be early, with the exception of the circular *laconicum* beside the row-type baths at the Hadrianic fort of Hardknott. Otherwise *laconica* at forts on Hadrian's Wall and its vicinity are square (Bidwell *et al.* 1999, 63).

The only masonry discovered in the position described by Gillam is the length of wall shown on plans by Bruce (1885, N on plan facing p. 98) and Holmes (fig. 7). A Gibson photograph of 1885 shows the wall projecting from the grassy slope to the west, cut by the excavators' trench (Macdonald 1931, Pl. L). On both plans the wall is straight, and in the photograph it stands eight or nine courses high. It is still *in situ*, but now only a few courses are visible; either the slope of the bank has been altered or some of the masonry has collapsed.

Nor is the wall curved; it has only a slight misalignment, perhaps the result of partial collapse. The wall is undated. Bruce (1885, 102) thought it was 'to all appearance, mediæval'. However in the photograph of 1885 (Macdonald 1931, Pl. L) its masonry does not look very different from the Roman masonry of the main building. The excavators' trench has removed evidence of any relationship with the main building; however a test pit by Gillam showed that it did not continue eastwards to meet the later attached *laconicum* suite (Gillam 1956–8, 1). In conclusion, it is possible that the wall was part of a primary detached *laconicum*, but one that was square rather than circular.

PERIOD 1B

Introduction

A stone-built construction containing a changing room (A) and latrine (M) was attached to the north wall of the primary block, replacing the presumed timber predecessor (fig. 14). The butt joint between the primary block and the west wall of the new construction proves that this was an addition. The stone-built changing room at Bewcastle is secondary (Gillam *et al.* 1993, xv, 21). Plans of Benwell and Carrawburgh baths also show stone-built changing rooms (Brand 1789, plan following p. 606; Bruce 1874, plan facing p. 17), but there is no indication of their phasing. Gillam suggested that this development was Antonine in date, because of parallels with the move from timber to stone changing rooms on the German frontier (Gillam and Johnson 1985, 5).

The north wall of the new Chesters changing room must have been very close to the base of the high ramp carrying the Military Way into the fort across a new bridge over the Tyne, built in the 160s (see Hodgson 2011, p. 21, lower illustration). The most practical way to roof the new changing room and latrine would be by a roof with a shallow pitch, its apex along the long axis; the changing room of the Segedunum reconstruction is roofed in this way, the pitch being 22½ degrees (fig. 12). Evidently drainage was needed in this damp part of the site, which possibly lay on the course of a streamlet. The substantial drain which curves around the north-west corner of the changing room may have been provided at this stage or later. It was eventually truncated by the construction of a porch (Period 2a), but presumably originally drained water along the front of the building and eastwards to the river.

CHANGING ROOM

The changing rooms of this group of baths vary in size, which may be a reflection of the size and status of the unit occupying each fort (Gillam *et al.* 1993, 22). The high status of Chesters as a cavalry fort may explain why its bath house has the largest changing room of the group. Internally it is a maximum of 14 m wide and 9 m deep, an area of 126 m^2, providing ample space for undressing and storing clothes, and for exercise before bathing. After bathing, bathers could return to the impressive — but noisy — changing room to dress, relax, meet friends and eat refreshments.

The entrance in the centre of the north wall was altered in late Roman times (Period 3) so its original width is unknown. The lower part of a stone door jamb is *in situ* on the east side; that on the west has been removed, leaving a ragged edge of masonry. There is no visible threshold slab. The walls had deep foundations; on the east side of the north wall Macdonald

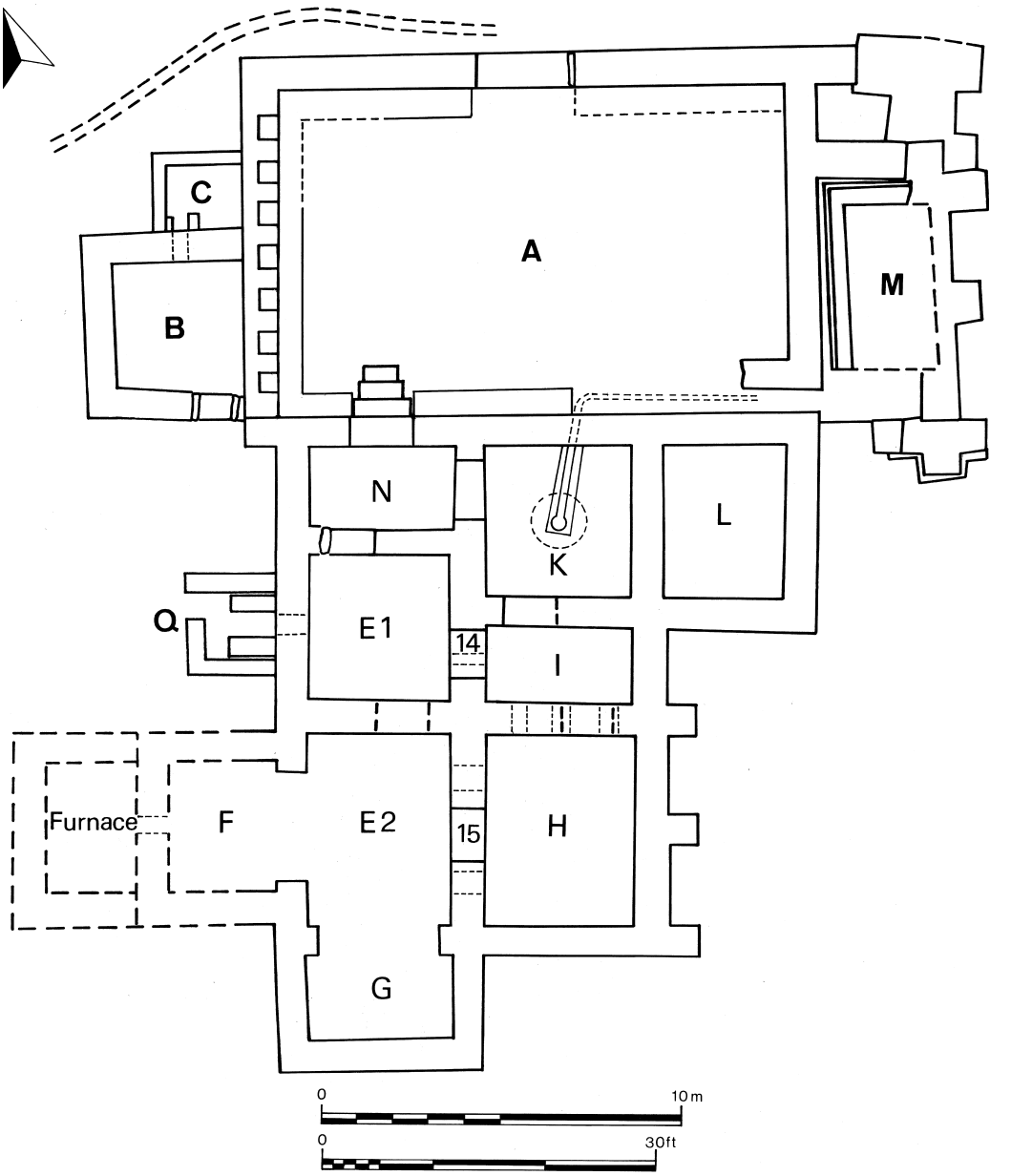


Fig. 14 Plan of the baths in Periods 1b and 1c. Scale 1:200.

found well-constructed masonry extending 3 ft (0.91 m) below primary floor level (Macdonald 1931, 238–9). Investigation of the west wall revealed foundations of the same depth, and also remnants of the plaster with which the outer face of the wall had been rendered (Macdonald 1931, 298). The east wall is heavily robbed; masonry does not survive above modern ground level. At its southern end are the broken remains of a return wall; this originally formed one side of a drain which carried excess water out of the *frigidarium* and flowed eastwards to flush the latrine.

LATRINE

There is no surviving evidence of a door through the east wall of the changing room into the adjoining latrine. Macdonald thought it was entered from the north-east through a small lobby (Macdonald 1931, 242), but it is possible there could have been an entrance in the south-east. He described in detail the remains of the latrine, which in spite of its substantial construction has not survived well; the buttressed substructure of massive stone blocks has sunk at its southern end (Macdonald 1931 233–4, 242–3; Pls XLIII, XLIV). Macdonald saw evidence of repair or even rebuilding in the Roman period, and levels taken in 1929 suggested subsidence has continued since then (Macdonald 1931, 233–4). In the interior, sewer trenches ran around the western and northern sides of a rectangular stone platform, of which only the rubble core survives. At the bottom of the trenches were well-cut gutter stones. The system was flushed by a drain entering the south-west corner of the latrine, carrying water from the underfloor drain in the centre of the *frigidarium*. Water flushed through the two sewer trenches, and discharged through an outflow drain at the north-east corner of the latrine, and thence to the river.

In the 1886 photograph of the changing room (fig. 8) there are numerous finds; some, like the tufa voussoirs propped against the south wall, were obviously brought from elsewhere for the benefit of the camera. To the left of the voussoirs there is an object resembling a latrine seat. Nearby is a rectangular stone trough which the excavators may also have brought from the latrine (similar troughs have been found in a latrine in the eastern corner of the fort at Binchester (Mason 2013, 14, 15, 17)). The Chesters rectangular trough is of sandstone; it measures 1.05 m by 0.62 m and is 0.35 m high and the sides are 0.12 m thick. There is a hole in one corner of the base which would have allowed dirty water to be drained away.

INTERIOR OF THE CHANGING ROOM

A prominent feature within the changing room, running along the full length of the west wall, is a row of seven niches. These would have been plastered over, and thus viewed as alcoves of equal size and spacing; but today, without plaster, their constructional detail can be seen. Each niche has an arched head formed from a single block of stone. These seem clearly to be re-used arcuate lintels, most probably window heads derived from the fort gateways (including perhaps from the porta *principalis sinistra* and *porta principalis dextra*, the upper superstructures of which would have become redundant when both portals of each gate were blocked). Macdonald was the first to propose that they were re-used, after noting that their weight was unevenly distributed between the supporting masonry piers, and misfits between blocks had been filled by wedges of stone (Macdonald 1931, 236–7). Indeed a close survey shows a discrepancy in their individual sizes, particularly their overall length, which ranges

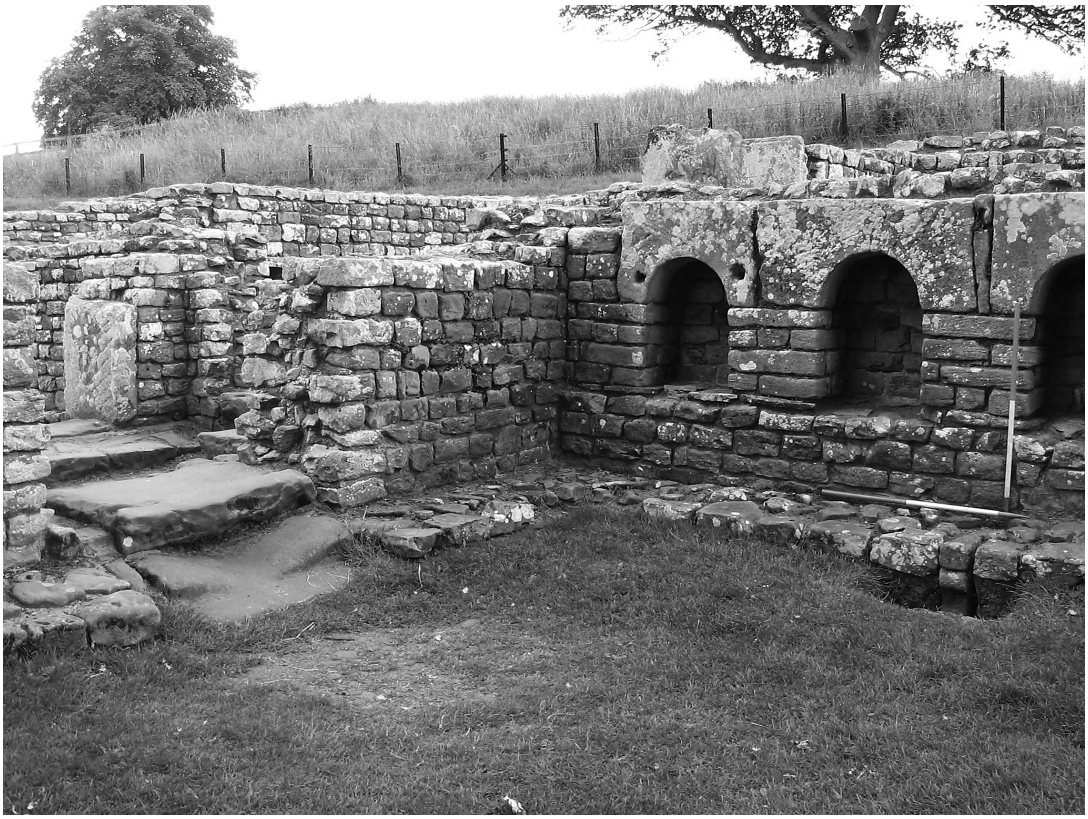


Fig. 15 The south-west corner of the changing room, viewed from the north-east. On right, surviving bench leg, on left, steps into lobby. Photograph, the authors.

from 0.90 m to 1.27 m. This would seem to suggest that they came from more than one original source. However, they share a similar height (between 0.58 m and 0.63 m), and thickness (between 0.24 m and 0.28 m). But more importantly the interior width of the arch is constant, at 0.58 m, the latter probably being the key factor in interpreting their former use as window heads, the other variations in size being easily compensated for in the surrounding masonry of the gateway.

At Birdoswald two arcuate lintels of similar dimensions to those from the Chesters niches lay amongst the remains of the *porta principalis dextra* for many years, but are now incorporated into the modern Visitor Centre as window heads. Arcuate lintels with thickness between 0.13 m and 0.15 m (thinner than those at Chesters) are also known, from South Shields and Housesteads. Some of these examples have either cut decoration, such as roundels and rosettes, and other decoration within the spandrels (Bosanquet 1904, 267; *CSIR* 1, 6, nos 244, 413–33). Some also have incised lines radiating from the window opening to represent voussoirs (Bidwell and Speak 1994, 148, no. 8, Fig. 5.4), while one shows signs of painted voussoir representation (Bidwell and Speak 1994, 7, Fig. 5.4); both of these techniques suggest that an arched opening formed from separate voussoirs was a preferred aesthetic style (Taylor 2000, 153). Examples with separate voussoirs are known from Birdoswald

(Wilmott 1997, 65). Though the thinner lintels from South Shields undoubtedly formed window heads in gateways (Bidwell and Speak 1994, 148), examples with moulded or applied decoration could have been used elsewhere on buildings within forts (Taylor 2000, 152).

Below the niches, also running the full length of the wall, was a stone bench with elaborately moulded legs. A sondage cut through modern layers, 2.80 m from the southern end — between the second and third niches — reveals one of the legs still *in situ* (fig. 15). One of the authors (GS) remembers being told by Charles Daniels that the sondage was dug by John Gillam. The lowest levels in the changing room have not been fully explored, so it is impossible to say whether benches were provided along any of the other three walls in the primary phase.

An initial suggestion that the niches were intended to hold statuary was discounted on the grounds that they were too low (Bruce 1885, 98–9). Holmes (1886–7, 128) suggested that they were used for the storage of bathers' clothes. Macdonald agreed, although noting that the sills were only *c.* 3 ft (0.91 m) above primary floor level (Macdonald 1931, 235–6, 237–8); it is now recognised that niches are a standard feature of baths, and therefore most likely intended for the storage of clothing. The internal measurements of the Chesters niches vary only slightly (on average 0.84 m high, 0.61 m wide and consistently 0.55 m deep). This would allow for the insertion of a wooden framework with three shelves; only 21 sets of clothes could therefore be stored, insufficient when the baths were crowded. Additional shelving would be needed elsewhere in the room, presumably in timber, which would not survive.

There may be a parallel for the niches in the changing room of the baths at Carrawburgh, the plan of which shows seven openings through the walls in the north-east corner of the room (Bruce 1874, plan facing p. 17). They are smaller than the window in the cold bath and are not splayed. They cannot have been flues, nor is it likely that so many drains were needed in one area. It is more likely that they were niches which the nineteenth-century excavators mistook for openings. The number may be significant; as mentioned above, the modular system for laying out bath houses of this group produced rooms with internal measurements of roughly seven or twice seven Roman feet. Was this number a particular feature of the work of the original architect? Was his influence still important when the stone changing rooms were built?

Choice of the number seven could have some special significance, perhaps representing the seven heavenly bodies known to the Romans — Mercury, Mars, Venus, Jupiter, Saturn, Moon and Sun. In the cult of Mithras, popular with soldiers, there were seven grades of initiates. A curious discovery was made in 1958; when the MoW workmen took down the outer face of the west wall, they found three bone needles lying together in the mortar 'in the centre of the wall', at about the position of the middle niche (Simpson 1956–77). This seems to mean that the needles were embedded in the mortar of the wall core, and since the outer surface was plastered, it is difficult to imagine how they could have slipped through a crack into the centre of the wall. A votive deposit seems a possible explanation.

The primary floor of the changing room is nowhere visible, lying below the modern ground surface, and the early excavators did not describe it. When the interim report was published, only the late Roman flagged floor had been exposed (Bruce 1885, 98, photograph facing p. 99). The primary floor was located later on in the excavation, perhaps in a sondage dug in the south-west corner of the room (fig. 8). Holmes states that the late floor was 'about 2 feet 6 inches (0.76 m) above the level of the original floor', without describing the latter (Holmes 1886–7, 125). Although Macdonald dug several test pits in the changing room, he

also refers only to 'the original floor' (Macdonald 1931, 238–9). However a record of this floor comes from a sketch drawn by Gillam of the east-facing section of a trench which he cut through the upstand south of the changing room entrance in 1958. This shows a primary floor surface of yellow sandstone flags (fig. 25).

The TWAM survey attempted to estimate the primary floor level. Though not directly accessible, its level could be estimated by measurement of the bench leg which rested upon it. Most of the leg was visible in the sondage, though the base was covered by an accumulation of soil. By careful probing the base of the leg was estimated to be at a level of 55.77 mOD, which was assumed to represent the level of the floor.

A flight of three steps led up to the door into the lobby, as shown on fig. 7. Holmes noted that they were worn by long usage (Holmes 1886–7, 129). Today the lowest step is below the modern ground surface; the second step is slightly worn and the centre of the top step very heavily worn (fig. 15). The threshold slab is a late-Roman replacement; its level in Period 1b is unknown, but Holmes' plan provides some indirect evidence. His plan shows two flagstones or steps leading down from the threshold into the lobby. They are worn to the same extent as the steps in the changing room, suggesting they were contemporary. The lower is now covered by the modern ground surface, but the upper is visible. Levels measured on the least worn areas of it and on the topmost step in the changing room are 56.43 mOD and 56.39 mOD, respectively. Allowing for wear, this suggests that the original levels may have been *c.* 56.46 mOD, the level elsewhere in the building. Perhaps the threshold slab was originally also at 56.46 mOD, and thus 0.69 m higher than the primary changing room floor at 55.77 mOD. This gap could easily be bridged by three steps, each of *c.* 0.23 m, as shown in Table 4.

Table 4 Postulated height of steps from changing room into lobby.

Feature	Measured level m OD	Estimated original level m OD
Primary floor of changing room	Not visible	55.77
Lowest step in changing room	Not visible	56.00
Second step in changing room	56.17	56.23
Top step in changing room	56.39	56.46
Period 1b threshold	Unknown	56.46
Highest flagstone/step in lobby	56.43	56.46

The unheated rooms

LOBBY

Evidence shows that the lobby floor was raised in this period. If it had remained at a height of *c.* 56.20 mOD there would have been no need for a flight of three steps in the changing room — two would have been sufficient. However the heights of the top step and the stone immediately inside the lobby suggest that this represents the height of a new lobby floor at *c.* 56.46 mOD.

Holmes' plan (fig. 7) also shows a worn flagstone or step leading to the door in the south wall, but this is no longer *in situ*, having been replaced by consolidated masonry. The door in the west wall and the worn flagstone leading to it, also shown on the plan, are later (Period 2a).

Macdonald describes this flagstone as 'much abraded' (Macdonald 1931, 248). The large slab now in this position has a level of 56.49 mOD; however it seems to have been turned upside down during consolidation as its upper surface is unworn. Also it rests on a thick layer of concrete, raising its level. Therefore its original level was probably closer to 56.46 mOD.

The best evidence for the raising of the floor to *c.* 56.46 mOD comes from the doorway between the lobby and *frigidarium*. If, as described above, this opening was not provided with a door in Period 1a, it was subsequently. This is shown by the remains of a threshold slab. In late Roman times the centre of the slab was broken through and robbed (Period 2b or 3), leaving only two strips at the sides, which are worn and damaged but preserve traces of the slots for jambs. Levels could not be taken on the southern strip which is partially obscured by the masonry of the wall, but the maximum level on the northern strip is 56.46 mOD.

The fate of the benches along the north and south walls is unclear. Macdonald found their maximum height to be 1 ft 4 ins (0.41 m) above the primary floor (Macdonald 1931, 247–8). This corresponds to a level of 56.61 mOD — too high to be incorporated in the newly-raised floor, but not high enough for bench supports. Provision of a large, well-equipped changing room seems likely to have removed the need for extra benches in the lobby. Perhaps these features were built up by Victorian restorers, as Macdonald suggested. However the possibility cannot be ruled out that the benches were raised in Period 1b by the addition of more slabs which were subsequently lost during late Roman stone robbing.

FRIGIDARIUM

The shower remained in use. A short section of the drain which carried away waste water is visible running eastwards along the southern edge of the changing room; there is a drain in the same position in the changing room at Bewcastle (Gillam *et al.* 1993, 21, Fig. 2). Levels along the sides of the drain at Chesters vary from 55.47 mOD at the west, 55.33 mOD in the centre and 55.11 mOD at the east, showing that water was discharged into the drain serving the latrine. Levels also indicate that the *frigidarium* floor in which the shower was set remained at its original height of *c.* 56.20 mOD; continued use of the primary floor explains the heavy wear on the surviving flagstone immediately inside the room (fig. 7).

As noted in the introduction to this paper, the only place in the building where bathers passed each other going in opposite directions was between the lobby and the *frigidarium*. In the primary phase it would have been easy to avoid congestion, since the evidence suggests that the floors of the two rooms were at the same level, and access between them could have been through a simple — possibly wide — opening. However, in Period 1b not only was a new door inserted, but raising the lobby floor while that of the *frigidarium* remained the same produced a step 0.26 m deep — thus creating a potential bottleneck.

As suggested above, the rectangular stone trough now standing in the changing room (fig. 8) may originally have come from the latrine. Another trough, also obviously out of its original position, is so similar it is likely to be contemporary. This second trough now stands at the top of the bank *c.* 7 m to the west of the baths (fig. 9.i). It is 1.04 m square and 0.48 m high and is made of the same sandstone as the rectangular trough, its sides are also 0.12 m thick. Unlike the rectangular trough suggested to come from the latrine, it does not have a hole in the base and so could have been used in the *frigidarium* as a free-standing reservoir of water for the shower. A possible reason for its move to the west of the building is described in Period 2a.

PERIOD 1B OR 1C

An auxiliary furnace for room E1

The final *tepidarium* was the least warm of the heated rooms in this type of bath house, and evidence of the provision of auxiliary furnaces is shown in the plans of Carrawburgh (Bruce 1874, plan facing p. 17; Gillam *et al.* 1993, 4, Fig. 3.5) and Benwell (Gillam *et al.* 1993, 4, Fig. 3.1). Evidence is lacking from Bewcastle as the outer wall of the final *tepidarium* was not fully excavated (Gillam *et al.* 1993, 4, Fig. 2).

Macdonald investigated a feature (Q on fig. 14) abutting the west wall of Chesters baths; finding the interior intensely reddened by heat, he interpreted it as an auxiliary furnace serving *tepidarium* E1 (Macdonald 1931, 261–2). Investigation prior to consolidation in 1956 (Gillam 1956–8, 1, 3) confirmed that Q had been an auxiliary furnace, until eventually demolished (Period 1c demolition) and replaced by an oven (Period 2a). A plan by Charles Daniels (fig. 16) shows surviving masonry of the furnace, its south wall, west wall with doorway,

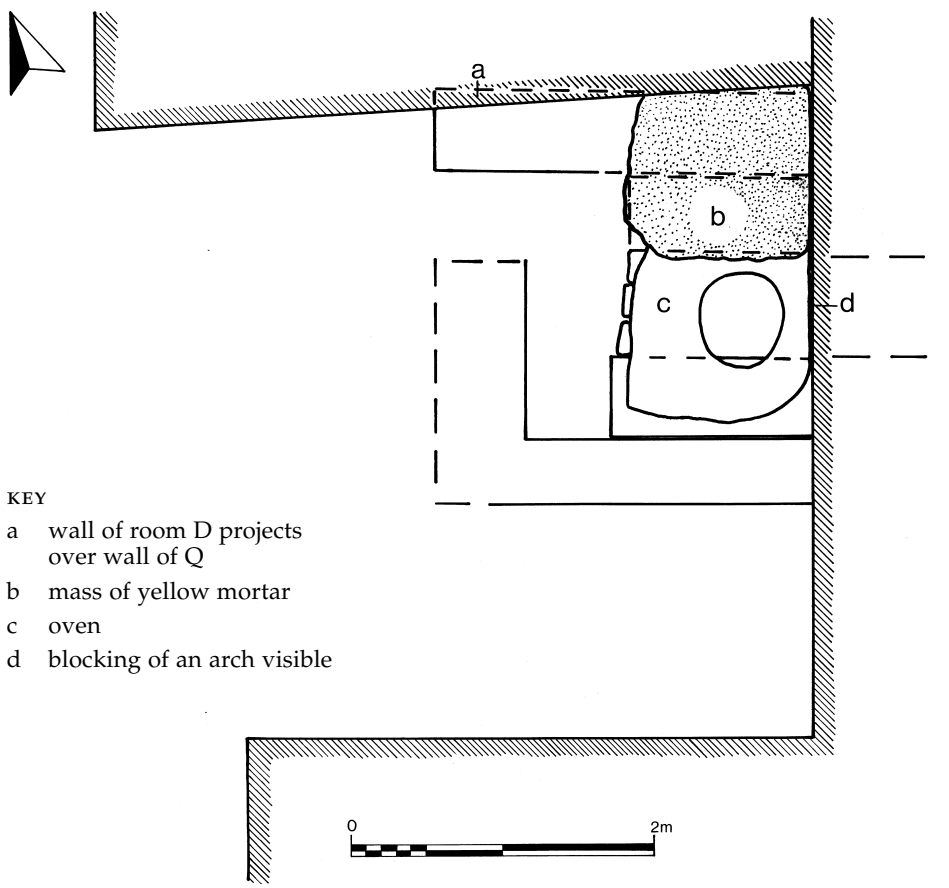


Fig. 16 The auxiliary furnace Q, redrawn by Graeme Stobbs from a plan drawn and annotated by Charles Daniels in 1956. Scale 1:50.

Fig. 17 Consolidated remains of the auxiliary furnace Q, viewed from the south-west. Photograph, the authors.

remains of the north wall and the cheeks of the furnace. An annotation indicates the position of the arched opening in the wall of E1 through which heat passed into the underfloor space. Gillam stated that the opening was put through where the primary chimney had been, which explained why Charles Anderson of the MoW had seen burning within the wall (Gillam 1956–8 1, 3). Presumably the chimney had been blocked near the top, so that some of the hot gases from furnace Q had penetrated it and caused reddening. Clearly it would have been inefficient to leave the chimney open; hot gases would simply have risen straight out into the open air instead of the hypocaust of room E1.

Ground outside the west wall was lowered by Victorian trenching; the slope of the Roman ground surface would have been higher. Bearing this in mind, examination of the visible remains of the furnace reveals how it was constructed (fig. 17). The south wall has an inner face of well-dressed masonry and a core of small stones, but the outer edge is unfaced. Clearly earth had been cut away so that the south side of the furnace rested below Roman ground level; the lower courses of this would require only a revetting wall faced on the inside, with earth banked up on the outside. Though the remains of the north wall are partly overlain by a later structure, sufficient survives to show that it had an inner and outer face as well as a core, as described below (Period 2a).

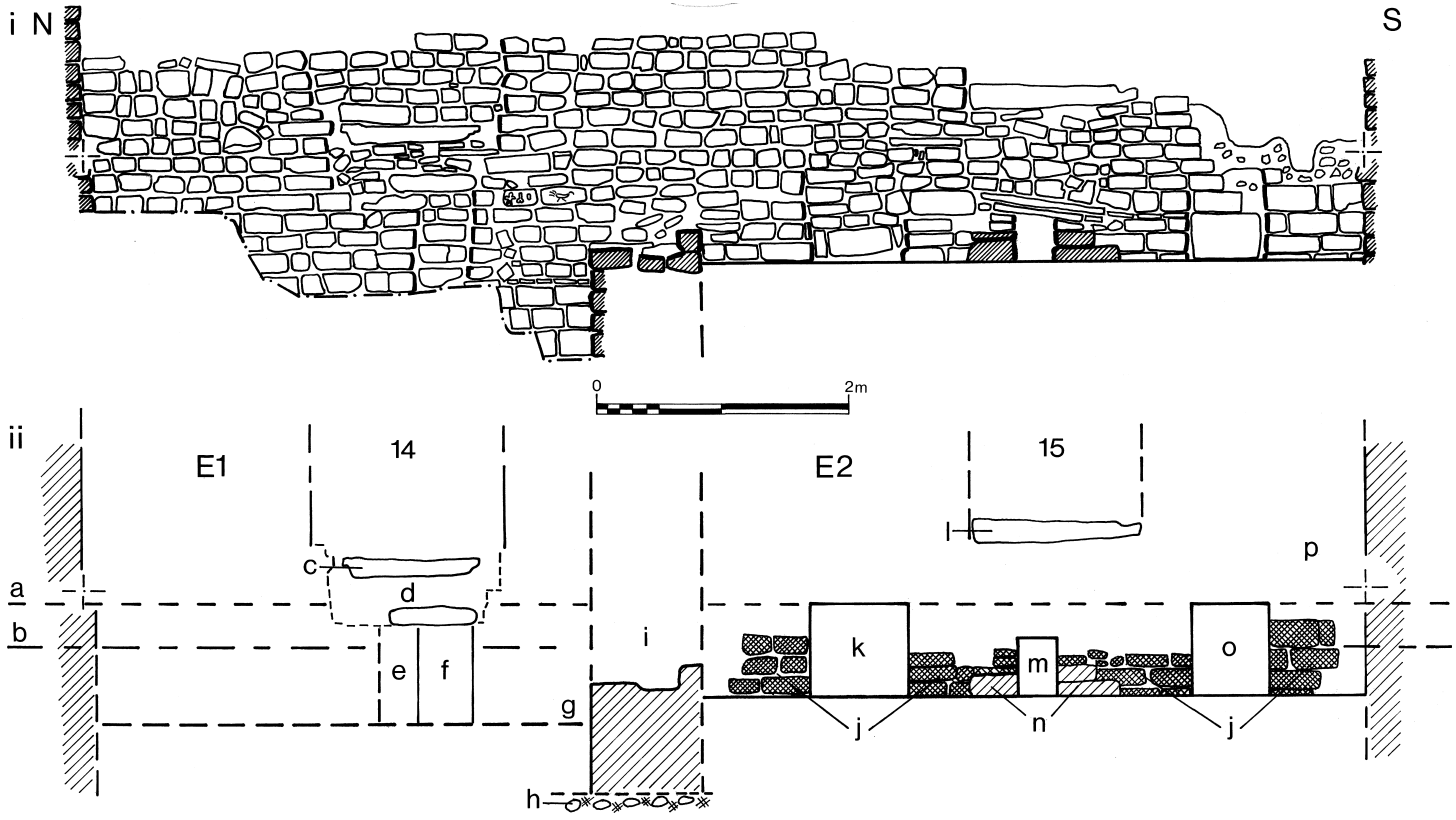


Fig. 18.i (top) Elevation of the west face of the medial wall between the heated rooms, redrawn by Graeme Stobbs from originals drawn and annotated by John Gillam and Charles Daniels in 1956. Scale 1:60.

Fig. 18.ii (bottom) Schematic outline of the above, showing positions of doors 14 and 15; annotations superimposed. Scale 1:60.

KEY

a ground level in 1956
b current ground level
c threshold (door 14)
d rough filling
e primary blocking of vent
f secondary blocking, yellow mortar
g surface of *opus signinum* floor
h clay and cobble foundation
i wall between E1 and E2 (white mortar)
j stones reddened and friable
k blocking of primary vent, yellow mortar
l threshold (door 15)
m 'ventilating drain'
n stones bound with yellow mortar
o blocking of primary vent, yellow mortar
p area of 19th C wall facing removed

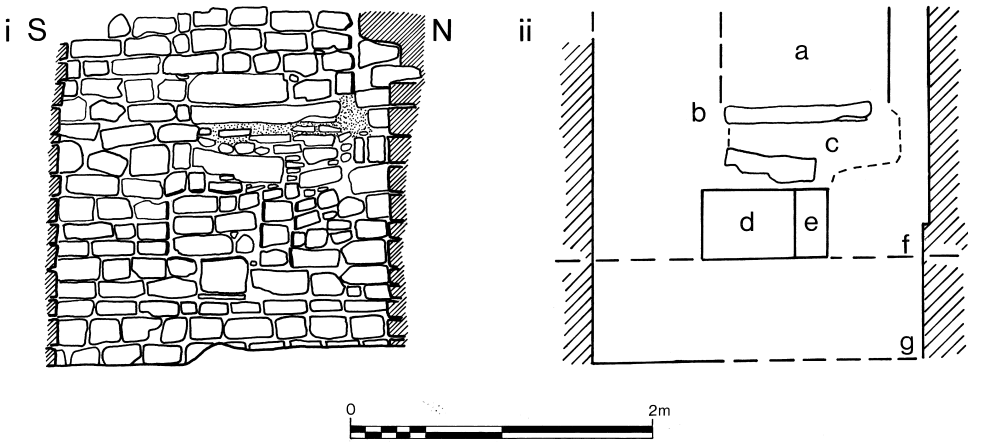


Fig. 19.i (left) Elevation showing blocked door 14, viewed from the east, redrawn by Graeme Stobbs from an annotated elevation drawn by Charles Daniels in 1956. Scale 1:50.

Fig. 19.ii (right) Schematic outline of the above, with annotations superimposed. Scale 1:50

KEY

a blocked door 14
b threshold
c loose slaggy filling, trails of floor debris
d second stage of blocking of vent
e stones of partial blocking of vent
f probable approx. level of Hadrianic basement floor
g ultimate (or penultimate) dressed stone course

The height of the superstructure of Q is unknown, but the interior measured only 5 ft 6 ins (1.68 m) by 6 ft (1.83 m) — an uncomfortably cramped space for the unfortunate workers.

Tepidarium *E1*

THE HYPOCAUST SYSTEM

If insertion of the auxiliary furnace also entailed blocking the primary chimney or evacuation duct, how could spent gases from the hypocaust system escape? Though wall jacketing was perhaps not necessary in the primary phase of room E1 (see Period 1a), it might have been installed at this stage; spent gases could then be discharged through the top of the jacketing.

Another modification is likely to be contemporary with the auxiliary furnace. Gillam's study of the medial wall revealed that the underfloor vent between rooms E1 and I had been blocked in two stages (figs. 18, 19). The northern half was blocked first and the southern half was blocked using yellow mortar typical of later modifications (Period 2a). Though blocking of the northern half is undated, it seems reasonable to link it to use of the auxiliary furnace; with additional heat supplied directly into the hypocaust of E1, the flow of heat via room I could be reduced. To access the vent would have involved lifting at least some of the suspended floors. Possibly this may have provided an opportunity for repairs to the basement floor. After Bewcastle baths had been in use for some time the basement floors were renewed,

but not in a completely uniform manner. The primary floor of the final *tepidarium* was covered by a thick layer of soot, overlain by concrete 120 mm thick; at the northern end of the *caldarium* a deposit of soot 145 mm thick was overlain by a thin layer of concrete (Gillam *et al.* 1993, 8).

PROVISION OF AN ADDITIONAL DOOR

A new door (14 on fig. 14) was inserted into the medial wall between rooms I and E1, above the partially blocked vent. Elevations drawn in 1956 show very rough masonry built into this wall between the top of the vent and the threshold slab of door 14 (figs. 18, 19). Annotations on the east-facing elevation (fig. 19) refer to a layer of 'loose, slaggy filling' containing 'trails of floor debris', the latter being *opus signinum* which had originally coated the flagstones of the *suspensura*, disturbed when the floor was lifted. The builders clearly knew that their careless work would be below floor level and therefore unseen, and this all-too-human failing provides us with an important piece of evidence. Namely, the threshold of door 14 immediately overlies the *opus signinum*, showing that the door was inserted after the floor was damaged and the vent blocked.

The reason for the insertion of door 14 is readily apparent. As noted above, in Period 1b access between the lobby and *frigidarium* was impeded by the addition of a step and a door, producing a bottleneck. The insertion of door 14 created an alternative exit route, allowing bathers to pass from the final *tepidarium* E1 to the *frigidarium* through room I, rather than through the lobby. The provision of door 14 can be seen as the result of a long sequence of events, starting with the difference in levels of the initial terracing and primary floors. This in turn led to the raising of the lobby floor and the creation of a bottleneck between lobby and *frigidarium*. At Bewcastle there is no equivalent of door 14. Perhaps it was unnecessary; since the terracing and floors were level, the need for the Chesters sequence would not have arisen. Perhaps at Bewcastle there was always a simple arched opening between lobby and *frigidarium*.

Evidence from the other baths of the group is inconclusive. The plan of Carrawburgh (Bruce 1874, plan facing p. 17) seems to show a door between the equivalents of rooms E1 and I, but this has been interpreted as a vent (Gillam *et al.* 1993, 8), and in any case the plan shows that there were modifications. The plans of Netherby and Benwell do not show doorways. At Wallsend a door in a position equivalent to door 14 is unlikely to be primary, more probably belonging to the extensive rebuilding when the main directional axis of the building was changed after a landslip (Nick Hodgson, pers. comm.)

PERIOD 1C

The laconicum

Attached to the west side of the building is a suite of rooms (B, C and D on fig. 2); its complex structural history is evident in the excellent state of preservation. Based on survey and a test pit, Macdonald concluded that there were three phases of construction (Macdonald 1931, 290–304). However further trial trenching in 1956 led Gillam to propose a simpler sequence of two phases — first the construction of the *laconicum* (B) and furnace (C), then secondly addition of the ante-room (D) (Gillam 1956–8, 1). After study of the Gillam archive and careful examination of the surviving structures, we concur with Gillam's interpretation; thus construction of the *laconicum* and furnace is assigned to Period 1c and that of the ante-room to Period 2a.

The *laconicum* stood in a terrace cut into the hillside; slightly irregular in layout, but roughly square, it has a door in the south-east corner (fig. 14). On at least two sides the superstructure rested on very wide basement walls forming an offset. A photograph of 1885 (Macdonald 1931 Pl. L) shows offsets projecting beyond the line of the north and west walls; today only a 750 mm length of offset at the southern end of the west wall is visible, the rest obscured by modern gravel. In a test pit outside the west wall Gillam found the offset was seven courses deep (Gillam 1956–8, 1). In another pit immediately outside the door he found eight courses of masonry but his notes make no mention of an offset (Gillam 1956–8).

The walls of the superstructure are *c.* 0.80 m wide, similar to those in the main block; the west wall survives to a height of *c.* 2.17 m (7.30 Roman feet) above the suspended floor. Curiously, there is an offset near the top of the north and west walls, the top four courses of masonry being set back by 50–70 mm. Perhaps this reduction of width was an attempt to reduce weight or it may have been related to the practicalities of construction; in the photograph of 1885 there seems to be a putlog hole just above the offset in the north wall (Macdonald 1931, Pl. L).

As excavated the furnace room (C) was square (fig. 2). The outer walls have since deteriorated and the height of the superstructure is unknown. The internal area was estimated at 5 ft 6 ins (2.59 m) by 6 ft 9 ins (2.06 m) (Macdonald 1931, 291) — only slightly roomier than auxiliary furnace Q. The cheeks of the furnace and the arched opening through the north wall of the *laconicum* are intact. The well-preserved hypocaust system was investigated by Macdonald (Macdonald 1931, 292–3). Through gaps in the flagstones he saw that the suspended floor was supported by four rows of four stone pillars, 2 ft (0.61 m) high and on the north, west and south walls by an offset (Macdonald 1931, 294–5). The internal offsets are visible today. Evidence for wall-jacketing consisted of regular apertures in the offset with gaps in the flags above for wall jacketing; some T-shaped iron holdfasts were still in position in the walls. During consolidation in 1956–8 the floor was repaired, broken or missing flagstones being replaced by modern slabs and missing iron holdfasts were replaced with modern replicas and jacketing indicated by some stone slabs in the north-west corner (Gillam and Johnson 1985, 2). Whether stone slabs or flat tiles had originally been used was not clear.

The door in the south-east corner of the *laconicum* is the best preserved in the building. Two monolithic stone jambs are *in situ* (fig. 20), resting in slots either side of the threshold slab, which has a pivot hole for the door in its south-east corner. The jambs are *c.* 0.20 m wide, slightly narrower than those in the main block. The maximum height is 1.80 m and this may be their full original height. At the top of the western jamb a cut along the inner edge seems to create a tenon to fit into a mortice in the lintel. If so, the height of the doorway would have been *c.* 6 Roman feet — causing tall bathers to stoop. Down the east jamb there is a slight rebate 0.16 m from the southern edge, and on the west jamb an eroded trace of a rebate. Macdonald suggested that three holes on the inner face of the west jamb represent three positions of the bolt for the door, and thus three phases in the history of the suite (Macdonald 1931 292, Pl. LI, Fig. 2). A simpler explanation is that the jamb is a re-used stone. The threshold slab of this door is at 56.84 mOD. Levels on the consolidated flagged floor are variable, the maximum being 56.79 mOD; perhaps a missing upper layer of *opus signinum* brought them up to the same level as the threshold.

There is no evidence for ceiling construction as there are no features on the interior face indicating the position of a wall plate or the springing point of a vault. But clearly a heated vault would have added to efficiency.

Fig. 20 Monolithic stone jambs in doorway between ante-room D and *laconicum* B, viewed from the south. Photograph, the authors.

Possibly the entrance to the *laconicum* could have been via a timber porch or ante-room attached to the south wall. If small, it need not have encroached on the auxiliary furnace Q which could have remained in use (fig. 14).

Changing room

The bench seating was modified prior to the major rebuilding of Period 2a. The bench along the west wall was rebuilt in a less elegant style. One surviving original bench leg is incorporated into a low masonry wall, 0.60m wide, running the full length of the wall. The masonry is level with the top of the leg; addition of upper stone slabs (now robbed) would have allowed the bench to remain at the same height. Similar benches were built along the

north and south walls now, if not before. Masonry walls, 0.65–0.70 m wide, run along the south wall for a short distance either side of the doorway (figs. 8, 14). Underlying the upstand of late flooring in the north-west corner is a short section of masonry, *c.* 0.70 m wide, running along the north wall; the disturbance recorded in Gillam's section (fig. 25) may indicate robbing of a similar feature. This method of construction resembles the benches found in the primary lobby, also those in the changing room in the baths at Bewcastle (Gillam *et al.* 1993, 21, Pl. 10) and the extra-mural baths at Binchester (Mason 2014b, 23–4, Figs 8, 10, 11, 14; 2015, Figs 8, 9).

Period 1c demolition

Period 1 ended with large-scale demolition in which the building was almost entirely gutted. The south wall of *tepidarium* H was demolished to below the level of the *opus signinum* basement floor (Gillam 1956–8, 1–2). Gillam's trenching also revealed that the crosswall between the *caldarium* E2 and *tepidarium* E1 'has been cut down to just below floor level' (Gillam 1956–8, 2). Holmes (1886–7, 126–7) observed breaks in the internal faces of the east and west walls where the crosswall had been ripped out; the scars can be seen in figs. 9.i and 9.ii. Probably this wall was not entirely demolished up to ceiling level, but sufficient was removed to create a wide opening between the two rooms (see below). The furnace and western hot bath F were demolished. Two short stumps of the north and south walls of the bath were left *in situ*, projecting from the west wall of the *caldarium*, ready for a new structure that was to be bonded on to them. The interior of the southern hot bath G was demolished, including its hypocaust *pilae*.

The auxiliary furnace Q was put out of use. Gillam (1956–8, 3) found that white mortar had been used in the blocking of the arched opening through the wall into *tepidarium* E1 Macdonald (1931, 261–2). As previously noted, white mortar was used in the primary building (Gillam 1956–8, 1), and perhaps also therefore in this Period 1c modification, as distinct from the yellow mortar of the Period 2 rebuild. Macdonald suggested that the blocking was also visible on the inside of the west wall of E1. This wall was examined during the TWAM survey. There is an offset course *c.* 0.50 m above modern ground level. Then 1.14 m from the north-west corner of the room there is a clear straight joint under the offset; 1.42 m further south there is a possible straight joint. Between these two the offset course dips slightly; the masonry below is less regular than elsewhere along the wall and the stones are smaller, presumably representing the blocking material (fig. 21). The walls of furnace Q were demolished down to the lower courses, apart from a 0.86 m length of core at the east end of the north wall. This stands to the height of the floor in ante-room D, perhaps left *in situ* in case its removal undermined the south wall of D which it closely abuts. Finally, all suspended floors in the heated rooms were removed so that work could be carried out in the basement.

PERIOD 2A

Introduction

Macdonald's survey records many modifications to the main block of the building, creating an enlarged bath house. The results of Gillam's work in 1956–8 and the survey by TWAM in 1997 shed fresh light on this process. Alterations to heated rooms were carried down to the level of the basement floor, on which was laid a system of drains extending into the new

Fig. 21 Discontinuity on the inner face of the west wall of *tepidarium* E1, viewed from the east, indicating position of blocked flue from auxiliary furnace Q. Photograph, the authors.

structures and extensions, proving that changes to the heated rooms were part of the same building programme.

These modifications (fig. 22) can be summarised as follows. *Tepidarium* H and the *caldarium* were enlarged and the western hot bath was replaced by a structure with the same footprint, but with an internal apse F. An oven was built on the remains of the demolished auxiliary furnace Q. The underfloor vents in the medial wall were blocked so the east and west ranges of rooms could be heated separately by new furnaces attached to the south wall. The door between the newly extended *caldarium* E and the *unctorium* was blocked, as was the door between the *caldarium* and the lobby, with the result that the building functioned as a row-type baths rather than a ring-type.

Other modifications are proposed in this account. An ante-room (D) was attached to the south of the *laconicum*. A small water tank (J) was inserted into the *frigidarium*. The porch at the main entrance (O) was probably added at this time.

Dating evidence

Direct dating evidence is lacking for the Period 2a rebuilding, but inscriptions suggest a date in the late second or early third century. A dedication slab found in the bath house in 1884 is

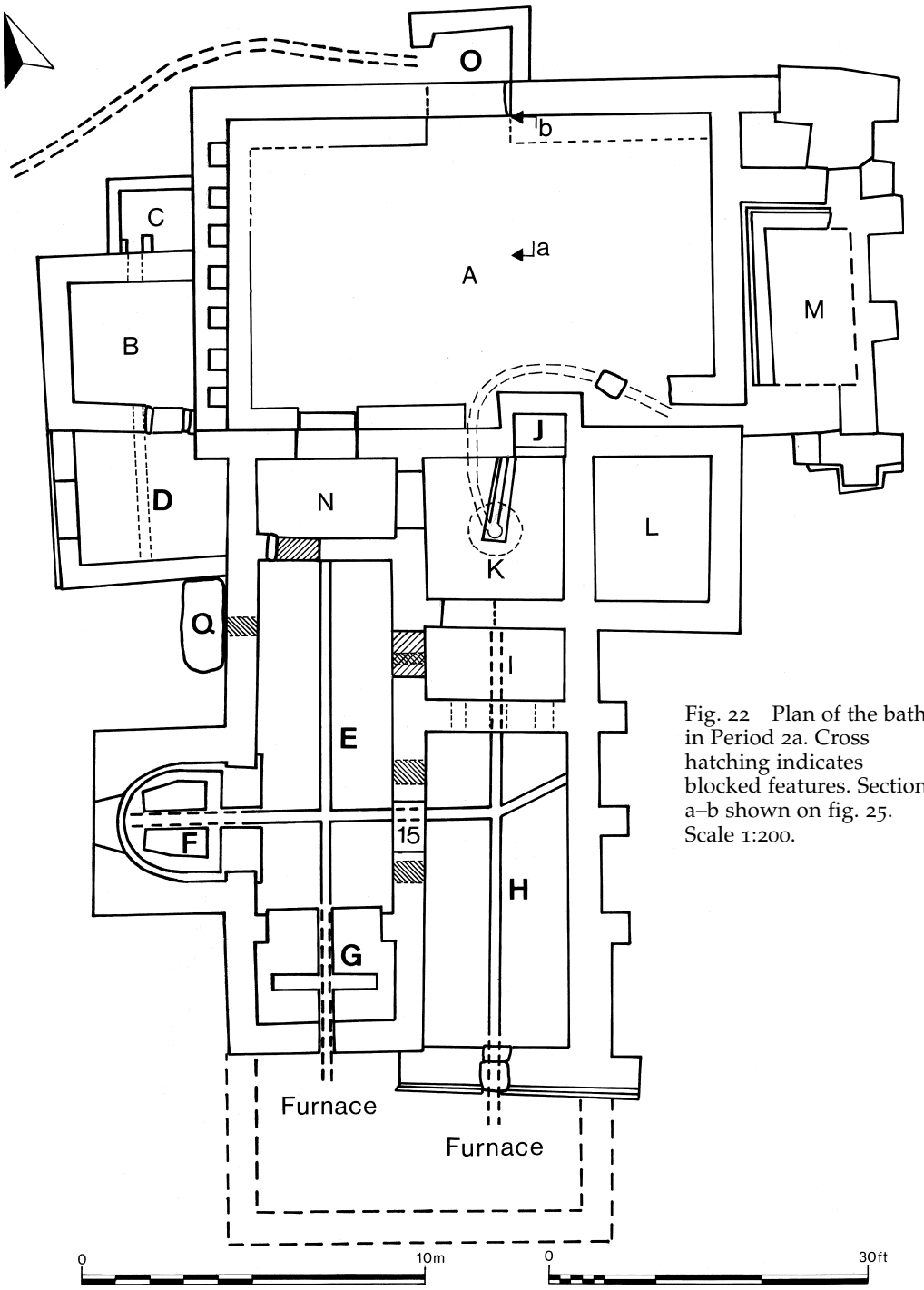


Fig. 22 Plan of the baths in Period 2a. Cross hatching indicates blocked features. Section a–b shown on fig. 25. Scale 1:200.

dated to AD 223 (*RIB* 1467) — probably the heyday of the military *vicus* and a time of much building work under the Severan regime. A programme of building work was carried out in the fort, as shown by inscriptions of *c.* AD 205–8 (*RIB* 1462) and during the reigns of Elegabalus and Severus Alexander (*RIB* 1465 and 1466).

Enlargement of tepidarium *H*

The *tepidarium* H was extended southwards by *c.* 3 m. The junction between the extension and the original outer wall shows as a straight joint. Gillam dug test pits in the extension and found 'debris from partial demolition and alteration, which contained a lot of mortar debris and sandy mortar, broken up and deteriorated' (Gillam and Johnson 1985, 5). The extension was substantially built, with thicker walls than in the rest of the building; the south wall rested on two offset courses of masonry. Macdonald (1931, 268) suggested this may have been to counteract subsidence. Alternatively the wall may have been strengthened to allow for the insertion of large new windows or to support the newly extended roof.

A new vaulted ceiling would have been needed and the roof of the original room H carried over it. There was a flue in the new south wall to admit heat from the newly-constructed furnace. This furnace was demolished in the late Roman period, but its existence was demonstrated by Macdonald who found that the soil immediately beneath the turf outside the south wall was burnt red (Macdonald 1931, 268–9).

Enlargement of the caldarium

Combining rooms E1 and E2 created an extended *caldarium c.* 10 m in length, excluding the southern hot bath. But how could the upper part of the former crosswall be demolished without undue damage to the complex ceiling vault? The sandstone 'armchair voussoirs' may provide the answer. As mentioned above, these are less markedly wedge-shaped than the tufa examples and the distance between ledges is greater, so the two types could not have been combined. The size and weight of the sandstone examples indicates that they could only have been used in a wide span (Paul Bidwell, pers. comm.). The Victorian excavators found 'a number' of them 'scattered about' on the ground outside to the west in the square space bounded on three sides by walls and on the west by the cut of the terrace in which the building stood (fig. 22). The excavators supposed the sandstone voussoirs had formed an arch 'in this vicinity' (Bruce 1885, 101).

We concur with their interpretation, the arch in question being in the centre of the extended *caldarium*. Rooms E1 and E2 could have been combined without damage to the ceiling vault, if the crosswall was not totally demolished, merely the lower part opened up to form an archway (as often happens in modern house conversions when two rooms are combined). The arch could have been constructed of re-used sandstone voussoirs, derived from building modifications in the fort. When eventually the abandoned extra-mural baths were robbed, the voussoirs of the arch either fell or were discarded into the area immediately outside *tepidarium* E1. This square space seems to have been filled with rubbish in late Roman or post-Roman times (Periods 3 and 4).

Two sandstone voussoirs can be seen in figs. 9.i and 9.ii, standing between rooms E1 and E2, at opposite ends of the former crosswall, possibly placed there by the Victorians to indicate the position of the wall. Alternatively they may be in, or near to, their original findspot.

Voussoirs at each end of the postulated arch could have been bonded into the east and west walls, remaining *in situ* when the rest of the arch was robbed, finally tumbling out during the final decay of the building. These two voussoirs were later moved to form steps beneath the door in the north wall of E1, replacing the pile of small blocks seen in figs. 9.i and 9.ii; they still form the steps today.

Drainage within the building

Problems of damp or flooding were common in the basements of baths (Paul Bidwell, pers. comm.). The rebuilding of hypocausts at a higher level in the Flavian baths at Castleford is interpreted as a response to flooding (Goodburn 1979, 288). There seems to have been a different solution at Chesters where the suspended floors in the heated rooms were lifted so that a system of drains could be laid in the basement. These features have been the source of much discussion and some confusion. A 'channel' running the length of room H was first noted in 1884 (Bruce 1885, 100–1, plan facing p. 98); more are shown on the plan by Holmes (fig. 7), who called them 'ventilating drains' (Holmes 1886–7, 126). Possibly this interpretation was based on similar features found in the basement of the baths at Netherby, described on the published plan as 'Two Funnels or Air pipes leading under the floors' (Roy 1793, Pl. XLVI). These pipes probably represent longitudinal drains running down the centre of each range of heated rooms between the rows of *pilae* and passing through apertures in the walls between rooms.

Macdonald, though still interpreting the features at Chesters as 'ventilating drains' providing fresh air into the building, doubted the accuracy and completeness of Holmes' plan (fig. 7). Visiting the site in dry weather he observed parch marks revealing the true layout, which he further confirmed by trenching (Macdonald 1931, 286–9, plan facing p. 304). A parch mark can be seen running down the centre of room E1 in fig. 9.ii; there is a similar parch mark in the centre of room H in fig. 9.i.

In both ranges of heated rooms the drains formed a cruciform pattern, designed to channel water away to the south and east (fig. 22). In the western range a drain runs from the north wall of the *caldarium* down the centre of the room, crossing the remains of the demolished crosswall, and was traced as far as the flue in the south wall of the southern hot bath. Presumably the central longitudinal drain in the eastern range originally began against the north wall of the *unctorium* — as at Netherby — but evidence of this was destroyed in late Roman times (Period 3). The surviving drain now runs from a point a little south of the central vent in the wall between rooms I and H to the flue in the south wall of the new extension. A transverse drain runs from the western end of the apse to the east side of the *caldarium*; from there it runs through a gap in the wall below door 15 into *tepidarium* H (fig. 18, m), where it joins the longitudinal drain. The final arm of the transverse drainage system runs from the eastern wall of *tepidarium* H to this junction. Macdonald (Macdonald 1931, 288–9) searched in vain for an outlet in the east wall of *tepidarium* H; however none would have been necessary if all of the drain flow was southwards, discharging through the south wall of H.

The drains were carefully constructed (Macdonald 1931, 287). Macdonald stated they were 12 ins (305 mm) wide and 10 ins (254 mm) high, and built directly onto the primary floor; the sides consisted of two courses of mortar-bonded masonry, and the cover slabs were 3 ins (76 mm) thick. However the height of the cover slabs was variable. Figures 18 and 22 show one of the drains passing through the medial wall; at that point the total height of the

drain including the lower cover slab is *c.* 5 ins (127 mm) higher than that measured by Macdonald.

In order to construct a drainage system at a uniform level throughout, the low-lying basement floor of rooms E1 and I (figs. 13.ii, 18) must have been raised to the same level as that in rooms E2 and H at this stage if not before. There is some evidence of how this was done. On excavation Macdonald found that the drain in E1 rested on a concrete floor. This was presumably a secondary surface at the same level as the primary basement in E2, since test pits dug throughout E1 and E2 revealed 'the concrete at a uniform depth of about 1 foot (305 mm)' (Macdonald 1931, 260). Further material was deposited on the basement floor to form another surface; the cover slabs of the drain in room E1 were 'nearly flush' with this surface (Macdonald 1931, 260), but Macdonald did not describe its composition.

After the drains were laid in *tepidarium* H the primary basement floor was also built up. Gillam described this material as a 'filling'. Since it contained much yellow cement he interpreted it as a secondary floor contemporary with the vent-blocking and drain construction (Gillam 1956–8, 2).

Changes to the southern hot bath

Macdonald found evidence of the furnace attached to the southern hot bath. Trenching outside the south wall of the bath revealed one surviving wall of the furnace room, and soil reddened by burning (Macdonald 1931, 272–3). Further evidence is shown in a watercolour in the Laing Art Gallery by Charles Richardson entitled 'Chesters Bath-House from the South West'.[1] This is one of a group of watercolours of the baths which, although undated, seems clearly to have been painted during the excavations of 1884–6. In this view a feature is shown abutting the external face of the south wall of the *caldarium*, below the level of the supports for the hot bath. The feature consists of a semi-circle of stone blocks, partially overlain by one or more large flagstones. This could perhaps represent the base of the boiler flanking the furnace channel (Paul Bidwell, pers. comm.).

The pipe supplying water for the hot bath would have passed through a hole, 0.16 m in diameter, at the western end of the south wall, 0.23 m above the masonry support of the bath (Macdonald 1931 274; see also figs. 9.i and 9.ii). A similar hole at the southern end of the west wall, 0.20 m above the masonry support, was for the pipe carrying away waste water, where it could discharge into a gutter running round the building (Macdonald 1931, 244–5).

The arched entrance to the bath was retained, but the primary pillared hypocaust beneath it was rebuilt as a channel hypocaust of cruciform shape. This was surrounded by a filling of broken hypocaust pillars (Gillam 1956–8, 3) overlain by closely-packed masonry rubble, topped by a layer of flagstones on which the bath rested. The best preserved of the flags are at height consistent with a floor level of 56.80 mOD.

There is one apparent anomaly. Throughout Gillam's notes 'hypocaust pillars' always refers to monolithic stone pillars, not tile *pilae*. To find broken stone pillars in this context runs counter to both the evidence indicating that the primary *pilae* were of tiles, and the evidence cited below that monolithic pillars belong to the Period 2a rebuild. One possible explanation is that primary tile *pilae* here had become heat damaged and had been replaced in stone later in Period 1.

Remodelling of the western hot bath

Projecting from the west wall of the building were stubs of the north and south walls of the demolished western hot bath; these were incorporated into a new structure on the same square plan with an internal apsidal recess. This is referred to in the following account as a *schola labrum* (an apsidal recess to take a *labrum* or stone basin with hot water fountain, see Yegül, 1992, 376–7); however the apse may instead have held a semi-circular warm bath.

Evidence of this rebuild is visible along the external face of the west wall of the building. An offset course running along the wall of the former room E1 and around the south-western corner of the building is interrupted by the *schola labrum*; there the offset is missing, apart from a vestige where the northern wall meets the *caldarium* wall. At that point the offset occurs as three large blocks before ending abruptly, representing the stump of wall of the primary hot bath incorporated into the new structure.

Trenching in the interior of the apse, Macdonald revealed a sequence of construction (Macdonald 1931, 275–6). Embedded in the primary floor was a large portion of red brick, presumably the base of a primary hypocaust *pila*. The new drain was laid on this floor, the cover slabs of which were then covered by a layer of red cement. The new heating system consisted of channel hypocausts — in a cruciform arrangement with an extra channel curving round the sides of the apse — surrounded by packed masonry rubble which rested on the red cement layer. This rubble is less well preserved than the masonry in the hypocaust of the southern hot bath, but presumably originally stood to the height of the suspended floor. A hole in the centre of the west wall of the apse (fig. 6.i, shown partially blocked in fig. 6.ii) below the level of the suspended floor let waste water flow into the gutter outside.

The arched entrance of the primary hot bath was retained, but the position of the apse within it is slightly irregular; the width of the rear face of the northern respond is 150 mm, while the average width of the rear face of the southern is 325 mm (fig. 22). Apparently the arch responds were treated differently from the rest of the walls, being coated with *opus signinum* rather than provided with wall jacketing. Fragments of *opus signinum* are visible on the outer face and side of both responds. There is no *opus signinum* on the rear face of the northern respond. However in the southern respond the *opus signinum* continues round to the rear face, ending with a straight edge 150 mm from the wall of the apse (fig. 23); at this point it would have met the wall jacketing around the apse, which was evidently 150 mm thick.

During the TWAM survey the apse was closely studied and a large number of measurements taken (Bidwell *et al.* 1997). The outer wall survives to a great height; the interior face is 1.89 m above presumed floor level. The face is unbroken, with no surviving indication of a ledge to carry the vault. The exterior face of the wall survives to a slightly higher level than the inner. The top courses preserve the sill and lower part of a window (figs. 6.i, 6.ii). During excavation in 1884 fragments of window glass were found outside the wall (Bruce 1885, 100). The window sill is 0.60–0.64 m deep and at a height of 1.30 m above the assumed floor level. Below the sill there is a downward splay which finishes 0.96 m above the floor. The external width of the window opening is 1.24 m (just over 4 Roman feet), but only survives to a height of 0.63 m (a little over 2 Roman feet). Internally the sides are splayed at an angle of roughly 15°, the internal width at the maximum part of the splay being 1.73 m. A window in the outer wall of the cold bath at Carrawburgh has the same angle of splay (Bruce 1874, plan facing p. 17); the angle of splay in the windows at Ravenglass varies between 13° and 18° (Brann

Fig. 23 Inner face of the southern arch respond of the apse. At centre left remnants of red plaster. Photograph, the authors.

1985, Fig. 1). There is a similar angle of splay in a window in the apse of the hot bath at Great Chesters (Gibson 1903, 46).

Use of the TWAM survey data in the design of the Segedunum baths reconstruction proved to be a valuable exercise in experimental archaeology; it also shed new light on the baths at Chesters, and in particular on the apsidal feature. Survey data was used by architects of the then David Ash Partnership to produce a computerised plot of its probable form. Paul Bidwell prefaced his study of the reconstruction of this feature as follows:

'There are two relevant points to consider:

i) When this apse was added to the main building, the Roman builders are likely to have constructed it so that it met with the main block in the simplest and most economical way — that is to continue the roofline of the main block as a lean-to roof over the apse, at the same angle.

ii) The outer wall of *schola labrum* stands to a great height; the topmost courses preserve the sill and lower part of a window of unknown height.

This imposes two constraints on any theoretical reconstruction. The outer wall of the *schola labrum* would need to be high enough to allow a window of reasonable size, but low enough to allow the roof of the main block to be brought down over it, assuming the height to the springing point [of the vault] in the main block to be 11 Roman feet or thereabouts' (Bidwell 1997, 3).

In addition the angle of the roof was assumed to be 22½°, and the level of the floor to be 56.80 mOD. Use of the computerised plot enabled measurements to be made of the width of the room, radius of the vault and height of the room. Full details of the calculations used in the design of the reconstruction are in the archive at Segedunum Museum (Bidwell *et al.* 1997).

The *schola labrum* reconstructed on the above assumptions is a well-proportioned room with a window approximately 4 Roman feet square (Griffiths 2008, photograph p. 62). This suggests 'that the original assumptions about the height of the vault in the main block and the continuation of the roofline were reasonable' (Bidwell 1997, 4).

Finally, an interesting point emerged relating to the original height of the outer wall of the apse. Although there is no surviving trace of a ledge to carry the ceiling vault, the exercise described above enabled a calculation to be made of the springing point of the vault. The theoretical height of the springing point was only 37.50 mm higher than the maximum recorded height of the surviving inner face of the wall above floor level. Allowing space for a possible wall plate, and given the fact that the surviving remains have been consolidated and that the floor level is only estimated, it is likely that the outer wall survives to the springing point of the vault (Bidwell 1997, 4).

Underfloor vents and doors

The underfloor vents in the medial wall between east and west ranges were blocked (figs. 18, 22) at the same time as the underfloor drains were constructed (Gillam 1956–8, 2). In contrast, the three underfloor vents between rooms I and H were retained and heightened, probably by 0.30 or 0.40 m (it is difficult to determine this precisely because of damage to the wall). One of the stones forming a lintel above the vents is a re-used jamb (Macdonald 1931, 258). Measuring 1.77 m × 0.75 m × 0.23 m, it had perhaps been removed from door 14 when this was blocked.

The jambs of door 14 between the *unctorium* and the former room E1 were removed and the doorway was blocked (fig. 22); this took place before floor levels were raised in these rooms. The original threshold slab at a height of 56.46 mOD survives within the blocking (fig. 19) and there is no secondary raised threshold. Access through door 15 between *tepidarium* H and the *caldarium* was fundamental to the bathing regime. The early excavators show the medial wall as solid (fig. 7; Bruce 1885, plan facing p. 98), while Macdonald (1931, 258, plan facing p. 304) believed that both doors 14 and 15 were blocked. At the time of his survey the walls were still topped with baulks of earth (Macdonald 1931, 256) containing many tumbled stones which could have given a misleading impression that door 15 had been blocked. However a previously unpublished photograph by James F. Robinson (archive of William Tailford Jnr) is the only known photograph of the Victorian excavations showing the east face of the medial wall (fig. 26). The baulk of earth overlying the threshold of door 15 contains some

small stones, but *no* evidence of blocking material; this is crucial in showing that bathers could move between *tepidarium* H and the *caldarium*.

Hypocaust pilae *and suspended floors in the heated rooms*

It would have presumably been impossible to carry out all this extensive work down to the level of the basement floor if all the primary hypocaust *pilae* had remained in place, and therefore new *pilae* must have been installed at this time. Many of these in the form of monolithic stone pillars have been found. An example can be seen in the foreground of fig. 9.i, and Tailford rests his left hand on one in fig. 6.i. Other broken examples were found in the area of the crosswall between rooms E1 and E2 (Gillam 1956–8, 2; Gillam and Johnson 1985, 4). The tallest surviving fragment, comprising the base and lower part of the shaft, is sketched in the Gillam archive; it was 21 ins (0.53 m) high. An annotation states that 'at least ½ a dozen' of 'approximately the same type' were found. Most significantly, the annotation adds that two examples from room E2 had yellow mortar adhering to them. As noted above, yellow mortar is characteristic of the Period 2a rebuild.

Heightening of the underfloor vents between rooms I and H is evidence that the suspended floor of room I was raised to the same level as that in room H, *c.* 56.80 mOD (fig. 13.ii). Providing a uniform floor level throughout the newly-enlarged *caldarium* would have involved raising the floor of former room E1 to 56.80 mOD. Extension of the *caldarium* made it impractical to use the door in the north wall of E1 leading into the lobby. Bathers moving from the *caldarium* into the unheated lobby would cool down too quickly; opening the door would let cold draughts into the heated suite while allowing steam from the *caldarium* to condense in the lobby.

The threshold slab is not heavily worn (the pivot hole and shallow slot leading into it are clearly visible), consistent with the doorway being blocked before seeing long use. As in other blocked doorways, the eastern jamb has been removed, but the lower portion of the western jamb is *in situ*. Possibly it broke during the attempt to extract it. There would be no need to remove the lower part; the southern face of the wall would subsequently be covered by jacketing and the northern face by plaster. No blocking material has survived *in situ* in the doorway, but this could have been removed in the late Roman period when the baths went out of use, or perhaps during the Victorian excavation. Some possible evidence of the latter can be seen in figs. 9.i and 9.ii; a large masonry block stands upright immediately beyond the threshold.

Heating of walls in the main block

In the newly-enlarged *caldarium* it would have been necessary to repair the gaps left in the north and south walls by demolition of the crosswall. Later robbing removed all evidence of how the walls of rooms H and I were treated.

The ceiling vaults: use of vaulting tubes

It was suggested above that the ceiling of *tepidarium* E1 might not have been heated in Period 1a. However, when this area became part of the new *caldarium*, the ceiling vault must have been heated to prevent steam condensing and dripping into the room. The new *schola labrum*

would require a vault or semi-dome. The barrel vault over *tepidarium* H would have been extended to cover the new extension. Some at least of these new ceilings may have been constructed using vaulting tubes (*tubi fittili*), as examples are known from Chesters.

Tubi fittili are hollow, cylindrical, earthenware tubes which narrow to a nozzle at one end. Their use is as follows: 'Rows of such tubes, fixed together with mortar or plaster during construction, were used to create an initial rough-and-ready vault very rapidly, providing an immensely strong centring on which to pour the mortared rubble aggregate of the vault proper. The need for a conventional centring made of timber was thereby dispensed with completely. Once the vault was set, a layer of plaster was applied to the underside of the vaulting tubes, so that they were entirely encased and invisible once the building was finished' (Wilson 2002, 180–1). This technique was particularly common in North Africa from the late second century, where its development has been linked to the scarcity of timber for centring. In Britain the clearest example of the use of vaulting tubes comes from the baths in the legionary fortress at Chester, as described by David Mason (Mason 1990). There a portion of the *tepidarium* ceiling was found where it had fallen; other fragments from the *caldarium* indicate the same technique was used throughout the principal suite (Mason 1990, 217–8). Rows of tubes joined together to form ribs were used in conjunction with hollow tile voussoirs to create a compartmentalised vault (Mason 1990, 220–1). The use of vaulting tubes in the legionary fortresses of Caerleon and York as well as Chester is seen as significant. It is noted that practically the only period when the principal baths of all three fortresses are likely to have been rebuilt more or less contemporaneously was during the refurbishment of military sites under the Severi in the early decades of the third century. This raises the possibility that the technique was introduced by a military architect from North Africa, the place of origin of the Severan dynasty (Mason 1990, 221–2).

Fragments of six earthenware pipes from Chesters, previously thought to be water pipes, have been reinterpreted as vaulting tubes by Roger Wilson (Wilson 2002, 2003). The examples are much smaller than water pipes, have a more pronounced nozzle and corrugated surfaces (Wilson 2002, 180–1; Brodribb 1987, 84–8). The surface of vaulting tubes is invariably corrugated, presumably so that the mortar of the vault and plaster of the ceiling would adhere more easily than if the tubes had been smooth (as were water pipes); slight traces of mortar on one example lends further support to the identification (Wilson 2002, 181). The use of this unusual vaulting technique was seen to imply the presence of a legionary architect and direct legionary help in construction at some stage in the third century (Wilson 2002, 183–4). Although their context is unknown, the examples were thought more likely to have come from the extra-mural bath house than the baths beside the *praetorium* (Wilson 2003, 192). This location may be confirmed by a possible example in the Clayton Collection in Corbridge Museum. The fragment of earthenware tube (fig. 24) is marked 'Chesters fort bath house, Oct 1958', indicating discovery during the MoW work at the extra-mural baths. Although not corrugated like the other examples, its diameter corresponds closely to the average diameter of 75 mm cited by Brodribb (1987, 87–8) for syringe-shaped tubes used in vaulting. It also has a similar nozzle.

An oven built over the remains of auxiliary furnace Q

Gillam's investigation showed that, 'The arch from Q into E1 is blocked up and a bread oven built in its remains' (Gillam 1956–8, 3). Annotations on a plan (fig. 16) indicate the use of

Fig. 24 Fragment of vaulting tube from the extra-mural baths, now in Corbridge Museum, kindly made available by Frances McIntosh, English Heritage. Photograph, Graeme Stobbs.

yellow mortar — the same material used in the heated rooms to block underfloor vents and construct the drains. Inspection of the remains reveals that the cheeks of the furnace had been lowered and the front blocked; the oven dome springs from the blocking material. It is impossible to know whether the oven was a temporary structure in use during the building programme, or whether it produced refreshments for bathers relaxing in the changing room.

The frigidarium

Although robbing has removed all traces of later surfaces in the *frigidarium*, a higher floor was now laid to match the floor of the lobby which was raised to 56.46 mOD in Period 1b. It is unlikely that the primary *frigidarium* floor at a level of *c.* 56.20 mOD could have remained in use when the floor of the *unctorium* was raised to 56.80 mOD. Surmounting a gap of 0.60 m would have required a flight of at least three steps to be fitted into the space between the stone basin and the doorway in the south wall of the *frigidarium* (fig. 22). It would have been more practical to raise the floor of the *frigidarium* to 56.46 mOD, so bathers would only need a step 0.34 m high to gain access to the *unctorium*. Evidence of this change of level comes from the doorway between the lobby and *frigidarium*. As stated above (Period 1a) initially there

may have been only a simple opening here, without a door. In Period 1b or 1c a door was inserted. In late Roman times (Period 3), the centre of the threshold slab was broken through, leaving only strips at the sides. The level of the northern strip is a maximum of 56.46 mOD (the southern strip is partially obscured by the masonry of the wall).

A feature (J on fig. 22) was cut into the north wall of the *frigidarium* and projected northwards, blocking the path of the outflow drain from the shower. The shower remained in use, its outflow being carried by a replacement drain which curved around the new feature. Feature J was interpreted by Holmes (1886–7, 126) as a cistern from which water could be drawn for use in the shower. The 'red cement' lining its base and sides (Mac Donald 1931, 252) indicated that it was intended to hold water. Because of its small size — 5 ft (1.5 m) by 2 ft 10 ins (0.86 m) — Macdonald interpreted it as a footbath (Macdonald 1931, 252) which served as a replacement for the cold plunge (Macdonald 1931, 254–5). However, surely a footbath could have been sited in the south-east corner of the *frigidarium*, thus avoiding the necessity of rerouting the outflow drain? It was suggested above (Periods 1a and 1b) that a reservoir of water would be required for the efficient working of the shower system — perhaps contained in a free-standing tank or trough, and sited conveniently close by. This could have been replaced by a built-in reservoir — or 'cistern' as Holmes called it — the proximity of J to the shower emplacement indicating it was part of the same system. Though dating evidence is lacking, this modification seems in line with other changes in Period 2a, such as enlargement of rooms and the addition of the apse in the *caldarium*.

A lead outflow pipe in the base of feature J discharged through the base of the north wall. Only a few courses of masonry of these walls now survive, but it is possible that there could originally have been an inflow pipe at a higher level

Laconicum *ante-room*

A stone-built ante-room (D) was attached to the south side of the *laconicum* (fig. 22). Its walls, like those of the *laconicum*, rested on wide masonry foundations; an offset projects beyond the line of the west wall (Macdonald 1931, Pl. LV.1). Part of an offset is also visible where the footings of the south wall rise over the remains of the north face of the north wall of the demolished auxiliary furnace Q (figs. 16, 17). A test pit through the floor in the south-east corner of the ante-room revealed foundations and two courses of masonry beneath the southern ante-room wall; Macdonald interpreted this as evidence that the ante-room was constructed over the remains of an earlier *laconicum* (Macdonald 1931, 297–8). However, Gillam was able to dig more extensively. A test pit outside the west wall, at the junction of the two rooms, found that the offset beneath the ante-room wall consisted of only three courses (Gillam 1956–8, 1), and therefore was not deep enough to be the basement of an earlier *laconicum*. Underlying the offset was a layer of soot, presumably derived from the auxiliary furnace. The masonry seen by Macdonald is therefore more readily interpreted as the remains of the north wall of furnace Q overlain by the primary south wall of ante-room D.

It is possible that room D could have replaced the postulated timber ante-room of Period 1c (fig. 14). The internal space of D is similar to that of the *frigidarium*, cold bath and *tepidarium* E1. However the walls of the superstructure are only *c.* 0.60 m wide, compared with *c.* 0.89 m in the rest of the building. It seems the inner face of the walls was plastered; on fig. 5 a patch of plaster is visible on the north wall to the left of doorway. The west wall survives to a height of 1.87 m (6.30 Roman feet) above the floor, making a straight joint with the west wall of the

laconicum, and is aligned with the four topmost inset courses, as shown in the photograph of 1885 (Macdonald 1931, Pl. L). Curiously the south-west corner of the superstructure projects 780 mm beyond the line of the western offset. There was a door in the west wall; although this was subsequently blocked, the threshold slab is still *in situ*, at a level of 56.80 mOD, which indicates the level of the flagstone floor.

An underfloor vent in the south wall of the *laconicum* communicated with a single channel hypocaust beneath the flagged floor of the ante-room; packed around this was rubble (Macdonald 1931, 296–7). The spent gases in the channel were discharged through a chimney, or evacuation duct, in the south wall (Macdonald 1931, 297). This was formed by box tiles and survived to a height of 3 ft (0.9 m) in 1886 (Holmes 1886–7, 125). When examined in 1929 all but the lowest of the box tiles was missing, and the upper part of the wall appeared solid; however Hepple recalled that the chimney hollow had originally extended to the top of the wall but had been built up to prevent the wall collapsing (Macdonald 1931, 297).

There is no evidence for ceiling construction, but while a heated vault is likely in the *laconicum*, a flat ceiling would have sufficed in the ante-room.

Water trough possibly associated with the laconicum *suite*

If, as suggested above, a water tank or cistern (J) was built into the *frigidarium* to serve the shower, what happened to the presumed free-standing container which it replaced? It could have been relocated to provide a source of cooling water for bathers emerging from the newly extended *laconicum* suite. A square stone trough stands at the top of the bank to the west, *c.* 7 m from the baths, and roughly in line with the north-west corner of the *laconicum*. It appears in this position in a photograph of 1885 (fig. 9.i). Possibly it was found when the excavators trenched around the *laconicum* or cut back the slope to the west, and because of its weight was not moved far, merely pulled to the top of the slope.

There is a wide opening in the top of one side of this trough, and a clearly-cut small opening in the corner of the opposite side; the former may have received a flow of fresh water, while the latter allowed excess water to drain away, perhaps into the gutter around the bath building. Water to fill the trough may have been brought down the hill from the fort. Roughly 12 m further up the slope, on a line between the square trough and the lesser east gate, water trickles into a modern cattle trough. An inscription of AD 178–84 recording the construction of an aqueduct was found inside the fort close to the lesser east gate (*RIB* 1463). However, the inscription was re-used (Bruce 2006, 200) so could have come from an aqueduct anywhere in the fort.

Changing room

Presumably Clayton's policy of clearing away the latest deposits was responsible for the decision to remove the paving of 'rough flags' (Bruce 1885, 98) found in the changing room. The excavators must soon have been aware of the complexity of the underlying stratigraphy. The sondage dug in the south-west corner of the room is close to the surviving bench leg (fig. 8); identification of this feature might naturally have led to deeper excavation in search of the primary floor on which the leg rested. In leaving a substantial depth of deposits, including two upstands of flagged flooring, the Victorian excavators bequeathed a valuable resource for future archaeologists. The results of the three subsequent studies — by

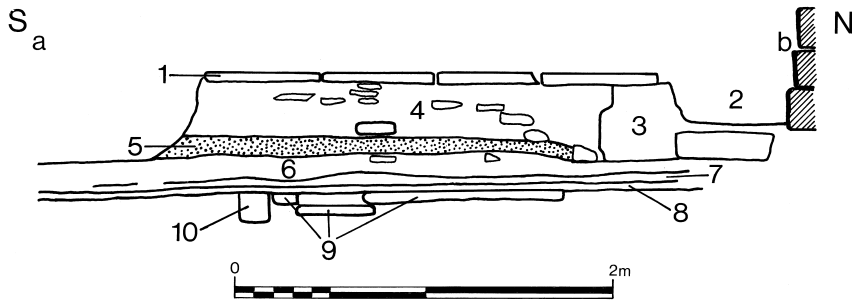


Fig. 25 East facing section through upstand in north-west corner of the changing room (see section ab on Fig 22), redrawn by Graeme Stobbs from annotated original drawn by John Gillam in 1956. Layer 5 not annotated, but shading suggests gravel. Scale 1:40.

KEY

1 surviving flags
2 disturbed
3 disturbed
4 grey powdery soil with much broken slabby stone
6 soil, broken stones, pebbles, sand
7 layer of brown and yellow soil
8 cobbles, black material
9 flag stones (yellow sandstone)
10 cut into sand and gravel

Macdonald, Gillam and TWAM Archaeology — now enable a significant new interpretation to be made, that the primary floor of the changing room was succeeded by the following:

i) a temporary gravel work surface,

ii) two successive phases of flagstone floor.

TEMPORARY GRAVEL SURFACE

Macdonald dug test pits in several places through the build-up of material and found that the stratification was remarkably uniform (Macdonald 1931, 239). Immediately above the primary floor was a layer containing fragments of lime; at three widely separated points above it there was a thin spread of red and black burnt material. Gillam cut a trench through the eastern side of the upstand in the north-east corner of the room (section ab on fig. 22) and found the lowest deposit to be a thin layer of 'black material' (fig. 25). These deposits suggest material, probably including demolition debris, trampled in by a workforce. A likely context would be the demolition preceding the Period 2a remodelling.

Macdonald found that the lime and burnt material were overlain by a layer of clay, then bedding material for a gravel floor which was not recognised by the Victorians (Macdonald 1931, 239). Gravel, forming a compact and worn surface, can still be seen in various places where modern turf is thinnest, especially near the door leading out through the south wall, where the gravel overlies the lowest of the steps. The latter is estimated to have been at *c.* 56 mOD (see Table 4), thus giving an indication of the level of the gravel. At first sight unlikely to form a floor in a prestigious building, gravel could indicate temporary conversion of the changing room into a workspace for builders. The extensive building programme described above may have lasted for months rather than weeks, a time span in which a temporary working surface would be worthwhile.

It is possible that the gravel surface is also seen in Gillam's sketch section (fig. 25). This shows a layer of 'soil, broken stones, pebbles and sand' overlain by a level layer which is unlabelled but shaded with dots and small dashes which could represent gravel. Based on measurements on Gillam's rough sketch the latter layer is estimated to be at 56 mOD or a little higher. Seen through the modern turf, the gravel surface seems to abut the masonry bench foundations along the west, north and south walls, confirming that the benches pre-date Period 2a.

FLAGGED FLOORS

The TWAM survey paid close attention to the two surviving portions of flagged floor, with interesting results. In the north-west corner a roughly square area of flags rests on an upstand of make-up material; the area of flagging is *c.* 2.66 m², roughly the same size as on the plan by Holmes (fig. 7). However Holmes is in error in showing the flags abutting the west wall of the room; the gap between the two, evident today, was caused by trenching at an early stage of the excavation (fig. 4). The plan also shows a large irregular area of flags, measuring *c.* 19 m², stretching across the main entrance, abutting the north wall in many places and stretching almost to the east wall. Today many large flags are missing from the western end, and two or three from the east (being removed by Gillam's trench). Disturbance along the north side has also separated the upstand from the north wall, as noted by Gillam (fig. 25). The surviving remains form a square *c.* 11 m² in area. Levels are noticeably lower at the eastern side, presumably because of subsidence into the backfill of Gillam's trench.

Levels on both areas of surviving flags immediately call into question whether they belong to the same floor surface. Those in the north-western upstand are at an average level of 56.65 mOD, not far below the base of the niches, thus clearly part of the latest floor shown in the photograph of 1885 (Macdonald 1931, Pl. XLV). However the average level of the north-eastern upstand (measured on the undisturbed side) is only 56.38 mOD, *i.e.* 0.27 m lower.

A logical interpretation of this discrepancy is that the upstands belong to two separate floor phases. The flags in the north-east would therefore be part of a secondary floor, most of which was removed, but some of which survived intact within the make-up material for a final tertiary flagged floor of Period 2b or 3. Clayton's excavators are likely to have noticed this — the difference in heights of the two areas of flagging is apparent in the photograph taken in late 1886 (Macdonald 1931, Pl. XLVI. Fig.1). Awareness of the complexity could explain why two upstands were left *in situ* at the end of the 1886 season — the result not of a careless oversight, but of a decision to consider the problem over the winter and return to tackle it the following year.

Therefore it is suggested in this account that in the extensive remodelling of Period 2a a secondary floor of large flags was laid in the changing room at a level of *c.* 56.38 mOD. This would have covered the two lower steps leading out of the room and into the lobby so that only the top step remained in use (fig. 13.ii). Supporting evidence can be seen today, as the top step is much more heavily worn than the one immediately below (fig. 15).

BENCHES

The masonry foundation along the south wall is higher than that on the west (fig. 8). During the TWAM survey two levels were taken on the southern foundation, the maximum being

56.47 mOD. As the bench remains are truncated, their original height is unknown. However, the top of the benches would need to be at least 0.50 m higher than the secondary floor, *i.e.* at 56.88 mOD or more. This is the same height as the string course which forms the base of the niches, making it impractical to have a bench of that height along the west wall. Perhaps that is why the masonry foundation here does not seem to have been raised above its original level.

DRAINS

Holmes' plan (fig. 7) shows the portions of two curved drains, one running from the centre of the room and one from the south-west, converging on the north-west corner. One of the drains can be seen on a watercolour by Charles Richardson, entitled 'Chesters, Bath-House from the North'[2] suggesting that the painting is an accurate record of the excavation. Macdonald dug several test pits in search of the drains but found no trace; he assumed that their remains were fragmentary and had decayed on exposure (Macdonald 1931, 239–40). However the remains of other drains have survived in the building. A more plausible explanation is that the Victorian excavators removed two isolated portions of drain which were not obviously associated with any flagged floor. Probably they immediately underlay the secondary floor, most of which was removed prior to construction of the latest floor in Period 2b or 3. These drains here may be contemporary with the installation of the drains in the heated rooms, confirming the suggestion that the baths were prone to waterlogging, either because of their damp location near a streamlet or because of episodes of river flooding.

PORCH

The entrance to the baths was overshadowed by the high road ramp carrying the Military Way (Hodgson 2011, 21, lower reconstruction drawing). After the road had been in use for some time, its surface would no doubt have built up, perhaps causing material to be washed down the ramp during heavy rain. The entrance to the changing room might have been liable to flooding. A small stone-built porch O was attached to the entrance, truncating the earlier drain running along the front of the building (fig. 22). A similar porch attached to the main entrance on the north wall of the extra-mural baths at Binchester was a secondary feature (Mason 2015, 31); then at a late date when ground surface outside the building had risen well above floor level, another entrance was created on the west wall, also equipped with a small porch (Mason 2014b, 24; 2015, 30–1).

The Chesters porch is roughly rectangular, with stone-built walls narrower than others in the building, varying between 0.50 m and 0.70 m. The east wall neatly abuts the changing room wall on the east side of the main entrance, so that the coursing of the porch masonry follows that of the end of the changing room wall (fig. 8). The north wall is very slightly out of alignment with the changing room. There is a short return wall on the west side, leaving a gap of *c.* 1.10 m between it and the front wall of the changing room. This gap formed the entrance, but there are no surviving door jambs or threshold slab. Perhaps the porch was simply open to the west.

Macdonald's description of the porch as 'ramshackle' (Macdonald 1931, 234–5) seems harsh. In plan it is no more irregular than the *laconicum*, and its walls, though narrow, are of regularly coursed masonry in keeping with the rest of the building (fig. 8). Rather than having

no foundation trench, as stated by Macdonald (*ibid*, 234), it is likely that the early excavators dug deeply enough to reveal slightly offset cobble and block foundations, visible today at the base of the short west wall and along some of the inside of the north wall. The floor has not survived, but levels on the offset foundation are 56.35 mOD and 56.40 mOD, indicating that the porch floor was level with the secondary floor of the changing room at *c.* 56.38 mOD.

The bathing regime

Blocking the door between the extended *caldarium* and lobby and door 14 between the *caldarium* and the *unctorium* marked a fundamental change in the bathing regime, specifically the way bathers moved around the main block. Their route would be from lobby, through *frigidarium*, *unctorium*, *tepidarium* H and through door 15 to the *caldarium* but then in order to cool down they would retrace their steps through rooms H and I before finishing at the *frigidarium* and cold bath. Thus the building was now used like a row-type bath house rather than a ring-type. Fundamental changes also occurred at Carrawburgh. Two semi-circular features described as baths occupy the eastern part of the *caldarium* and abut its eastern wall (Bruce 1874, 17, plan opposite); in this position the original ring-type circulation would also have been impossible.

PERIOD 2B

Introduction

The building underwent many modifications in its later history. There is no unifying factor like the drainage system of Period 2a to link the late changes in a clear structural sequence. However there are several minor modifications which suggest simplification and economy of labour and resources, while leaving the bathing regime basically unchanged. These are classed as Period 2b.

Laconicum *suite*

A new door cut through the west wall of the lobby enabled the *laconicum* suite to be accessed from the main block (fig. 2); the original door in the west wall of the ante-room was partially blocked to create a window. Thus all bathers would use the main entrance and changing room, and presumably the numbers of doormen and bathing attendants could be reduced.

ANTE-ROOM

The jambs of the new door between lobby and ante-room D are missing, but the slots in which they rested are visible, the space between indicating a doorway 0.95 m wide. The door opened inwards into the ante-room, pivoted from the western side of the threshold. There are two pivot holes in the slab, one beside each jamb. The simplest explanation is that the slab was re-used. The northern hole is irregularly-shaped with a broken edge to the slab where an earlier pivot was removed; the circular southern hole with a neat groove running into it is a re-cut.

When the door in the west wall of the ante-room went out of use its threshold slab was left in place; the lower part of the opening was blocked while a window was created in the upper

part (Macdonald 1931, Pl. LV). The maximum surviving height of this wall above floor level is 1.87 m; though the window was later blocked, its maximum surviving height is 0.74 m. On the external face the northern edges of door and window are out of alignment by 0.20 m, probably caused by the removal of the jambs. The southern edges cannot be compared as there is no straight joint for the door, and this edge of the threshold slab is broken. The window opening on this face is 1.34 m wide, but there is a gap of 40–50 mm each side of the blocking material. However on the interior the width of the window is only 1.26 m (Macdonald 1931, Pl. LV, Fig. 2). The discrepancy therefore seems to be the result of the way the exterior face was consolidated, the true width of the window being that seen on the interior — 1.26 m (a little over 4 Roman feet).

In the interior of the room as consolidated, two clear straight joints can be seen in the upper part of the wall; a horizontal line is apparently the lower limit of the window opening (Macdonald 1931, Pl. LV, Fig. 2). At the bottom of the wall are two straight joints representing the lower part of the blocked door. Between are four courses of stonework with no straight joints, but with one patch of very irregular coursing. The northern edges of door and window are almost in line. However the straight joint for the southern edge of the door is misaligned with the southern edge of the window by *c.* 0.24 m, the result of blocking the gap left by removing the jamb. On the interior face, the horizontal lower line of the window blocking, representing the sill, is 1.16 m above the threshold. As the window was created out of an original doorway, it is likely that there would be no splay at the sides — the alignment of the northern edges of door and window on the interior seem to confirm this. Curiously, Macdonald refers to a splayed window (Macdonald 1931, 299–300), and it is drawn as such on Parker Brewis's plan (Macdonald 1931, plan facing p. 304); perhaps confusion arose because of the discrepancy between external and internal measurements. However there may have been a splay beneath the window. Possibly the clear horizontal line is the product of consolidation, but irregular coursing below it may be the result of blocking a splay below the window. As the walls of the ante-room are only *c.* 0.60 m wide — narrower than in the main block — the splay below the window would have been correspondingly smaller. A splay of 0.20 m below sill level would have resulted in an interior window opening at *c.* 0.96 m above the floor, similar to that in the *schola labrum* (Bidwell *et al.* 1997).

Levels on the north-west and south-west corners of the flagged floor are 56.83 mOD and 56.78 mOD respectively, consistent with the threshold slab of the blocked door at 56.80 mOD. However a complete floor at this level would have presented problems of access from the lobby, the floor of which was at 56.46 mOD. This would have made for an inconveniently high step. The solution adopted was to insert the threshold of the new doorway at a more convenient height of 56.70 mOD, so that the step from lobby to ante-room was only *c.* 0.24 m. The flags in the eastern half of the ante-room were re-laid to slope down towards the new door; levels at the north-east and south-east corners are both 56.70 mOD, the same as the new threshold. Macdonald noted that some flagstones were cracked and split, and in places there was 'a patchwork of small stones' (Macdonald 1931, 303, Pl. LVI, Fig. 2). Damage occurring in Period 2b while the floor was relaid could have been concealed by a layer of mortar flooring. Alternatively the damage could have occurred in later Roman times when the building was abandoned for bathing (Period 3). Macdonald lifted a flagstone close to the west wall and found sealed within the underlying rubble packing a small fragment of pottery dated by Eric Birley to the late third or early fourth century (Macdonald 1931, 296–7), which could relate to either circumstance.

LACONICUM

The record book kept by Grace Simpson (Simpson 1956–77) includes a section written during consolidation of the baths by the MoW in 1956–8, in which there is a reference to a 'lime floor' in the *laconicum*. This could represent decayed mortar flooring. The record book details finds derived from this layer, including coins (see Table 5).

On a further page the position is given as: '6 & 8 were both in the lime floor which covers the flagstones which lie on the pilae. Room B is the sudatorium or hot dry room.' At first sight this appears to provide a *terminus post quem* of AD 286 for the latest layer of flooring in the *laconicum*, and thus for Period 2b. However, it is unfortunately not recorded whether the 'lime floor' layer was sealed, and thus the coins could be intrusive.

Table 5 Extract from list of finds made during consolidation of the *laconicum*.

DATE	NO.	OBJECT	BUILDING
1958	6	Good. Coin. Silver denarius (early style) of Severus Alexander (AD 222–35) MARTI PACIFERO, Mars standing RIC 4 (2)	Bath-house Room B
1958	8	Coin. Bronze. Carausius (AD 286–93) Rev. ? Pax Aug ?Mint	Bath-house Hot dry heat room i.e. "B" Room

The frigidarium

The large cold bath L was reduced in size (as in the secondary rebuild at Wallsend (Hodgson 2015, 23)). On Holmes' plan (fig. 7) dotted lines may indicate partitions, dividing the bath into three sections. The narrow strip along the west side represents steps of which Macdonald found a surviving flagstone at the north-west end (Macdonald 1931, 249). Division of the remaining area seems to represent a reduction in the size of the bath. The southern portion could have been retained as a bath, if the outlet for waste water was in the south-west corner, as at Bewcastle. The northern portion was put out of use as a bath by the insertion of a feature recorded by Holmes. This abutted the east wall and was described as 'a square block of masonry, which appears to have formed a base on which some object might have stood' (Holmes 1886–7, 126; see also fig. 7). Macdonald found traces of this feature in the form of an oblong patch of earth, 5 ft (1.52 m) by 3 ft (0.91 m), resting on the concrete floor and overlain by broken flagstones (Macdonald 1931, 251). He cited a possible parallel in a masonry pedestal, 3 ft 6 ins square (1.07 m^2) and 1 ft 3 ins (0.38 m) high, in the *frigidarium* of the large bath house in the fort at Mumrills (Macdonald and Curle 1928–9, 476–7; Fig. 59). This was suggested to be the stand for a basin.

These changes could have catered for a reasonable number of bathers while being more economical in water usage and less labour intensive to operate.

The caldarium *and* tepidaria

Macdonald found evidence that the furnace room to the south of the *caldarium* was reduced in size at some stage (Macdonald 1931, 272–3). Otherwise the *caldarium* and *tepidaria* could have remained in use as in Period 2a.

Dating evidence

Reduction in the use of extra-mural baths could be related to the abandonment or shrinkage of the military *vicus*, an event observed at many northern forts, and often datable to *c.* AD 270.

PERIOD 2B OR 3

Changing room

A new (tertiary) floor of large flagstones was laid, of which only the upstand in the north-west corner remains, at a level of 56.65 mOD. The benches went out of use and their remains were overlain by flagstones, as were the well-worn steps leading into the lobby. The worn threshold of this doorway was renewed. The level on the centre of the threshold slab is 56.58 mOD, at first sight seeming at odds with the value of 56.65 mOD for the remaining floor in the north-west corner. This is explained in a photograph of 1885 (Macdonald 1931 Pl. XLV). From the centre of the room the floor slopes down to the south. The threshold slab leading into the lobby stands a little proud of the floor, suggesting a downward slope across the room from north to south. The excellent preservation of the flagged floor, as seen in the photograph, may indicate that it was not laid until the building was out of use for bathing (Period 3). There were no stone benches for the use of bathers, and it is hard to see how the niches — only 0.23 m above the floor — could have served any practical purpose. Alternatively, in the final brief period of bath house use (Period 2b) the floor may have been covered by *opus signinum*, preserving the flagstones in good condition. As the newly-modified threshold slab in the doorway leading to the lobby stood several centimetres proud of the floor, this may indicate that a missing *opus signinum* layer was originally flush with the threshold. Also the room could have been provided with timber benches which have not survived.

The photograph of 1885 (Macdonald 1931, Pl. XLV) shows two stone pillar bases at the western end of the room, apparently part of a line of roof supports running transversely across the centre of the room. They were dissimilar (fig. 7), obviously recycled from elsewhere. They might indicate that the roof with its wide span was in poor repair during the final use of the baths; however they might belong to the more radical changes of Period 3. Some slight evidence of possible roofing material can be seen amongst the finds propped up against the south wall of the changing room in fig. 8. The object on the right appears to be a small stone slab. Enlargement of the photograph reveals a small hole in the top right-hand corner, possibly the nail hole in a roofing slate. The larger stone to the left has cross-hatching.

The renewal of threshold slabs in the entrance to the changing room and in the other doorways described below would have eased movement around the building, whether it was used for bathing or other purposes.

Door from changing room into lobby

The centre of the worn threshold slab was cut away, leaving narrow strips on either side of the entrance; on each there is a possible indication of one side of the slot for the former jambs though no jambs remain *in situ*. The central part of the slab was turned upside down and re-used (Macdonald 1931, 240–1). The effort involved would be insignificant compared with the effort of dismantling the entire structure of jambs, door and lintel in order to replace the threshold with a new slab, then reassembling the whole. The slab is positioned so that its

northern edge projects beyond the line of the wall (fig. 15) and the southern side is slightly recessed. There may have been a door stop running across the threshold, 0.16 m from its northern edge, set in a shallow groove, indicating that the door opened inwards towards the lobby. The centre of the slab is slightly worn, the groove only surviving for a distance of 0.37 m at the western side, and 0.18 m at the east. Behind the groove at the western side the pivot hole for the door survives as an oval hollow, 0.10 m deep.

Other doors

In the doorway between the lobby and the *frigidarium* the centre of the threshold slab was also cut out, presumably so that it could be similarly reversed. However, the central part is now missing, probably robbed. The door between the *frigidarium* and *unctorium* was similarly treated; on the surviving west side of the wall between the two rooms, a strip of the west side of the threshold slab is *in situ*, neatly cut through.

PERIOD 3

Introduction

The Victorian excavations removed almost all evidence of the final sequence in the history of the bath house. However, although the latest layers were removed without recording in the modern sense, the standing remains preserve evidence of a variety of changes to the structure, which we consider sufficient to propose an interpretation. Whilst emphasising the speculative nature of this interpretation, we suggest that the building went out of use for bathing, but was used for other purposes, the nature of which is as yet unknown. We term these events Period 3. There is no direct dating evidence for the beginning of this period, but we suggest that the abandonment of the building for bathing coincided with the creation of replacement bathing facilities within the fort, probably in the early fourth century. The duration of Period 3 is also unknown; possibly parts of the former bath building served some useful purpose until the end of the Roman period, or even into early post-Roman times.

A bath house in the fort

The bath house in the fort immediately to the east of the *praetorium* has traditionally been described as the private baths of the commanding officer, but it is free-standing and of considerable size, so is more likely to have been for the soldiers (Hodgson 2011, 13). Excavation within the fort in 1843 showed that this bath house was not the first building on the site. The finds included 'upwards of fifty Coins of various Emperors, from Hadrian down to Gratian ', 20 of which were published (Clayton 1844, 145–7). Two of these were of the late third century and eleven were fourth century. Of the seven others, three were described as 'defaced' — possibly meaning 'worn' — so these could be residual coins derived from an earlier structure. Though this selection may not necessarily reflect the composition of the whole assemblage, it seems to suggest a fourth-century date for the new baths.

One of the trends observed in the structural archaeology at northern military sites in the late Roman period relates to bath suites. It is suggested that in the late fourth century bath suites may be altered, extended or added to existing buildings within the fort, typically —

though not exclusively — to the *praetorium* (Collins 2012, 75, 78–80). Examples of baths within forts include the bath suite at Binchester (Ferris 2010, 59–77) and the bath building in the north-west corner of Halton Chesters (Dore 2010, 1); at Housesteads a small bath suite was inserted into a large storehouse (Rushworth, 2009, 171–3; Crow 1995, 93, Fig. 54, Pl. 5).

Possible re-use of the extra-mural baths at Chesters

The remains provide evidence of robbing, possible conversion of some rooms for purposes other than bathing, and also deposition of rubbish. Our suggested interpretation comprises two phases:

i) Parts of the building were demolished, while other parts were retained for other uses. Rubbish deposition was initially concentrated around the outside of the building and in outlying rooms, so this process could have begun while main rooms of the interior were still in working use.

ii) Most or all of the building went out of use, and was more heavily robbed.

Phase i

ROOMS H AND I

The latest changes to these rooms, as recorded by the Victorian excavators, raise great difficulties of interpretation. Just two areas of evidence stand out as significant. The furnace room outside the south wall of H (fig. 22) was demolished — only burnt soil remaining (Macdonald 1931, 268–9) — but the flue in the centre of the south wall of H was retained and altered. It was heightened by a maximum of 0.43 m and capped by a new lintel, the top being at roughly the height of the suspended floor. The opening was unrelated to heating because the underside of the lintel was not reddened (Macdonald 1931, 270). On excavation, a gutter stone was found in the bottom of the opening (Bruce 1885, 102; Macdonald 1931, Pl. LI, Fig. 1), suggesting the purpose was for drainage.

Secondly, evidence indicates that the interior was heavily robbed, down to basement floor level. In contrast with the west range, there is no record of surviving hypocaust *pilae* or iron holdfasts. The underfloor drains survived in room H. However in room I the drain was removed, together with the secondary floor or make-up layer on which it rested, although the primary basement floor apparently survived (Bruce 1885, 101) together with remains of the primary tile *pilae* (Holmes 1886–7, 126; see also fig. 7). The extra heavy robbing of room I occurred 'perhaps through a mere misunderstanding of instructions '(Macdonald 1931, 270). The basement floors were then covered with a layer of sand (Bruce 1885, 101).

One observation assists us in making a speculative interpretation. If rooms H and I were roofed as the suggested reconstruction of Bewcastle baths (fig. 12), it would have been possible to demolish these two rooms without undue damage to the rest of the building. They could therefore have been robbed for building materials. The buttressed east wall would have provided a plentiful source of dressed stone, its position on flat ground at the bottom of the slope facilitating its removal and that of the south wall. Stripped of the roof and all but the lower courses of east and south walls, the site of rooms H and I could have become a large enclosed yard, a working area for some process which required drainage through the opening in the south wall.

At first sight the discovery of the sand layer seems puzzling. On excavation, the area of room I was found to be 'filled with sand up to the level of the floor of the other [room H], which also had a covering of sand over it' (Bruce 1885, 101). In room I the sand was 'about 2 feet' (0.61 m) deep (Holmes 1886–7, 126). The present study confirms these findings. The primary basement floor of I was 9 ins lower than that of H (see Period 1a). The drain resting on the primary floor of H was at least 13 ins high and packed around it was a secondary floor of yellow concrete (see Period 2a). Therefore the difference in height between the primary floor of I and the secondary floor of H was *c.* 22 ins, and thus to provide a 'covering' of sand over the secondary floor of H would require the depth in room I to be 'about 2 feet'. Sand could be deliberately deposited for a variety of reasons. It was used in the construction of Bewcastle baths to infill the basement space of the unheated rooms (Gillam *et al.* 1993, 15). When a hypocaust went out of use in a large extra-mural house at Corbridge (Site II), the space left by demolition of the furnace was filled with sand (Forster 1908, 224, plan facing p. 240). More commonly sand is used as a bedding layer for a higher surface, for which the sand would also aid drainage. We therefore suggest that the sand was deposited as bedding for a rough working surface of cobbles, clay or gravel. Unrecognised by the Victorian excavators, this could have been removed together with the stony overburden covering the remains of the building.

In conclusion, we suggest that the outer walls of rooms H and I were demolished down to their lower courses, forming an enclosed yard, its working surface drained by means of the gutter stone in an opening in the south wall. As the crosswall between the two former rooms would be redundant, the lack of blocking in the three vents which puzzled Macdonald (1931, 271) would then be explicable. Only the western 1.98 m of this wall survives (fig. 9.i); the missing eastern side could be the result of collapse or robbing, or a deliberately made opening.

Access to this postulated yard could have been through the door in the south wall of the *frigidarium*, and also possibly through door 15 in the medial wall. It is not clear how the latter was treated. Propped against the wall beside it is a single door jamb which seems to have been modified. Measuring 1.76 m × 0.80 m and a maximum of 0.23 m thick, there is a slot 1.30 m long and 50 mm wide cut into the outer face (fig. 26). Possibly the slot could have held a lightweight timber shutter or louvres.

Conversion of other rooms for uses other than bathing

CHANGING ROOM

The main entrance was widened to 2.80 m; this was done by simply removing the western door jamb and cutting back the wall, which remains ragged. Part of the eastern jamb is *in situ*. The flagstone floor escaped the attention of stone robbers, presumably because the room was in use. A large, stone-flagged room with a widened entrance would provide excellent storage space. Its location close to the Military Way could have made it a convenient facility for collection and storage of the *Annona* — the rations of food, clothing and fodder which formed a large part of the soldiers' pay in the fourth century.

LACONICUM

Furnace C went out of use — apparently buried rather than demolished, because the Victorian excavators found it well preserved (fig. 7; Bruce 1885, fig. facing p. 98). Wall jacketing was robbed, leaving some T-shaped iron holdfasts *in situ* in the west wall (Macdonald 1931,

294). The suspended floor remained intact, providing a level working surface, and was never robbed.

There is a gap in the north wall of the *laconicum* at its junction with the changing room. Today the broken masonry has a ragged edge, but a photograph of 1885 shows a gap *c.* 1 m wide, with a neat straight edge on the western side (Macdonald 1931, Pl. L). The possibility that this is a result of Victorian trenching cannot be ruled out. However it is possible that after the building went out of use for bathing a doorway was inserted, providing direct access into a re-used *laconicum* suite, without passing through the rest of the building. Some evidence comes from the watercolour by Charles Richardson 'Chesters, Bath-House from the North'.[3] This shows a monolithic stone jamb *in situ* on the west side of the gap, but there is no eastern jamb, nor any indication of where it might have been, and no threshold slab. This is puzzling, since there is no western jamb in the photograph of 1885, and no record if its whereabouts. It is hard to believe that the portrayal of the stone jamb is artistic licence in what seems to be an otherwise accurate painting. Perhaps the jamb was in position when the painting was done, but had collapsed or been removed by the time of the photograph.

LACONICUM ANTE-ROOM

A small opening was made at the eastern end of the south wall, in the corner of the room. The opening is 0.90 m high and 0.70 m wide, and its base is at floor level (Macdonald 1931, Pl. LVI, Fig. 1). A slab 100 mm thick forms the lintel and upright slabs of the same thickness form the east and west sides. This opening (*cf.* the above-mentioned heightened vent in the south wall of room H) could have functioned as a rubbish chute. Gradually ground level outside — over the disused oven — could have built up until it was at the level of the ante-room floor. This may also be the period in which the window in the west wall of the ante-room was blocked.

EXTENDED *CALDARIUM*

The *caldarium* furnace and the hot bath were demolished. More strikingly, an opening was knocked through the centre of the south wall (figs. 9.i and 9.ii). The gap, *c.* 2 m wide with ragged edges, was perhaps knocked through in order to rob the boiler and *testudo* (Paul Bidwell, pers. comm.). These could have been re-used in the baths in the fort; alternatively the metal would have been a valuable resource for any other purpose. Significantly, the opening did not extend down to the level of the basement floor; the rubble packing which supported the hot bath remained *in situ* topped by fragments of sandstone flags at a height of 56.78 mOD, *i.e.* roughly the estimated height of the suspended floor. This suggests the opening was made while the suspended floor — or a replacement at the same height — was still *in situ*. If equipped with timber jambs and doors this opening could cater for the passage of items too large to pass easily through the northern part of the building with its changes of level and doorways only *c.* 1 m wide.

There is no direct evidence of how the extended *caldarium* was re-used. However, the photograph of 1885 (fig. 9.i) shows a broken quern stone propped against the outer face of the south wall, and in fig. 9.ii a complete quern is propped against the east wall. These could simply be discarded objects which arrived as part of general rubbish deposition, but a large room with a wide entrance would have been ideal for the storage or processing of grain.

FRIGIDARIUM

A pit was dug in the south-west corner of the cold bath, where the original outlet may have been (fig. 7). Macdonald (1931, 250–1) recorded that the solid concrete lining of the bath had been hacked away to a depth of 6 ins (152 mm) and the pit was 4 ft by 3 ft (1.20 m by 0.91 m). Embedded in the middle was a brick about 6½ ins square (165 mm²), presumably covering the outlet to the drain.

Refuse disposal

Collections of animal bones are displayed prominently in several Victorian photographs (figs. 3, 5, 6, 8, 9.i; Macdonald 1931, Pls XLIII, XLV and XLVI.1). But there are also other objects, for example the above-mentioned querns and a fragment of a small pillar placed on one of the latrine blocks (Macdonald 1931, Pl. XLIV). Enlargement of some of the photographs reveals what appear to be pottery sherds amongst the animal bones, suggesting the bone was just one component of general refuse disposal. The photographs suggest that rubbish may have been piled up outside the building and in the small peripheral rooms. In fig. 3, showing the initial trenching around the west wall of the changing room, animal bones lie on the baulk on top of the wall. They were placed along the outer edge of the baulk, closest to the *laconicum* suite, suggesting that is where they were found. Excavators standing on the raised floors in the suite would have been able to reach the top of the baulk. However the northern end of this trench would have reached a greater depth, down to the base of the sunken furnace room. From this depth it would be impossible to place finds on top of the baulk (the difference in depths clearly shown in a photograph of 1885 (Macdonald 1931, Pl. L)). This may explain why a collection of bones was placed in the niche on the opposite side of the wall (fig. 3). Not only the *laconicum* suite but eventually the whole of the gap between the western side of the building and cut of the terrace into the hillside could have become a midden. The latrine trenches could also have been infilled, and perhaps refuse thrown down the slope to the east. Photographs show animal bones laid out on the stone blocks of the latrine (Macdonald 1931, Pls XLIII, XLIV).

Rubbish need not have been deposited in the large rooms of the interior. In a photograph of the changing room in 1885 (Macdonald 1931, Pl. XLV) all the niches are filled with bones, standing upright for display. However, these are likely to be the bones found in the *laconicum* suite and originally placed on the baulk above the west wall, which is empty of finds in this photograph and the one taken in 1886 (fig. 8). Figure 8 also shows animal bones on the porch wall, but they could have been found outside the building during clearance of the north wall that year. Another heap of bones on the upstand of late flooring immediately inside the entrance in another photograph (Macdonald 1931, Pl. XLVI, Fig. 1a) could also have come from outside the building. Similarly a few animal bones arranged in the apse in fig. 6.i could have been found in trenching the outer face of the wall. Some bones are visible at the front of the apse in the photograph taken at the end of the 1885 season (fig. 9.i), but the largest collection, including a cow skull, was arranged on the masonry supports for the hot bath in the foreground of the picture. Possibly, like the hypocaust pillar and gutter stone in the foreground, they had been found elsewhere and collected together for the photograph (Macdonald 1931, 256).

These deposits raise an interesting question. Does their presence indicate an empty abandoned building, fit only for rubbish dumping, or are they the result of some occupation or

activity still being carried out? An abandoned structure as large as a bath house would make a convenient site for rubbish disposal at any date. For example, the remains of the Agricolan baths at Corbridge Red House contained two dumps of 'thousands of broken and split food bones' (Daniels 1959, 108, Pl. X, 2, Fig. 4, J). The animal bones in the disused bath house at Chesters may simply reflect its status as a late Roman rubbish dump. However, there is another possibility. Large animal bone deposits in very late Roman or sub-Roman contexts have recently been interpreted as indicating a cultural change taking place on the northern frontier in which feasting played a crucial part. It is suggested that following the loss of Imperial control, commanding officers of frontier units began to change into independent warlords who held together bands of followers by a culture of patronage and feasting (Collins 2012, 163–6). Such feasting may have occurred at Chesters. Clayton's excavations in the fort recovered 'frequent' animal bones, belonging to 'the red-deer, the roe-buck, the ox, the wild boar, and the sheep', and not found in the 'lowest levels of the excavations' (Bruce 1885, 97–8). As usual the bones were displayed for photography. A Gibson photograph in the album (CH5980, acc. no. 03.5066) in the Clayton Collection in Corbridge Museum shows part of the barracks in the north-east quadrant of the fort (the *praetentura*), excavated in 1889. The walls of the officer's house are covered with excavated animal bones, including cow skulls. The animal bones found in the extra-mural bath house (fig. 3) include not only part of a skull and a large jawbone, but also a scapula pierced with a hole, indicating a joint of meat which had been hung up for processing. Perhaps here we see the remains of meals eaten within the building.

Phase ii

INCREASED STONE ROBBING

Floors

Although the floor of the changing room remained intact, flagstones seem to have been robbed from the other floors of the main block. In the enlarged *caldarium*, flagstones were robbed, leaving behind debris including *pilae* on the basement floor. Many small stone pillars were seen by Gillam in 1956–8 while digging to investigate the site of the demolished cross-wall (Gillam and Johnson 1985, 4). Debris between the basement floor and modern ground surface contained a mixture of tufa voussoirs, facing stones and sections of soot-blackened *pilae* (Gillam 1956–8, 2), indicating that the suspended floor had been robbed before the collapse or robbing of the ceiling vault and walls.

Flagstones were robbed from the floors of the lobby and *frigidarium*. Perhaps this is when the cold water basin was broken and the two pieces abandoned. A parallel for this comes from the demolition of the baths at Corbridge Red House, when the *labrum* basin in the *frigidarium* was pushed off its pedestal and lay broken, two portions surviving, because '… either its great weight or breakage in removal was responsible for its being abandoned' (Daniels 1959, 115, Pl. XV, 2; Fig. 9). With a diameter of 5 ft (1.52 m) it was roughly the same size as the Chesters basin.

ROBBING OF CEILINGS, ROOFS AND WALL JACKETING

Robbing of materials was selective; the imposing height of many standing walls is in stark contrast to the scarcity of surviving roofing material and wall jacketing.

Ceilings

The bath house in its final form in Period 2b would have contained a large number of voussoirs and tiles. An attempt has been made to estimate the number needed for the ceiling vaults, based on the average width of the surviving voussoirs, and a drawing of the suggested reconstruction of the arch (de la Bédoyère 1991, 24. Fig. 9). The estimate is as follows:

i) a single hollow-ribbed barrel vault running north/south over the west range heated rooms from the hot bath to the north wall of the extended *caldarium* would have comprised 22 arches of voussoirs with intervening voids (an estimated 1298 voussoirs)

ii) a similar vault running north–south over rooms H and I would have comprised 20 arches of voussoirs with intervening voids (an estimated 1180 voussoirs).

On this basis the number of tufa voussoirs required for the heated rooms in the main block would be *c.* 2500. In addition the *laconicum* may have been similarly vaulted. If the *frigidarium* and cold bath were covered by an east/west barrel vault constructed solely of tufa voussoirs with no voids, as at Bewcastle, this would comprise 25 arches. This would require 1475–1534 voussoirs. It is not known whether the vault over the lobby would have been similarly formed solely from voussoirs, or whether there would have been voids. In conclusion, the number of tufa voussoirs could have been 4000–5000, and clearly a large number of spacer tiles would be needed.

Roofs

There is no indication of the size of roof tiles or stone slates, as no examples have survived. However, complete *tegulae* in Corbridge Museum are on average 450 mm long by 330 mm wide. A pitched roof as described above (including the changing room and the various smaller roofs) using tiles of this size could have needed 6–7000 *tegulae* and the same number of *imbrices*, or a corresponding number of stone roofing slates.

Wall jacketing

Without knowing the exact height of walls, it is still possible to make a rough estimate of the area covered by wall jacketing at the end of Period 2. This involves two assumptions:

i) the walls involved were those of the *unctorium*, extended *tepidarium* H, extended *caldarium*, hot bath and *schola labrum*, and the *laconicum*.

ii) the wall height would be in the region of 10 or 11 Roman feet — roughly 3 m.

On this basis, the area covered by wall jacketing would be *c.* 250 m^2. However this was constructed — by *tubuli* or flat tiles with spacer bobbins — a large amount of tile would be needed. Yet the Victorian accounts make no mention of tiles of any kind, and none can be seen in the Gibson photographs, although one box tile was illustrated by Holmes (fig. 7).

Total robbing

Clearly thousands of voussoirs, tiles or stone roofing slates were robbed. This could have occurred in two stages:

i) only the roofs of H and I were robbed during demolition of these rooms, while other rooms continued in use, retaining their roofs, which may have been finally robbed in late Roman or early post-Roman times (late Period 3 or Period 4).

ii) all roofs were stripped; complex vaulted ceilings would have been unnecessary in the storage or working rooms, and could have been replaced by simpler roofs of timber or thatch, which have not survived. Possibly this was the time when the pitched roof of the changing room was stripped of its tiles for re-use, to be replaced by a simpler roof supported by the stone pillars.

Tiles stripped from roof, ceiling vault and wall jacketing would have had a wide variety of uses, in construction or repair, or crushed for inclusion in *opus signinum* — to be used in the new baths within the fort and many other buildings. But what purpose could have been served by the thousands of highly specialised tufa voussoirs, so few of which survived? Being carboniferous, they could have been burnt to produce lime. Lime mortar would have been needed for late Roman rebuilding and repairs (as in later periods). Perhaps when the *caldarium* roof and vault were stripped, a few tufa voussoirs mortared directly onto the top of the walls were left *in situ*, to fall in later centuries as the building decayed. Hence the surviving voussoirs include some which are flat on one side, forming the end of ribs attached to the walls.

PERIOD 4

Early post-Roman to medieval

Possibly the changing room remained in use in the early post-Roman period, the pillars supporting the roof dating from this time if not before. But inevitably all of the building eventually succumbed to decay and collapse. Gillam's trenching in room E2 revealed debris containing tufa voussoirs, hypocaust pillars and facing stones (Gillam 1956–8, 2), the latter providing evidence of tumble from the walls. Figure 6.i shows how the western wall survived almost to its full height, possibly supported by the massive refuse tip engulfing it, but the internal walls of the apse — and presumably the other internal walls — had fallen away steeply.

The remains of the building were sufficiently impressive to have become the focus of an inhumation cemetery, presumably dating to very late Roman or early post-Roman times. Discovered at an early stage in the Victorian excavation, it received only this brief record:

'On clearing away the soil from the southern and eastern faces of these chambers [rooms I and H], thirty-three human skeletons were found, all of them in a remarkably perfect condition. The skeletons of two horses and that of a dog were also met with' (Bruce 1885, 101).

A newly-discovered piece of evidence sheds further light on this. In the unpublished photograph by James F. Robinson (fig. 26) a collection of bones can be seen displayed on the outer face of the east wall of *tepidarium* H, between the two southern buttresses. Malin Holst is of the opinion that the collection includes at least one human femur and two human tibiae.[4] Bruce's brief statement does not clarify whether the burials were found inside or outside the building. The new evidence is important in not only confirming the existence of the burials, but also seems to indicate that they lay outside. This is surely logical. If the burials had been within the building, there is no obvious reason why they should cluster in only two areas.

Fig. 26 Photograph taken by James F. Robinson in 1885, of the east side of the building, viewed from the south-east. Bottom centre, bones displayed on the outer face of the east wall of *tepidarium* H include one human femur and two tibiae (Copyright Trustees of the Clayton Collection and English Heritage).

However, outside the building, only the southern and eastern sides would have been readily accessible; on the west there was the slope of the hillside and on the north the steep slope of the ramp carrying the Military Way. The perfect condition of the remains suggests a well-ordered cemetery with no intercutting graves.

A study of cemeteries outside Roman forts is beyond the scope of this paper, but it should be noted how unusual it is to find such an extensive cemetery in this position. Furthermore, if the excavators only cleared a narrow trench beside the walls, they may have exposed only a fraction of a much larger burial ground. The possibility of further burials lying outside the excavated area presents important opportunities for further research; in future samples could be recovered for analysis and dating.

The presence of the horses and dog calls for explanation. However their context is unknown and might not be associated with the human burials. They could be relatively modern, or could be Roman, pre-dating the cemetery. The disposal of horse remains in the environs of a cavalry fort should not be surprising. The first indication that the fort at Stanwix in Cumbria was occupied by cavalry came in 1772 when the antiquarian Thomas Pennant observed the remains of the nearby milecastle 66 on the steep scarp above the River Eden

c. 0.5 km west of the fort. He reported that '... near Hissop Bank is a stupendous number of horses bones, exposed by the falling of the cliff ...' (Birley 1961, 206).

Decay and collapse of the building would have continued throughout the medieval period. The western walls, already partially buried by rubbish deposits, would have been further protected by soil washed down the slope. What remained of the eastern walls was almost certainly not buried so deeply and could have attracted stone robbers. In particular, the latrine at the north-east side contained large masonry blocks potentially useful elsewhere.

Today the consolidated bath house stands almost exactly as found by the excavators in 1884. Visiting the site one cannot fail to be impressed by the richness of the remains, the skill of its builders, and the work of all those who have gone before.

ACKNOWLEDGEMENTS

The survey of Chesters baths carried out in 1997 by the Archaeology Department of Tyne and Wear Archives and Museums was part of the Segedunum Project, funded by the Heritage Lottery Fund and partners. We are grateful for the advice, support and enthusiasm of all who have assisted us in our study of Chesters baths. Paul Bidwell provided guidance, advice and information throughout the project, and commented on various aspects of the text. Frances McIntosh's assistance throughout was invaluable in enabling us to access items in the Clayton collection Corbridge Museum, and gave permission to reproduce Figures 8, 9.i, 9.ii and 26 (Copyright Trustees of the Clayton Collection and English Heritage). Nick Hodgson provided valuable information on the excavation of the Wallsend bath house in advance of post-excavation analysis and publication. Alex Croom kindly gave permission to reproduce Figures 3, 4, 5 and 6 (Tyne and Wear Archives and Museums). Andrew Parkin assisted in accessing the J. P. Gillam archive in Discovery Museum. Geoff Woodward and staff at Segedunum Museum helpfully provided access to the archives there. Derek Welsby, Kate Wilson and the Council of the Cumberland and Westmorland Archaeological and Antiquarian Society kindly granted permission to reproduce Figure 12. Malin Holst provided valuable new information by identifying the human bones shown in Figure 26. Graham Tench provided information on the Segedunum baths reconstruction. The staff at Chesters were helpful and welcoming on our visits to the site. To all these people we extend our warmest thanks. Any errors or omissions are the responsibility of the authors.

NOTES

[1] http://collectionssearchtwmuseums.org.uk/charles richardson watercolours, Unique Object Nos TWCMS H12845 and G10349, website accessed in autumn 2015

[2] http://collectionssearchtwmuseums.org.uk/charles richardson watercolours, Unique Object Nos TWCMS H12843 and G3854, website accessed in autumn 2015

[3] see note 2.

[4] York Osteoarchaeology Ltd and Department of Archaeology, University of York

BIBLIOGRAPHY

CSIR – Corpus Signorum Imperii Romani

BIDWELL, P. T. 1979 *The legionary bath-house and basilica and forum at Exeter*, Exeter Arch. Rep. 1.

BIDWELL, P. T. 1997 'The *schola labrum* and the west wall of the bath-house at Chesters', note in Bidwell, Snape and Stobbs, *Research leading to the Segedunum bath house reconstruction* Segedunum Museum.

BIDWELL, P. T. 2010 'A survey of the Anglo-Saxon crypt at Hexham and its reused Roman stonework', *AA*[5], 53–145.

BIDWELL, P. T. and HODGSON, N. 2009 *The Roman Army in Northern England*, Newcastle.

BIDWELL, P. T. and HOLBROOK, N. 1989 *Hadrian's Wall bridges*, English Heritage Arch. Rep. 9, London.

BIDWELL, P. T. and SNAPE, M. E. 1993 *The Roman fort at Chesters and its environs*, unpublished documentary survey, English Heritage.

BIDWELL, P. T., SNAPE, M. E. and STOBBS, G. C. 1997 *Research leading to the Segedunum bath house reconstruction*, unpublished archive, Segedunum Museum.

BIDWELL, P. T., SNAPE, M. E. and CROOM, A. T. 1999 *Hardknott Roman Fort, Cumbria*, CW Res. Rep. 9, Kendal.

BIDWELL, P. T. and SPEAK, S. C. 1994 *Excavations at South Shields Roman fort. Vol. 1*, Newcastle.

BIRLEY, E. 1961 *Research on Hadrian's Wall*, Kendal.

BOSANQUET, R. C. 1904 'Excavations on the line of the Roman Wall in Northumberland.1. The Roman camp at Housesteads', *AA*[2], 25, 193–300.

BRAND, J. 1789 *History of Newcastle*, London.

BRANN, M. L. 1985 'Survey of Walls Castle, Ravenglass, Cumbria', *CW*[2], 85, 81–5.

BRODRIBB, G. 1987 *Roman brick and tile*, Gloucester.

BRUCE J. C. 1874 *The Wall of Hadrian: Two lectures*, Newcastle.

BRUCE J. C. 1884 *Handbook to the Roman Wall*, 2nd ed., London and Newcastle.

BRUCE J. C. 1885 *Handbook to the Roman Wall*, 3rd ed., London and Newcastle.

BRUCE J. C. 1978 *Handbook to the Roman Wall*, 13th ed., [ed.] Daniels, C. M., Newcastle.

BRUCE J. C. 2006 *Handbook to the Roman Wall*, 14th ed., [ed.] Breeze, D. J., Newcastle.

BUDGE, E. A. W. 1907 *An account of the Roman antiquities preserved in the Museum at Chesters, Northumberland*, 2nd ed., revised, London.

CLAYTON, J. 1844 'Account of an excavation recently made within the Roman station of *Cilurnum*', *AA*[2], 7, 171–6.

COLLINS, R. 2012 *Hadrian's Wall and the end of Empire*, New York and London.

CROW, J. 1995 *Housesteads*, London.

CSIR: COULSTON, J. C. N. AND PHILLIPS, E. J. 1988 *Corpus Signorum Imperii Romani: Great Britain 1, 6: Hadrian's Wall west of the North Tyne and Carlisle*, Oxford.

DANIELS, C. M. 1959 'The Roman bath house at Red House, Beaufront, near Corbridge', *AA*[4], 37, 85–176.

DAVID ASH PARTNERSHIP 2001 'The Roman bath-house reconstruction at Segedunum, Wallsend', *Practical Archaeology* 4, 25–7.

DE LA BÉDOYÈRE, G. 1991 *The Buildings of Roman Britain*, London.

DORE, J. N. 2010 *Halton Chesters: Excavations directed by J. P. Gillam at the Roman fort 1960–61*, Oxford.

FERRIS, I. M. 2010 *The beautiful rooms are empty: Excavations at Binchester Roman fort, County Durham 1976–1981 and 1986–1991, vols 1 and 2*, Durham County Council.

FORSTER, R. H. 1908 '*Corstopitum*. Report of the excavations in 1907', *AA*[3], 4, 205–303.

GIBSON, J. P. 1903 'Excavations on the line of Hadrian's Wall: 3. Great Chesters (*Aesica*)', *AA*[2], 24, 19–64.

GILLAM, J. P. 1956–8 *Notes on work at Chesters bath house*, unpublished archive, Discovery Museum, Newcastle.

GILLAM, J. P. AND JOHNSON, J. S. 1985 *Transcript of an interview conducted by Stephen Johnson*, unpublished, English Heritage archive, Swindon (copy in Bidwell, Snape and Stobbs, 1997, Segedunum Museum).

GILLAM, J. P, JOBEY, I. M. and WELSBY, D. A. 1993 *The Roman Bath-house at Bewcastle, Cumbria*, CW Res. Rep. 7, Stroud.

GOODBURN, R. 1979 'Roman Britain in 1978', *Britannia* 10, 288.

GRIFFITHS, W. B. 2008 Segedunum *Roman fort, baths and museum*, 2nd ed., rev. Bidwell, P. T. and Woodward, G. N., TWAM guidebook, Newcastle.

HODGSON, N. 2011 *Chesters Roman fort*, English Heritage Guidebook, London.
HODGSON, N. 2014 'WallQuest: Hadrian's Wall and its legacy on Tyneside: the second year', *Hadrian's Wall Archaeology*, Issue 5, Durham County Council, 5–9.
HODGSON, N. 2015 'WallQuest: Hadrian's Wall and its legacy on Tyneside: the third year', *Hadrian's Wall Archaeology*, Issue 6, Durham County Council, 21–5.
HOLMES, S. 1886–7 'On a building at *Cilurnum* supposed to be a Roman baths', *AA*[2], 12, 124–9.
JACKSON, W. 1883 'An account of some excavations made at Walls Castle in 1881', *CW*[1], 6, 216–24.
JOHNSON, S. J. 1990 *Chesters Roman fort*, English Heritage Guidebook, London.
MACDONALD, G. 1931 'The bath-house at the fort of Chesters, (*Cilurnum*)', *AA*[4], 8, 219–304.
MACDONALD, G. and CURLE, A. O. 1928–9 'The Roman fort at Mumrills, near Falkirk', *PSAS*, 63, 396–575.
MASON, D. J. P. 1990 'The use of earthenware tubes in Roman vault construction: an example from Chester', *Britannia* 21, 215–22.
MASON, D. J. P. 2013 'New excavations at Binchester: Results of the 2013 season', *Hadrian's Wall Archaeology*, Issue 4, Durham County Council, 13–24.
MASON, D. J. P. 2014a 'Vinovia: 'A buried Roman city in the county of Durham?'', *Current Archaeology* 291, 32–7.
MASON, D. J. P. 2014b 'New excavations at Binchester: Results of the 2014 season', *Hadrian's Wall Archaeology*, Issue 5, Durham County Council, 10–25.
MASON, D. J. P. 2015 'New excavations at Binchester: Results of the seventh and final season', *Hadrian's Wall Archaeology*, Issue 6, Durham County Council, 26–38.
RIB: COLLINGWOOD, R. G. and WRIGHT, R. P. 1965 *The Roman inscriptions of Britain*, Vol. 1, Oxford.
ROY, W. 1793 *The military antiquities of the Romans in North Britain*, London, 197–9.
RUSHWORTH, A. 2009 *Housesteads Roman fort — the grandest station. Excavation and survey at Housesteads 1954–95, by Charles Daniels, John Gillam, James Crow and others*. English Heritage, London, vol. 1.
SIMPSON, G. 1956–77 *Record Book: Chesters Museum*, unpublished notebook, Corbridge Museum.
SNAPE, M. E. 1999 'The baths', in P. T. Bidwell (ed.) *Hadrian's Wall 1989–1999*, Kendal, 117–119.
TAYLOR, D. J. A. 2000 *The forts on Hadrian's Wall. A comparative analysis of the form and construction of some buildings*, BAR Brit. Ser. 305, Oxford.
WELSBY, D. A. 1980 'Roman building inscriptions, recording buildings collapsed though age or destroyed by the enemy?', *AA*[5], 8, 89–94.
WELSBY, D. A. 1993 'The metrology of the baths', in Gillam, Jobey and Welsby, *The Roman Bath-house at Bewcastle, Cumbria*, CW Res. Rep. 7, Stroud, 24–6.
WILMOTT, T. 1997 *Birdoswald. Excavations of a Roman fort on Hadrian's Wall and its successor settlements: 1987–92*, English Heritage Arch. Rep. 14, London.
WILSON, R. J. A. 2002 'Roman vaulting tubes (*tubi fittili*) from Chesters', *AA*[5], 30, 180–5.
WILSON, R. J. A. 2003 'Roman vaulting tubes (*tubi fittili*) from Chesters; an addendum', *AA*[5], 31, 192–3.
YEGÜL, F. K. 1992 *Baths and bathing in classical antiquity*, New York.
YEGÜL, F. K. 2010 *Bathing in the Roman World*, New York.

Margaret Snape, October House, 6 Vernon Green, Bakewell, DE45 1DT.

colin.snape1@btinternet.com

Graeme Stobbs, 47 Hewitson Terrace, Gateshead, NE10 9HQ.

graeme.stobbs@gmail.com