

City of Hereford Archaeology Unit

SALTFORD BRASS BATTERY MILL SALTFORD AVON



SECOND INTERIM REPORT

September 1994

Hereford Archaeology Series 220

**SALTFORD BRASS BATTERY MILL
SALTFORD
AVON**

NGR: ST 687 670

SECOND INTERIM REPORT

Text

G Adrian G Griffiths *BA*

Illustrations

Steve Macklin

Site Work

Tim Hoverd *BA PIFA*

Photography

Ken Hoverd

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City of Hereford Archaeology Unit

This report is produced by the

City of Hereford Archaeology Unit

TOWN HALL HEREFORD HR1 2PJ

Tel. (0432) 268121 ext. 310

Tel and Fax (0432) 342492

for:

English Heritage

23 Savile Row

London

W1X 1AB

The City of Hereford Archaeology Committee (Director: Ron Shoesmith) was founded in 1974 and is a registered charity. It operates through the City of Hereford Archaeology Unit, which has a permanent staff of ten people. Besides dealing with the buried archaeology of Hereford - an important Saxon city dating back to the seventh century - the Unit has specialised in recent years in the archaeological recording and analysis of standing buildings. This work has usually been on a commission basis on behalf of English Heritage or developers and the Unit now has considerable experience in this field.

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SALTFORD BRASS BATTERY MILL
SALTFORD
AVON

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Second Interim Report

Synopsis

An outline survey of Saltford Brass Battery Mill has resolved this complex industrial site into four major phases of construction and use, indicating the development and growth of the mill from its eighteenth century origins to its gradual decay this century.

1 Introduction

Saltford Brass Mill lies on the south bank of the River Avon between Bristol and Bath. It was in Somerset until 1974 but since then has been in the County of Avon. The mill is the best preserved complex related to the once flourishing Bristol Brass industry. Because of its local and national importance it was scheduled as an Ancient Monument on the 27th February 1986 (Avon 185). The main buildings on the site were already listed Grade II.

For many years the buildings have been in a poor state of repair, though a programme of restoration has been planned for some time. The first section to be restored by the present lessees of most of the site, the Avon Industrial Buildings Trust, was the area around the north annealing kiln. Since then plans have been made for further repair work to the fabric and it was agreed that an archaeological assessment of the whole structure was needed in advance of such work. In December 1992 the City of Hereford Archaeology Unit produced a consultative report on Saltford on the survey work already available. This also provided an outline assessment of the structure and recommendations for future research priorities (Morriss, 1992).

In 1993 agreements were reached to repair the rest of the fabric of the mill and scheduled monument consent was granted in August. In advance of this repair work an archaeological survey and analysis of the building was commissioned from the Hereford Unit by English Heritage. This work started in March 1994. It was carried out in close co-operation with the Avon Industrial Buildings Trust and with their appointed architects, Niall Phillips of Bristol.

Soon after the site work commenced, it became apparent that the many loose timbers lying in heaps on the ground needed urgent analysis, recording, and salving. These timbers included

most of the roof structure that had formerly covered the north-eastern portion of the complex, and the balance beam arrangement that served the east annealing kiln. From the survey and study of these timbers it would be possible to recreate, on paper, the roof structure, and to understand exactly how the balanced beam had operated. It was agreed by all parties at that time that this additional recording work was vital to the overall success of the project. A decision was therefore made that the Archaeology Unit should record these timbers, and liaise with the architects over the proposed reconstruction of the roof and balance beam.

Unfortunately, the funding for the initial survey and analysis had already been agreed and no additional funding was available to pay for this unexpected additional work. This meant that at least some survey work elsewhere in the complex would have to be abandoned or down-graded. The extent of the survey work had always depended on the amount of scaffolding available for the less accessible areas. As such scaffolding was not available during the timespan of the survey, some areas could not be surveyed in detail. These areas were those parts immediately next to open leats - including most of the west wall of the site and the western end of the south side. These areas were surveyed only in outline, with individual features picked out where possible.

The roof trusses had been assessed in the first report and were re-examined as part of the main project. These would have required scaffolding for a more detailed survey, and it is doubtful if any significant information would have resulted. It was therefore decided that the existing updated survey drawings were of sufficient quality to stand and so only those trusses on section-drawing lines were drawn by the Unit. Finally, to stay within the budget parameters, the northern portion of the complex, around the restored north kiln, was surveyed only in outline. The lower reaches of the kiln itself had been surveyed by the AIBT previously. The upper sections require scaffolding and have not been surveyed.

2 Outline History

Brass manufacturing has a long history in western Europe and was used during the early 13th century for the manufacture of ornamental church brass-wares. Brass sheet for this purpose was imported from Cologne in Germany, from where its name 'cullen' was derived (Goodall 1981 63). There is little evidence of primary brass processing in Britain before the end of the 17th century. This situation was given serious attention from various governmental agencies in an attempt to establish an indigenous industry. In 1684 state monopolies were held by The Society of Mines Royal and the Society of Mineral & Battery Works. Following the ending of these, a British based industry did start to emerge. The Bristol region was involved from an early stage and Abraham Darby had established one of the first brass mills in the region, at the start of the 18th century.

The river Avon was presumably an ideal location for this type of industry. Transport facilities for the necessary raw materials (such as copper from Cornwall and calamine from the Mendips) were provided via the Bristol Channel and the river. Plentiful supplies of water to drive the under-shot wheels, were also supplied by the river. This combination permitted the industry to develop on a number of sites between Bristol and Bath during the 19th century, including Keynsham, Kelston and Warmley.

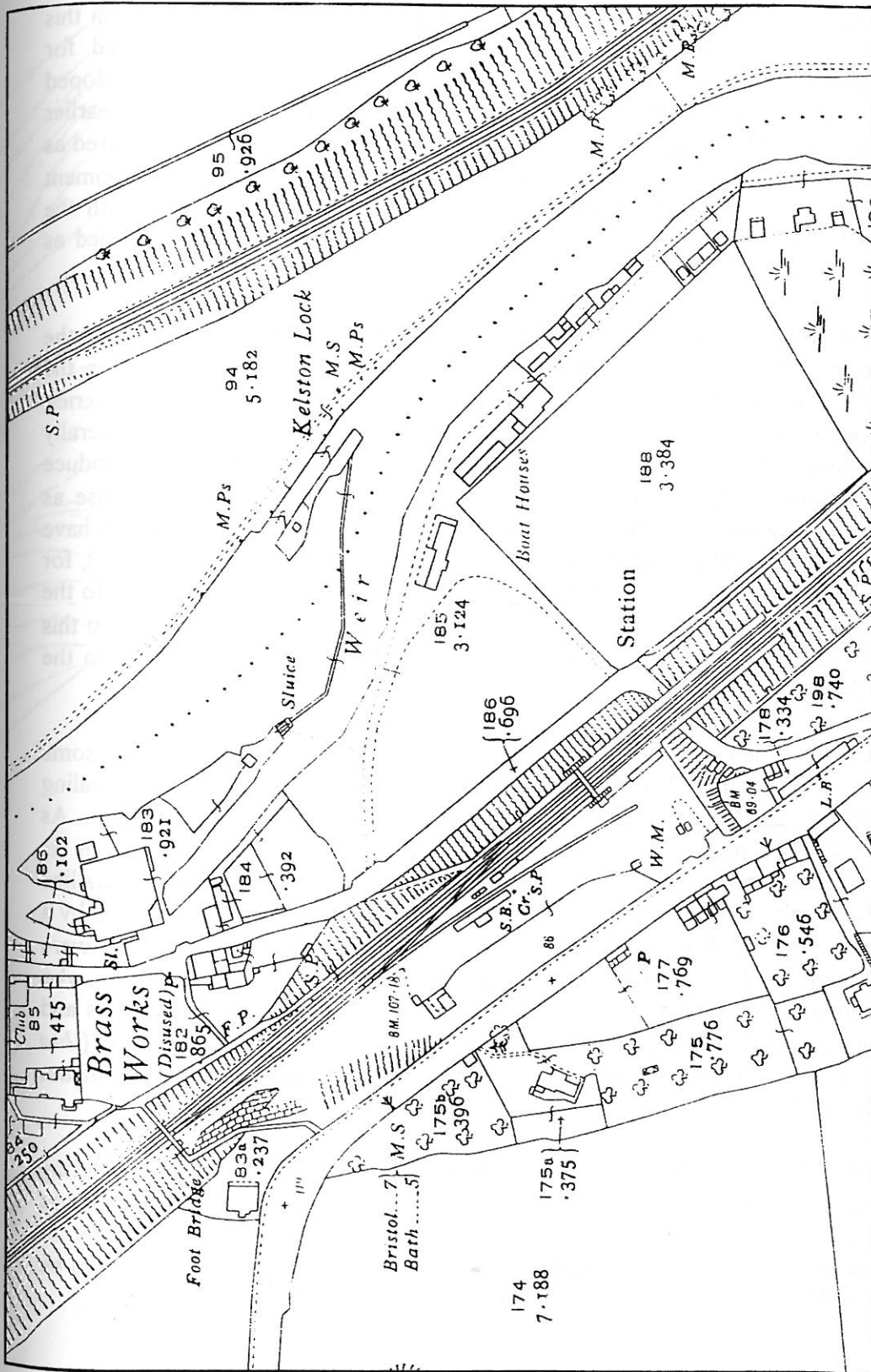


Fig. 1 Salford Brass Battery Mill
 Extract from the 1932 1:2500 OS map

Mill Island appears to have had a long history as a mill site. Prior to its association with brass manufacturing, which commenced during the 18th century, the site may have been connected with cloth-processing or perhaps corn-milling. It is significant that at each lock site on this part of the river Avon, the lock and weir facility appears to have been utilized for water-powered manufacturing. In particular this occurred at Mill Island with what developed as the local brass-industry and Saltford weir would appear to have existed in an earlier context than its present form. A significant re-development would doubtless have occurred as part of the process of extending the Avon navigation upstream to Bath. (This development was important to the Saltford site for the early part of its history was concerned with the processing of cast brass plates brought upstream from Bristol and subsequently returned as processed sheets).

Brass processing at Saltford appears to have started after the 18th century, following the leasing of the site in 1721 by the Bristol Brass Company. Initially this concentrated on the production of sheet-brass utilizing heavy tilt-hammers. As these were known as 'batteries' the mills themselves became known as 'battery mills'. The heavy brass plates were generally transformed into thinner sheets by a variety of hammers. Brass sheet was then used to produce either brass wire for use in the paper and woollen industries, or hollow wares for use as domestic cooking implements. The heavy tilt hammers used for flattening, appear to have been replaced during the late 18th century by the introduction of rolling machinery (rolls), for rolling the brass plates. The use of the smaller hammers however continued in relation to the production of hollow brass-wares. Processing on this basis seems to have continued into this present century. The north annealing kiln appears to have been largely operational into the 1920s (Day 1979 36).

The development of the brass industry in the region seems to have been innovatory in some important respects. In particular this concerned improvements in the process of annealing during the 18th century, particularly in association with Nehemiah and William Champion. As an essential part of brass processing the metal required annealing. This consisted in its repeated heating in order to render it into a malleable state without damaging its crystalline structure. Initially this involved the use of the charcoal-fired kiln that was later replaced by a more cost effective coal-fired kiln, once the problems of sulphur contamination were satisfactorily overcome. This was achieved during the 1760s by William Champion who developed the improved 'muffle' kiln. This restricted the furnace gases to the side walls and roof of the furnace, avoiding the use of the separate containers that were previously used (*ibid* 34). The introduction of the coal-fired annealing process would have represented a significant development at the Saltford works.

In the later stages and probably before, the heavy furnace doors were operated by a lifting mechanism. This consisted of a longitudinal beam balanced on a pivot-beam which was located across the front of the kiln. Compact heavy-duty trolleys were used in order to transport the brass from one place to the next. A revolving turntable enabled the kilns to be loaded from a point directly in front of the kiln door (Day 1976 22).

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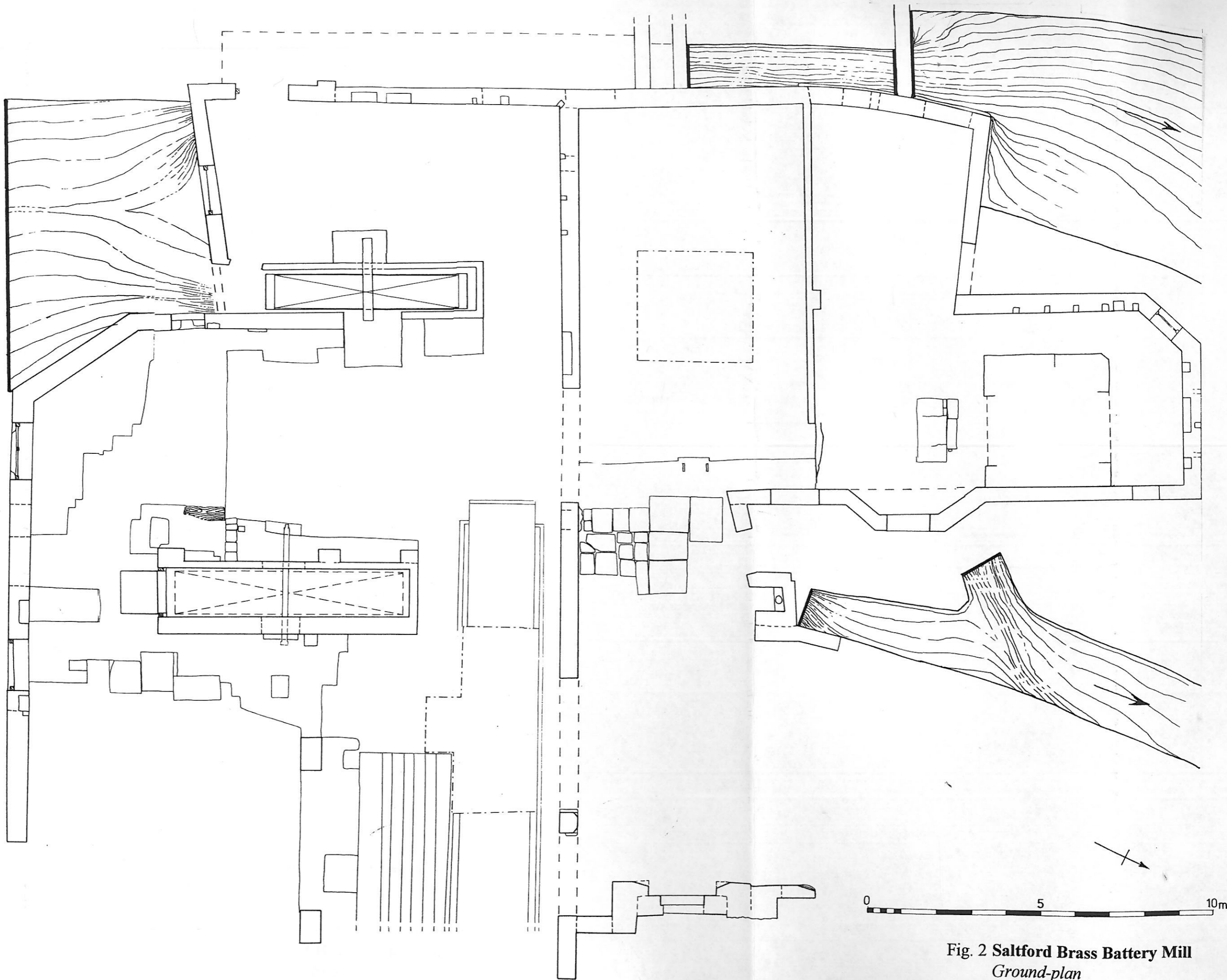


Fig. 2 Saltford Brass Battery Mill
Ground-plan

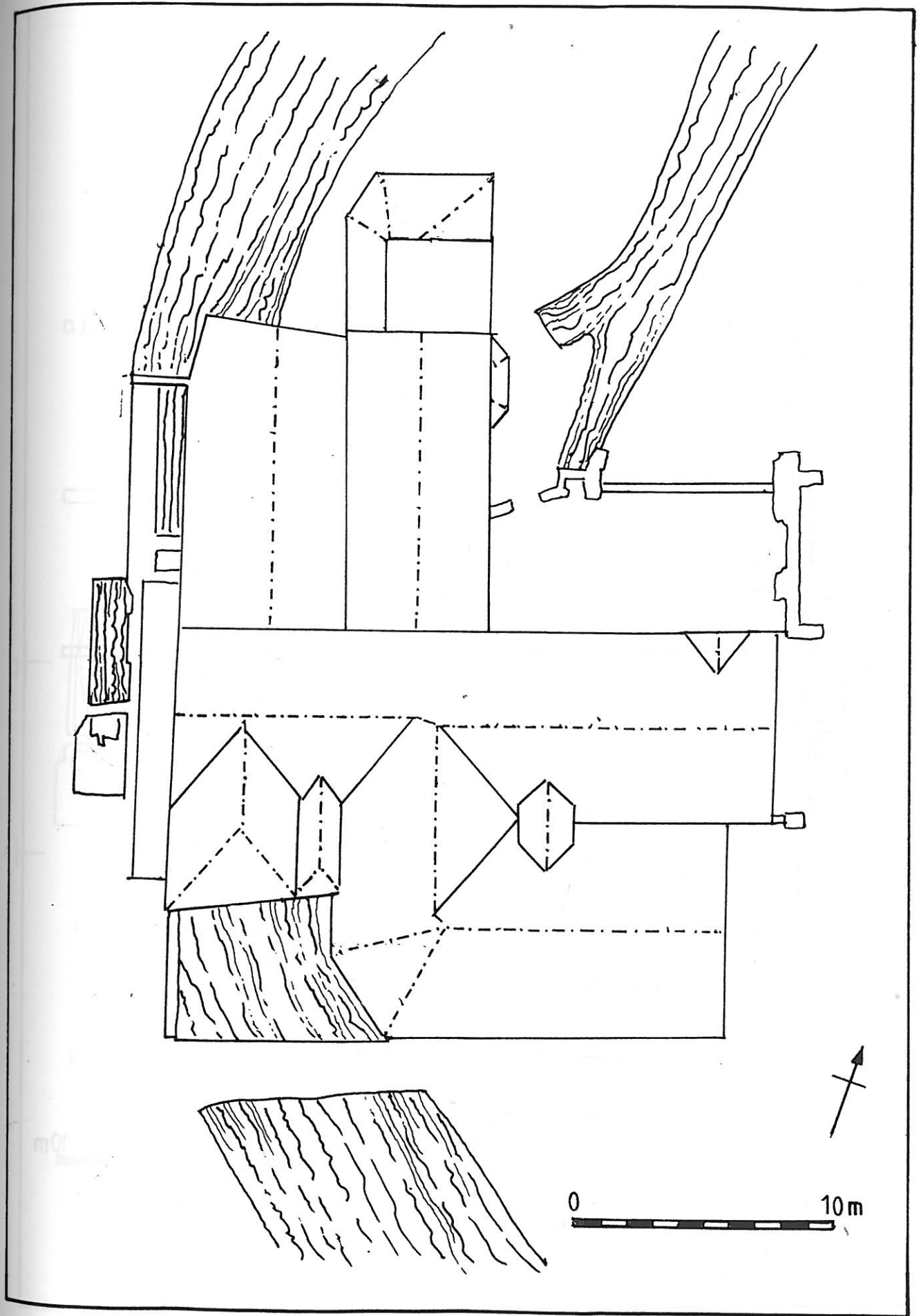


Fig. 3 Saltford Brass Battery Mill
View of Roof Alignments

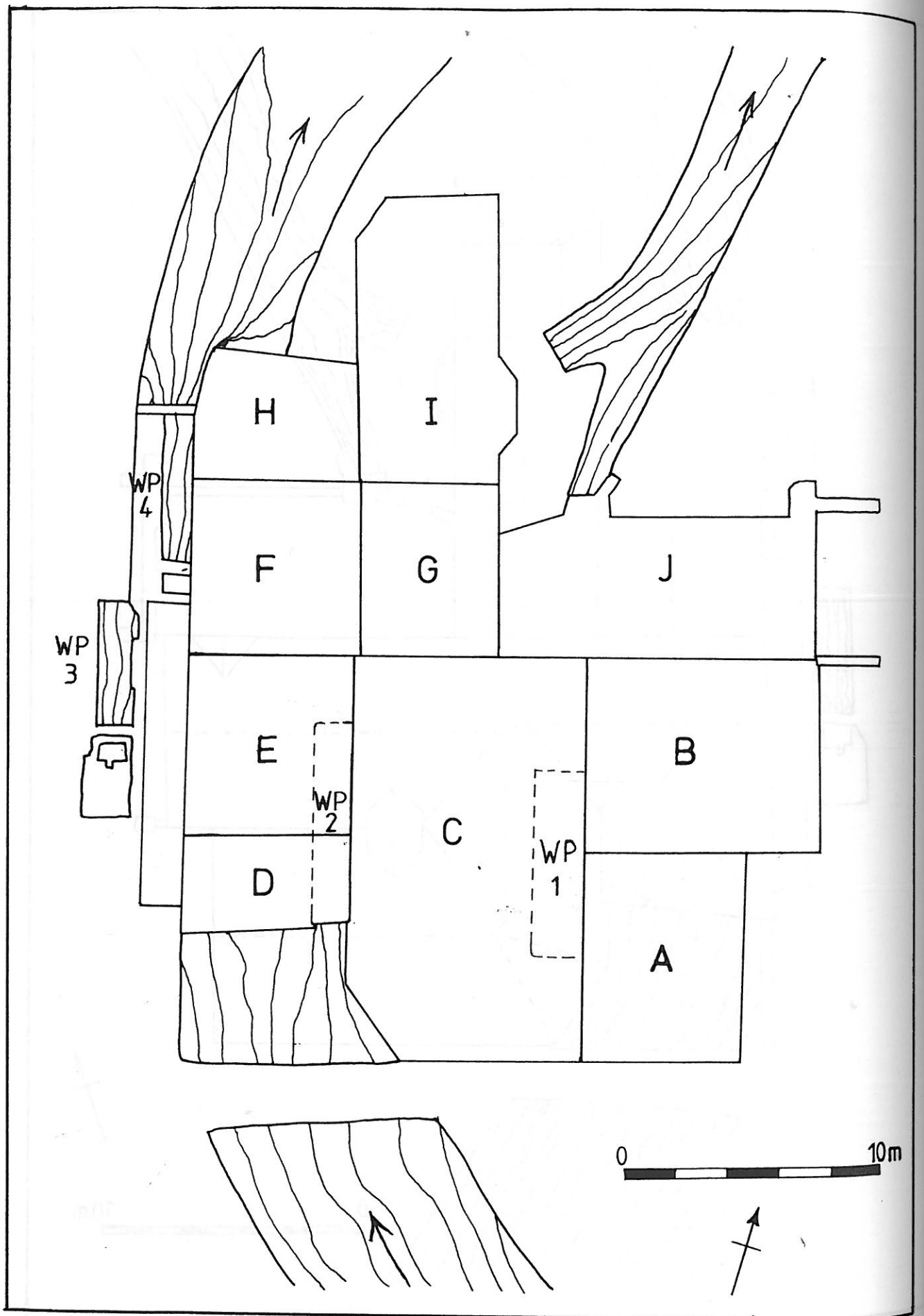


Fig. 4 Saltford Brass Battery Mill
Location of Areas A-J

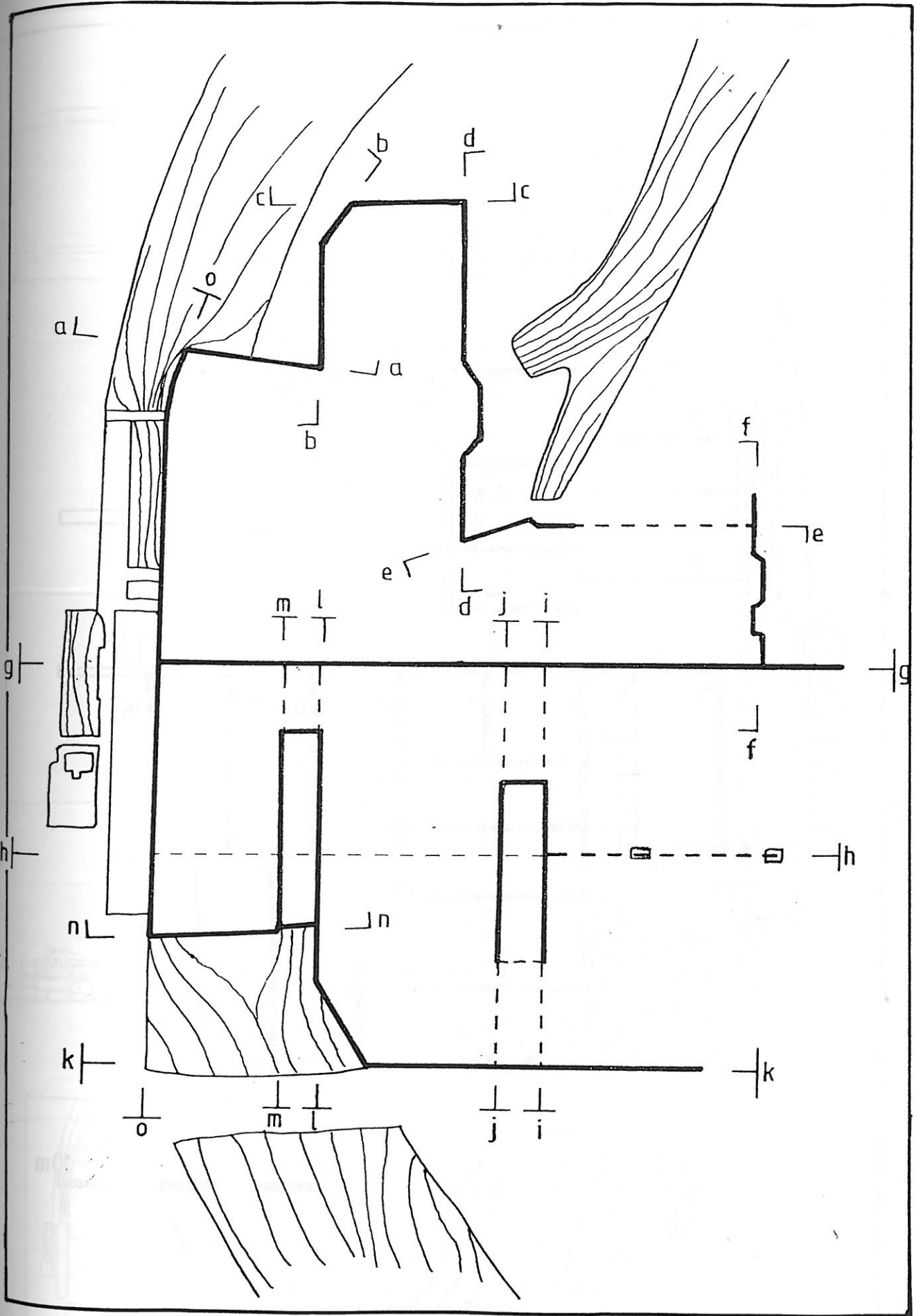


Fig. 5 Saltford Brass Battery Mill
 Location of Elevations a-o

Mill

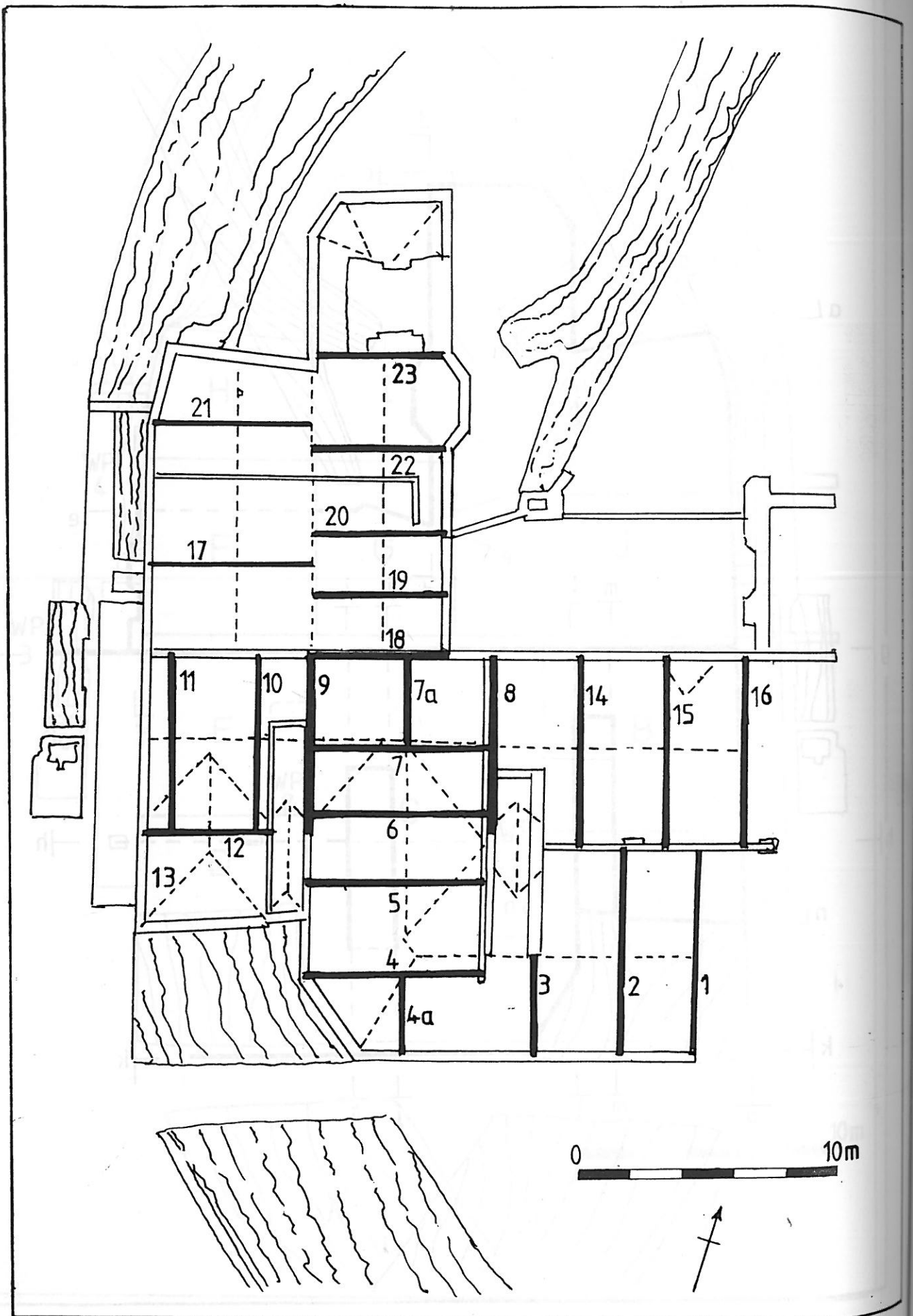
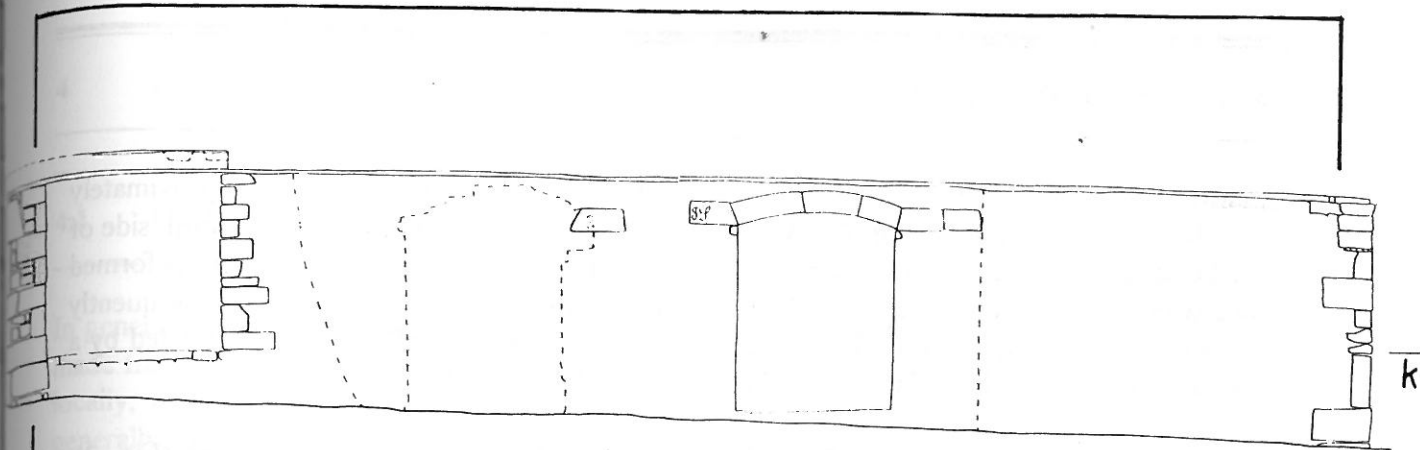
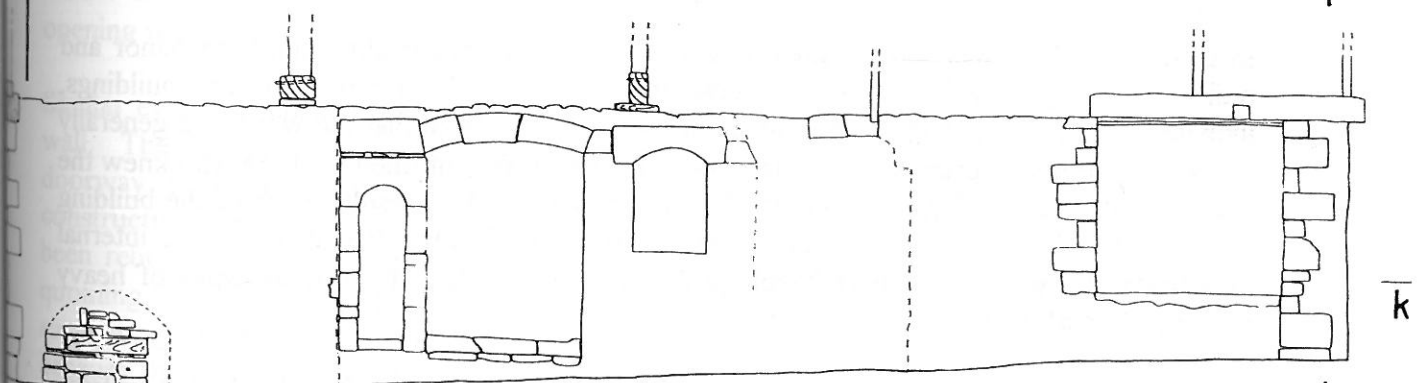


Fig. 6 Saltford Brass Battery Mill
 Location of Roof Trusses Nos 1-23



a South external elevation



b South internal elevation

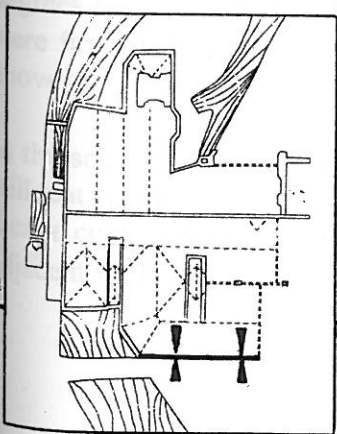


Fig. 7 Saltford Brass Battery Mill
Areas A & C, Internal and External elevations

Mill
Nos 1-23

3 Outline Description

Saltford Brass Mill is located on a small plot of land that forms an island of approximately 0.27 hectares (1.23 acres) (*Fig. 1*). Access is by a small stone-built bridge on the south side of the buildings. The River Avon forms the eastern boundary. The western boundary is formed by a wide leat taken off the river at the large weir a little to the south. This race subsequently rejoins the river to the north. The water supply to various parts of the mill is regulated by a series of sluices and channels that pass beneath the buildings.

The mill consists of a number of closely-grouped and linked rectangular buildings (*Fig. 2*). The complex would perhaps be more accurately described as a brass factory, although relatively little of the manufacturing apparatus survives. Overall the complex is approximately 33m (120ft) from north to south, by 24m (80ft) from east to west. The buildings are generally stone-built and single-storey, with pantile roofs. Most of the roofs are gable-ended but some have hips. The gables towards the eastern half of the complex are aligned east to west, whilst those to the west tend to be aligned north to south (*Fig. 3*).

The main surviving evidence for the brass manufacturing industry essentially consists of four, possibly five wheel pits. Each took an undershot water-wheel. One has the remains of a water-wheel (No1) whilst the other contains a fully restored wheel (No2) linked to a small saw-bench and an early 20th century electricity generator. In addition, there are the remains of an annealing kiln in the eastern area and a restored annealing kiln to the north. There is also evidence for a third kiln in the western area. A small detached building approximately 180m (60yds) away to the south contains water-powered grinding stones. These are powered off another sluice-controlled leat.

In general the buildings show a great deal of evidence of regular alteration both minor and radical. Consequently both the structural and functional development of the buildings, individually and as a group, is difficult to interpret. It is notable that the work was generally carried out 'in-house' using skills available on-site. This was confirmed by those who knew the mill when it was working (pers. comm. RW Headington). As a result much of the building work is of a distinctly ad-hoc nature. An additional problem is that much of the internal masonry and therefore much archaeological evidence, is hidden by various types of heavy coatings such as lime-wash and render.

For reference purposes the individual Areas of the complex are here referred to by letters from A to J (*Fig. 4*) and the elevations drawn are numbered from a to o (*Fig. 5*). These letters also relate to the various groups of truss types that form the respective roof-structures. The roof-trusses are also individually numbered from one to twenty-three (*Fig. 6*).

4.1 The Southern Elevations

In general the masonry walling within the complex consists of loosely coursed random rubble, made from a Jurassic lias limestone. This relatively good quality building stone was obtained locally, as is confirmed by its frequent use within vernacular houses in the area. This is generally bedded in a mortar made from lime and a fine aggregate which contains flecks of charcoal included from the production of the lime. The quoining predominantly embodies good quality freestone ashlar blocks (probably oolitic limestone) again of local origin. These were either quarried from the immediate vicinity, or perhaps from the extensive quarries around Bath. The use of freestone quoining is shown most clearly in the south and south-westerly facing areas of walling. In particular this applies to the external walls of Areas A and C (*Fig. 7*). Other parts of the complex utilize blocks made from copper-slag, a waste by-product of the local brass industry.

In the south wall of Area C (*Fig. 7*), an existing doorway in the eastern end notably has a segmental arched-head. Surviving remnants also indicate that two, possibly three, similar openings existed in this stretch of walling, all of which are now blocked. At the west end of this wall there is a large multi-paned, oak-framed, casement window. Its outer lintel is formed by the oak wall-plate (on which the roof-rafters terminate) whilst the internal lintel is formed by a large oak baulk. The upper part of its western jamb contains copper-slag blocks and what is possibly a disused ashlar arch-springer, indicating that the window is secondary. Below the sill level in line with the jamb, a construction break possibly suggests that the opening was previously a doorway.

Similar evidence indicates that two further openings also previously existed in this southern wall. The first opening is located approximately central between the west window and the doorway to the east. The second is 0.90m (3ft) to the east of the doorway. At this point a construction break exists and the masonry from here to the end of the wall appears to have been rebuilt. At the east end, the wall seems to end abruptly and is finished with ashlar quoining. The quoining here is not very well-constructed and is assumed to be secondary, suggesting that the wall previously did not end at this point. This suggestion is reinforced because the eastern face of the complex contains two gable-ends which are presently entirely open with their exposed wall-plates extending eastwards.

The roof above this area, as with the rest of the complex has a pitch of approximately 45 degrees and is covered with pantiles. This reflects a regional tradition, for in Britain pantiles were first made in the late 17th century in Bridgewater. There is a roof-light immediately above the western window, providing additional light to Area C.

In the southwest corner of Area C, the south wall turns at an angle following the line of the mill-leat (*Plate 1*). Here, as in most parts, the leat walls are built in stone. The southern facade continues to the west as part of Area D, by forming an area stepped back to the north, adjacent to the watercourse. The water passes under the west corner via a culvert formed by a

particularly low stone-arch. This arch in turn is intersected, seemingly precariously, by a further low arch. This supports the ground-way leading to the western part of the complex under which the watercourse continues.

In this wall there is an early industrial mullioned window, with over-lapped panes set in a recess with a segmental arched head, which seems to be primary. Its recess contains a number of copper-slag blocks. In the corner to the east of this, an arched opening gives access to a sluice-gate and the restored iron undershot water-wheel. Next to this in the west wall of Area C, there is a small opening with an arched-head constructed without springers. This means that the water-wheel can be operated and observed from within Area C. In general, Area D appears to be a later build than Area C and the acute angle at which Area D meets C seems to support this suggestion. There are two small hipped roofs to Area D, these protrude at right-angles from a gable-ended roof towards the north, above Area E.

4.2 The Western Elevations

On the western side of the complex the upstanding walling is more varied and generally cruder in construction (*Fig. 8*) (*Plate 2*). It is also clearly of several phases. The west wall of Area D contains a poorly constructed doorway with jambs made from copper slag blocks and a reused oak lintel. Above the lintel there is a single course of copper-slag blocks on which the wall-plate is located. Although the doorway looks primary to the wall, the poorly-fitting ledged door is at best secondary. To the north there is narrow masonry projection made from lias limestone which seems to be the remains of an earlier wall aligned east to west. This is now part of a complex gable-end wall of Area E that includes several phases of construction. The lower part is constructed from copper-slag blocks with a large semi-circular ashlar wheel-arch to the north side, now filled with rubble masonry. The upper part of this gable contains lias rubble masonry with the stub-end of an oak beam at wall-plate level.

To the north of this, the walling (as part of Area F) is now higher but shows signs of having been raised in height at some time. Immediately to the north of the gable wall of E, there is a filled doorway with a segmental brick head, which intrudes into this gable. Approximately 1.50m (5ft) to the north of this there is a vertical construction break beyond which the masonry is noticeably more regular in construction. This continues for about another 4.20m (14ft) to another break. There is a small blocked opening, which is probably a wheel-arch, towards the north of this section of masonry. The rubble masonry beyond this point relates to Area H and seems to be of a Carboniferous lime-stone. There is a return at the north end, beyond which is the tail-race. This north-western area includes the pit locations of three or possibly four, under-shot water-wheels. There is substantial archaeological and documentary evidence for a building or buildings to the west, adjacent to the road.

4.3 The Northern Elevations

The northern area is in close proximity to the water-courses, which re-emerge as tail-races at this point. Towards the east side, one emerges to separate this area from the eastern parts of the complex. On the west bank of the main eastern tail-race there is evidence for a bridge.

This area includes the restored northern annealing kiln and part of Areas G, H, and I (Figs. 9 & 10). Externally the building fabric in this area appears to be more homogeneous and less subject to alteration than the rest of the complex. Ashlar quoining is more predominant and the use of copper slag is significantly less evident. It is notable that apart from the immediate vicinity of the kiln, the walling here reaches a greater height than in other areas.

External access to the north-west is presently via a door through the north wall of Area H which has a segmental brick head. In the north-west end of the kiln area there is a window with a segmental ashlar head. This has a pegged transomed oak frame with a lightly moulded edge and is similar in construction to the window in Area D to the south. The infilled masonry below the sill shows that this was previously a doorway. There is a similar window located in the east wall opposite, which appears to be primary.

In the north wall there is a stone arch at low level that seems primary and presumably relates to the operation of the kiln, possibly for fuel access. There are two more oak framed windows in the east walls of Areas G and I that also have segmental brick heads. That in Area I is located in a bay area immediately to the east side of the kiln front. To the south of this there is a return projecting to the east which forms the north wall of Area J (Fig. 11).

A doorway leads into the western part of Area J through the north wall. Immediately to the east of the door, there is a latrine which is constructed directly over the tail-race. At a point slightly east of this there is a construction break marked by quoining which using copper-slag blocks. There is also a construction break to the west where the wall abuts with Area G. The wall turns north-east after the quoining but ceases soon afterwards. The line of the north wall of J consists of an open area that ends with the remains of the east kiln (Fig. 11). The open area is bridged by an oak beam. Previously this beam formed the wall-plate for the roof which covered Area J. In the roof above the northern kiln area there is a louvred vent and there is a hipped-end to the northern part of the roof.

4.4 The Eastern Elevations

The east face of the complex is partly obscured by a modern bungalow to the north-east. This area is presently roofless with the remains of the east kiln to the east end. An inscription in the kiln masonry is dated 1836, marking the building of this section of the Great Western Railway.

The other two east facing areas are A and B, which have open gable-ends which end abruptly. Area B extends approximately 1.20m (4ft) further east than Area A, to a point that aligns with the east kiln.

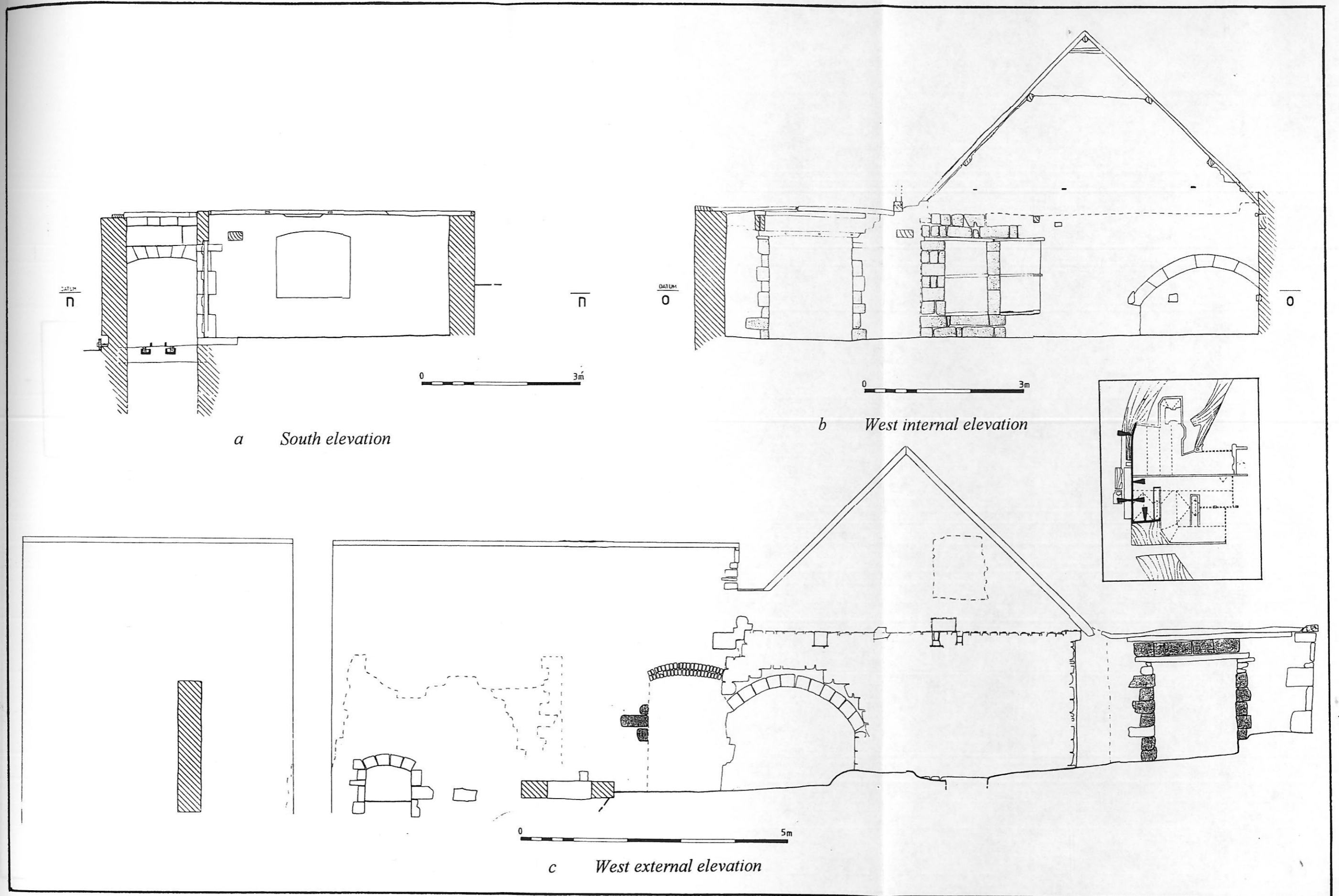
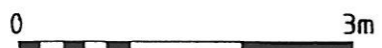
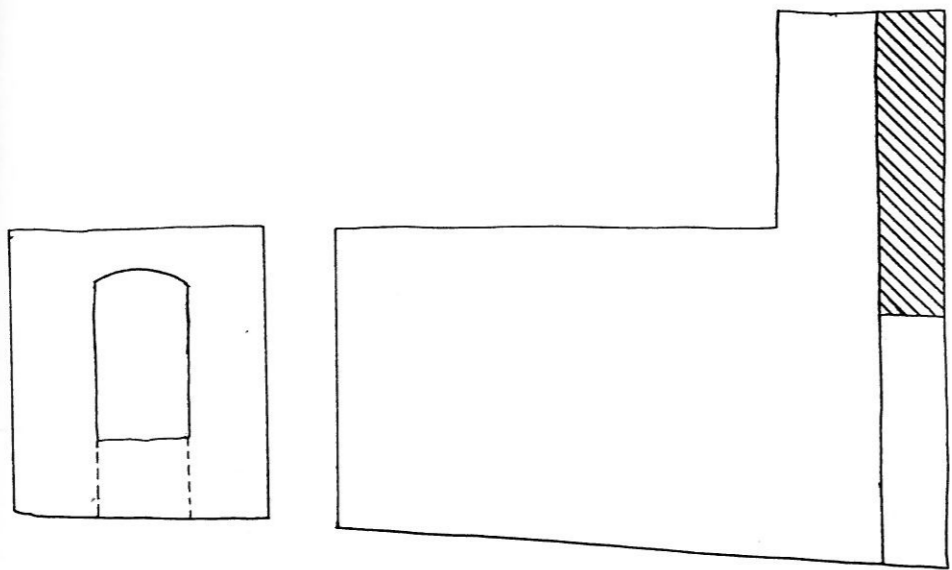
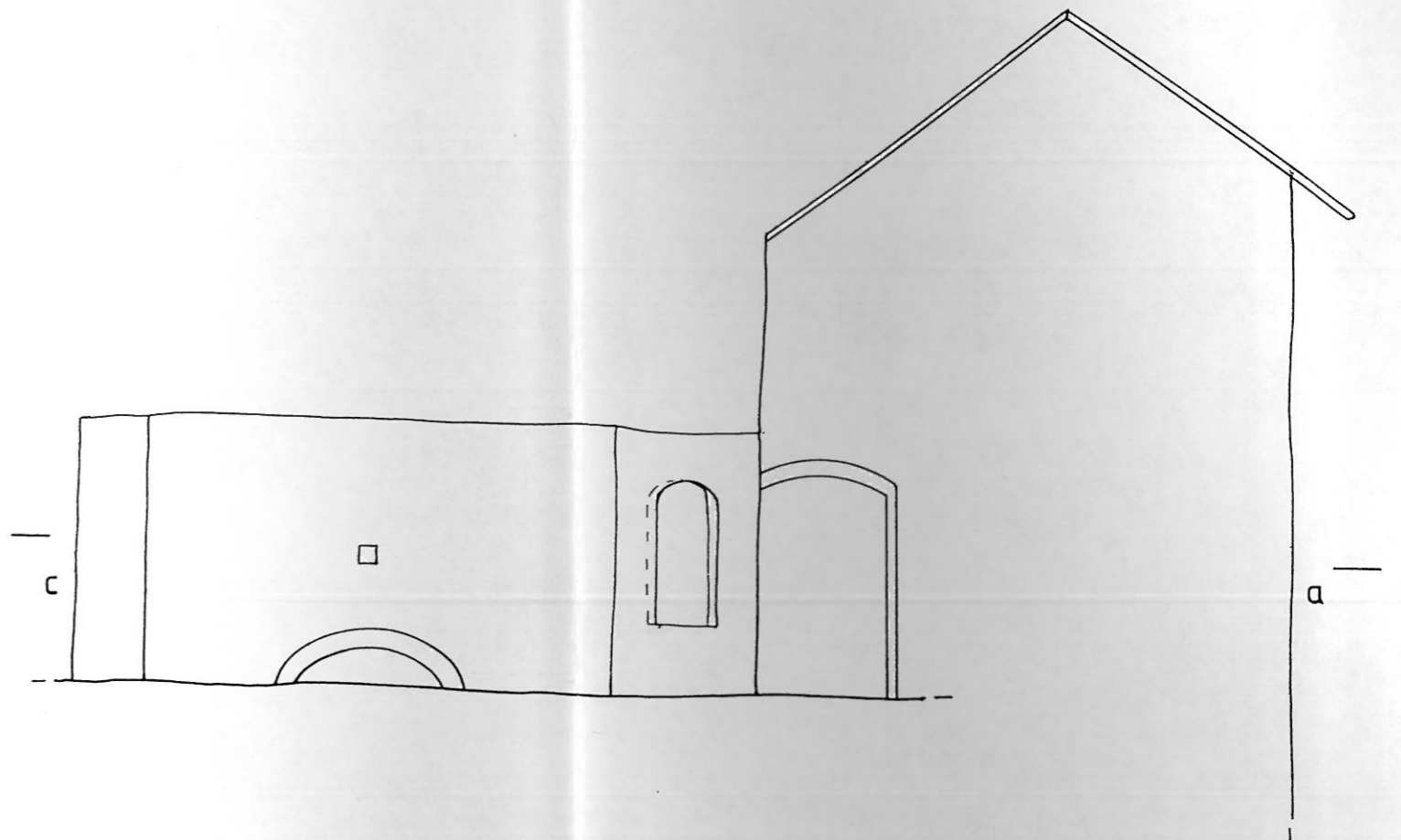


Fig. 8 Saltford Brass Battery Mill
 Areas D & E, Internal and
 External elevations



a West elevation



b North elevation

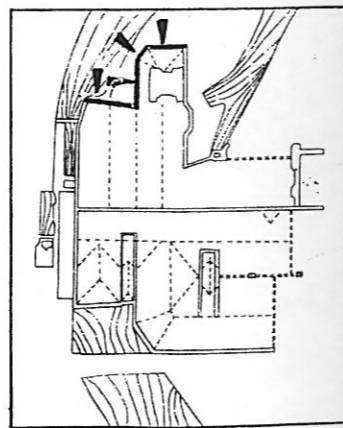


Fig. 9 Saltford Brass Battery Mill
Areas H & I, External elevations

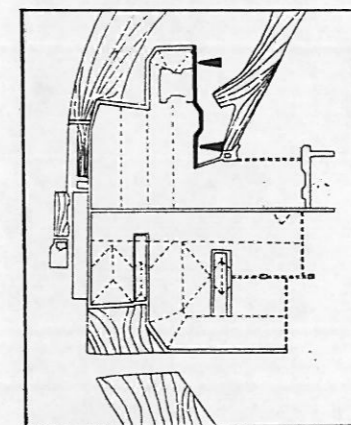
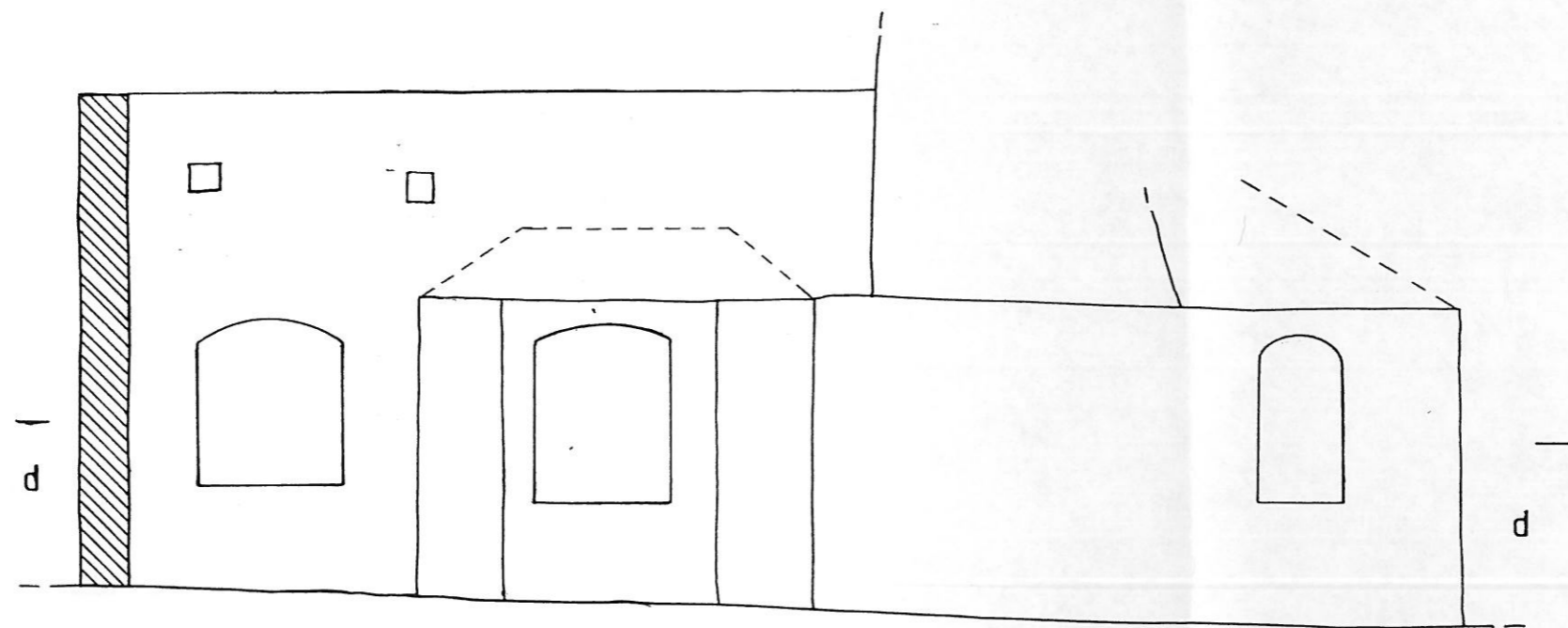
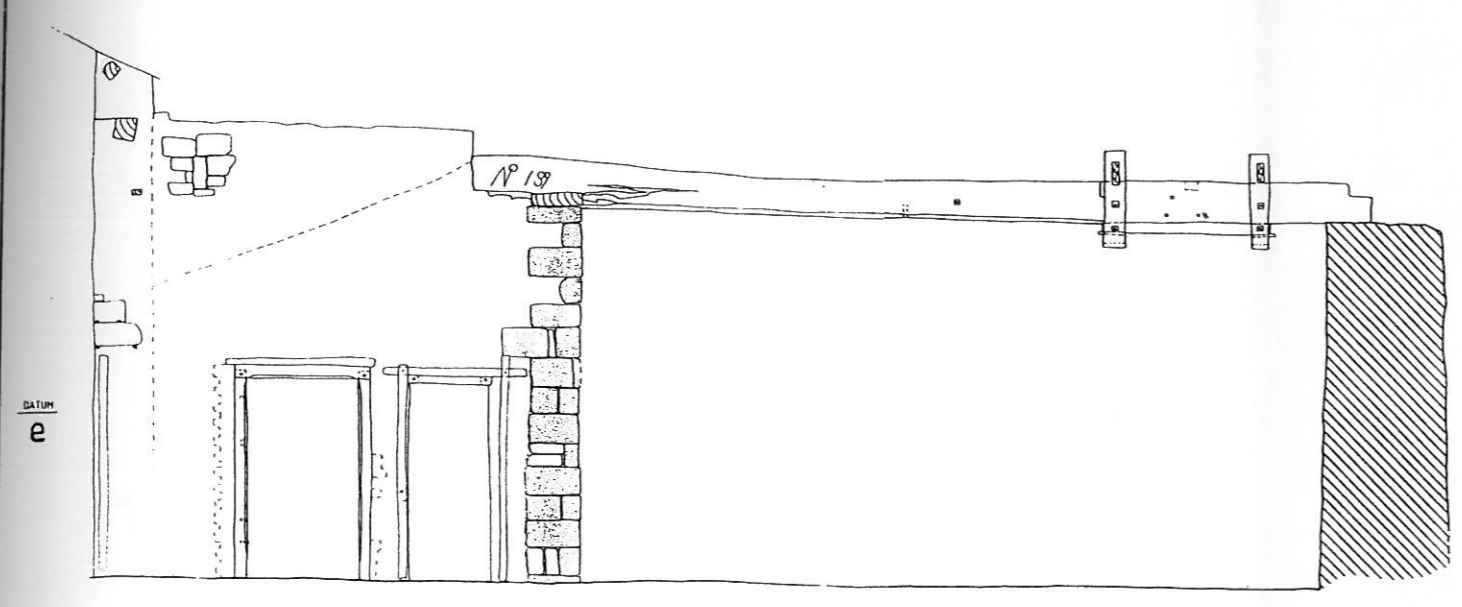
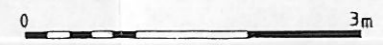
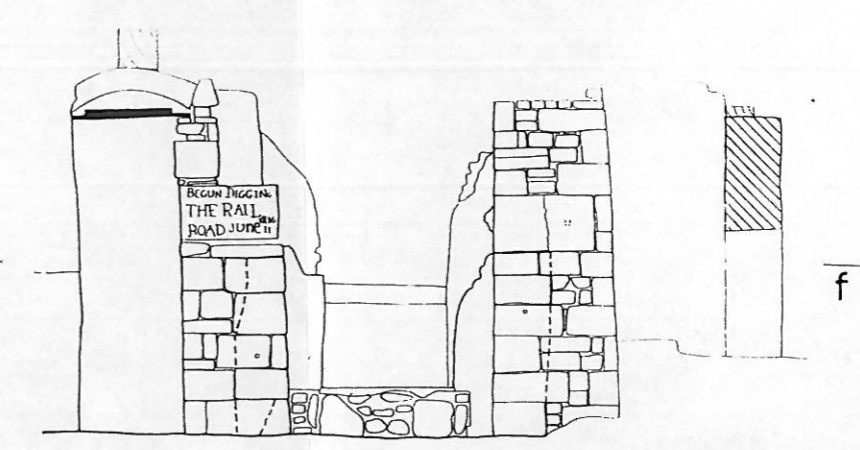


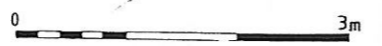
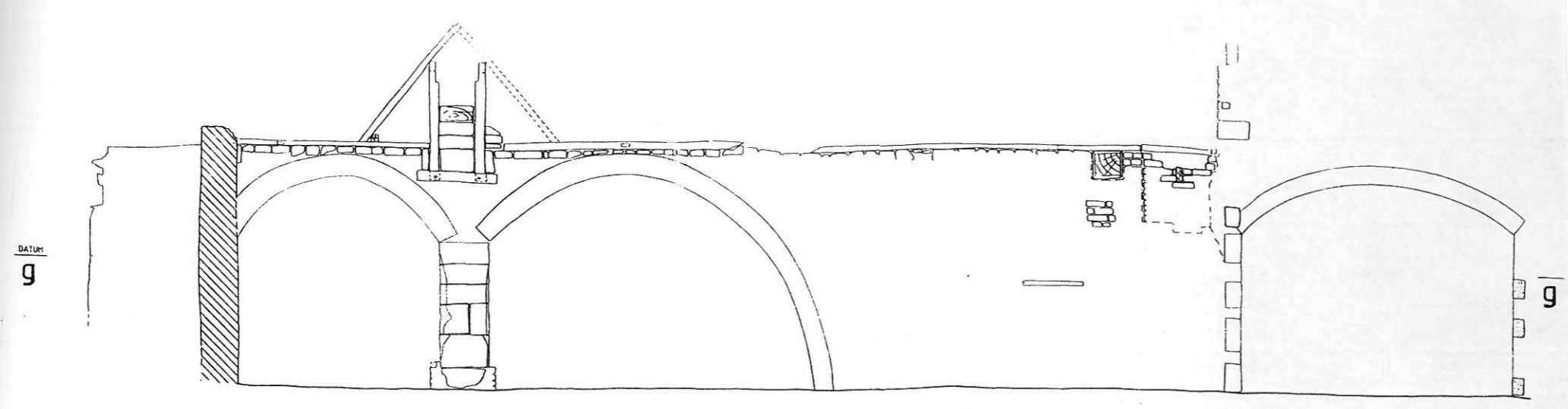
Fig. 10 Saltford Brass Battery Mill
Areas G & I, East external elevation



a North elevation



b East elevation



c South elevation

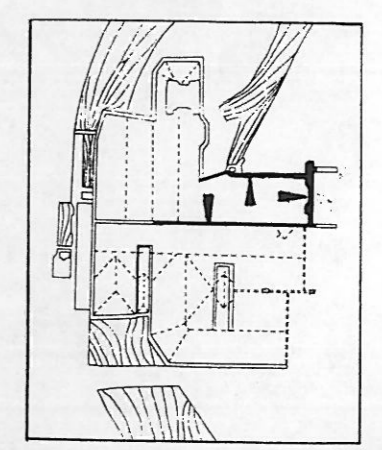
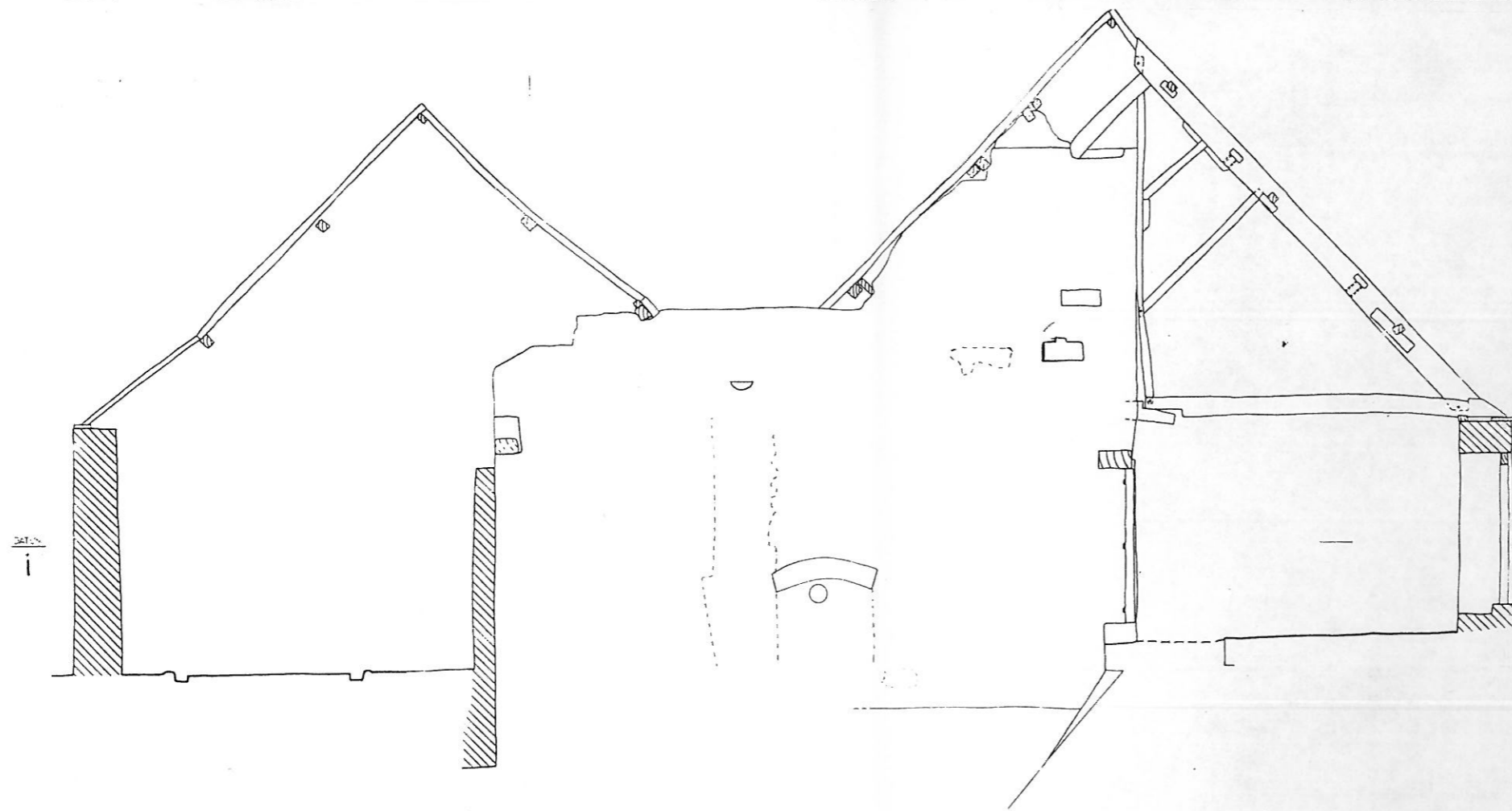
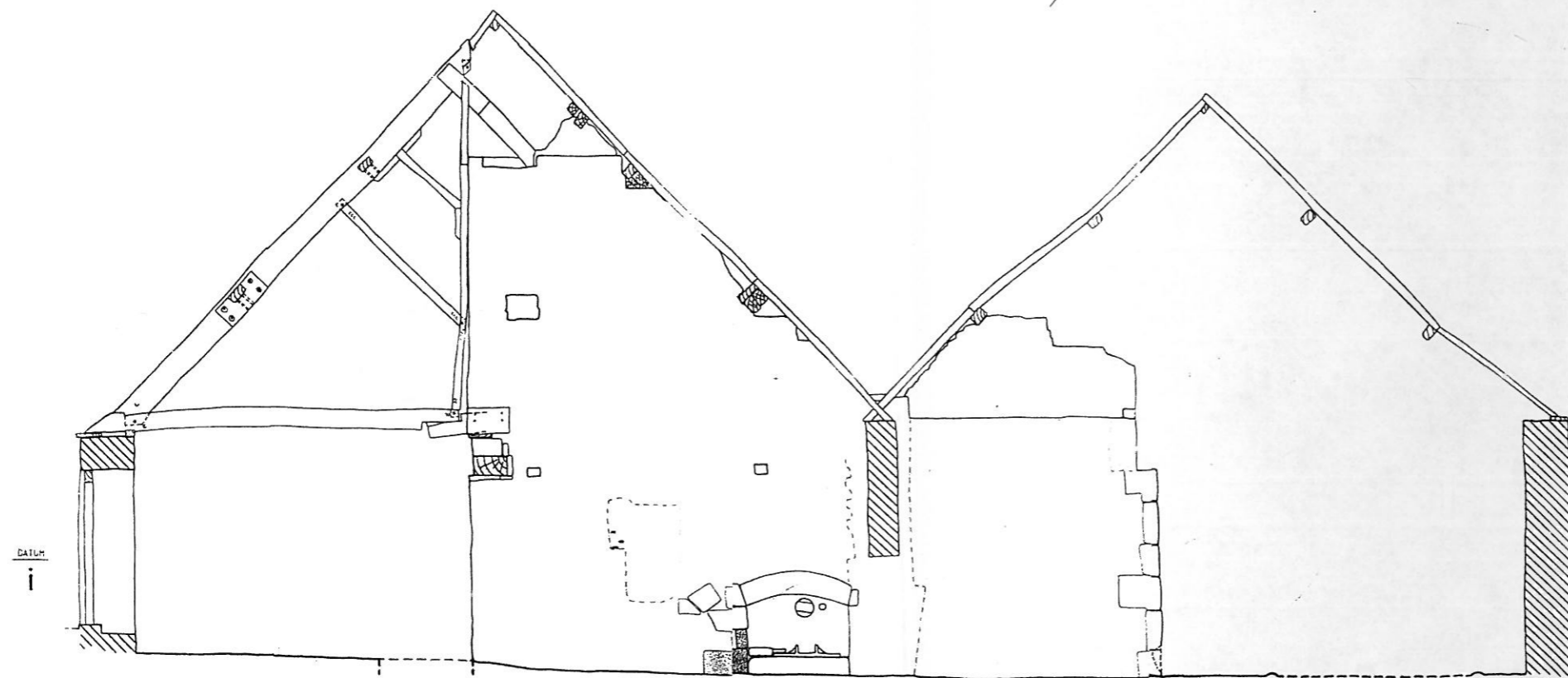
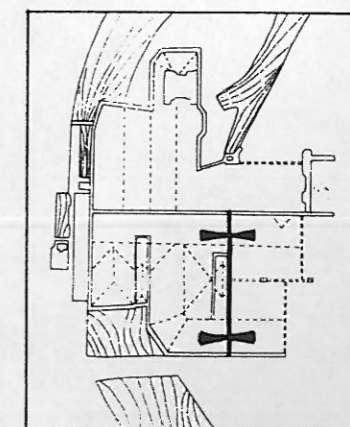


Fig. 11 Saltford Brass Battery Mill
Area J, Internal elevations



a Wheel-pit No. 1, East elevation



b West elevation

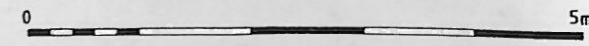
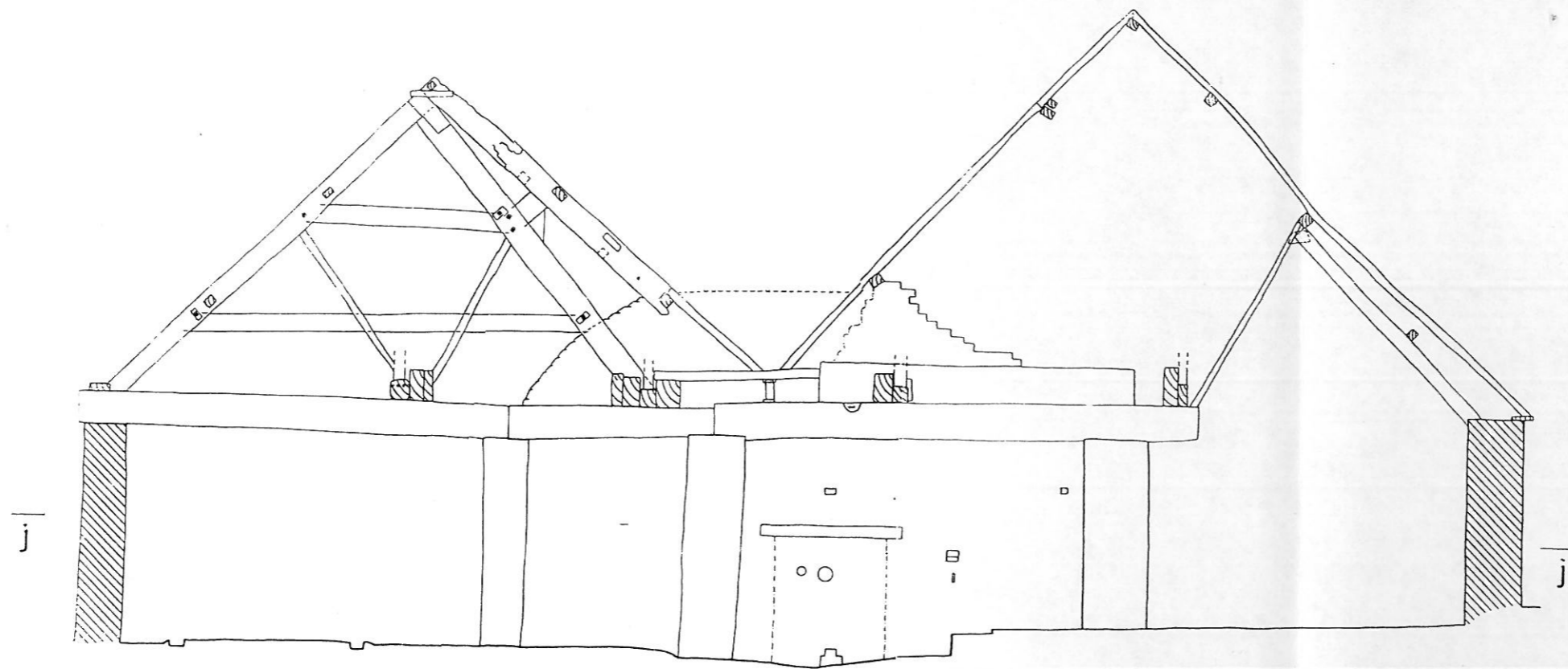
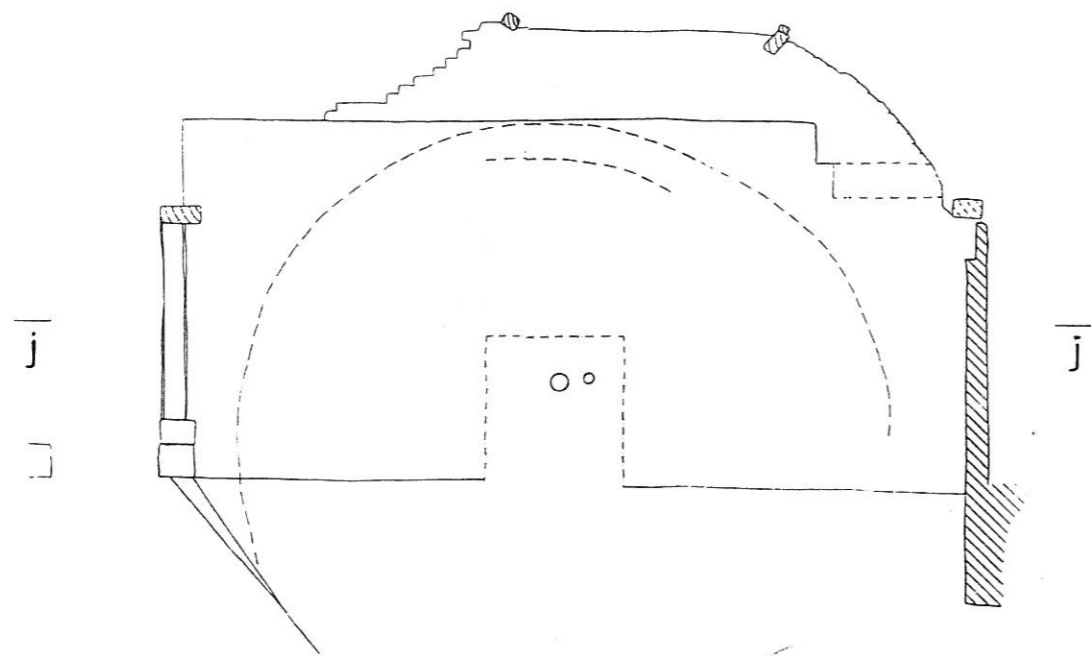


Fig. 12 Salford Brass Battery Mill
Areas A & B, Internal elevations



a East elevation



b Wheel-pit No1, West elevation

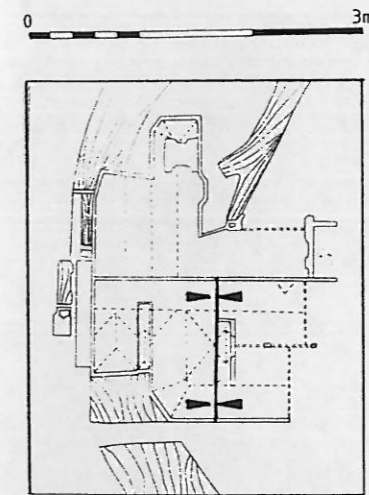
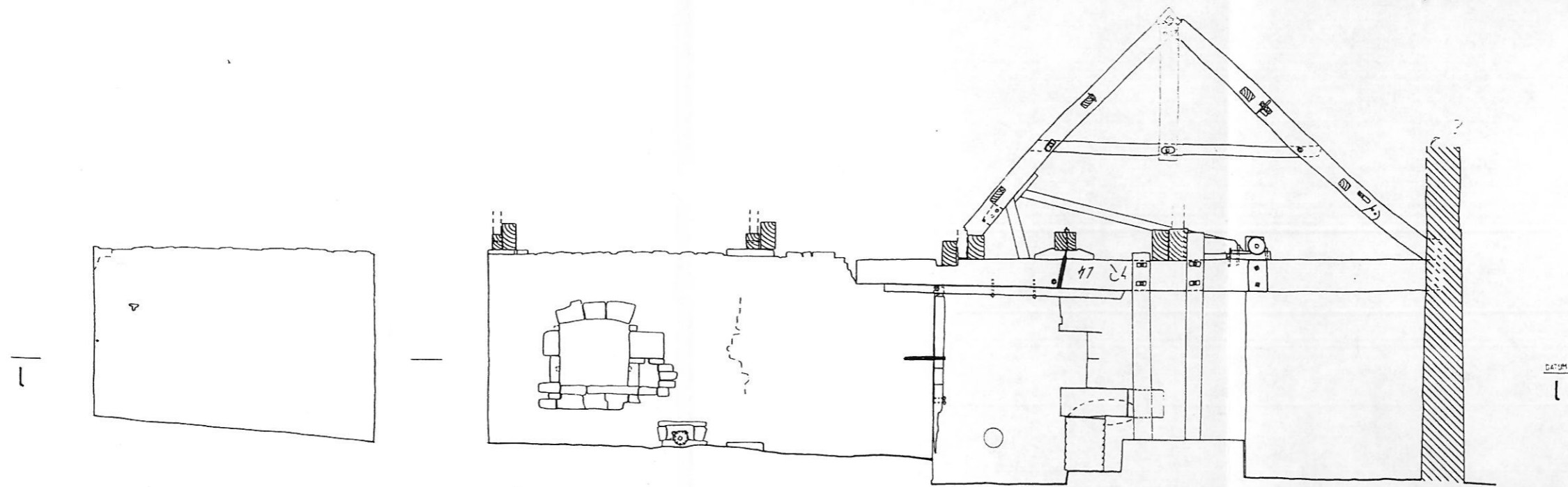
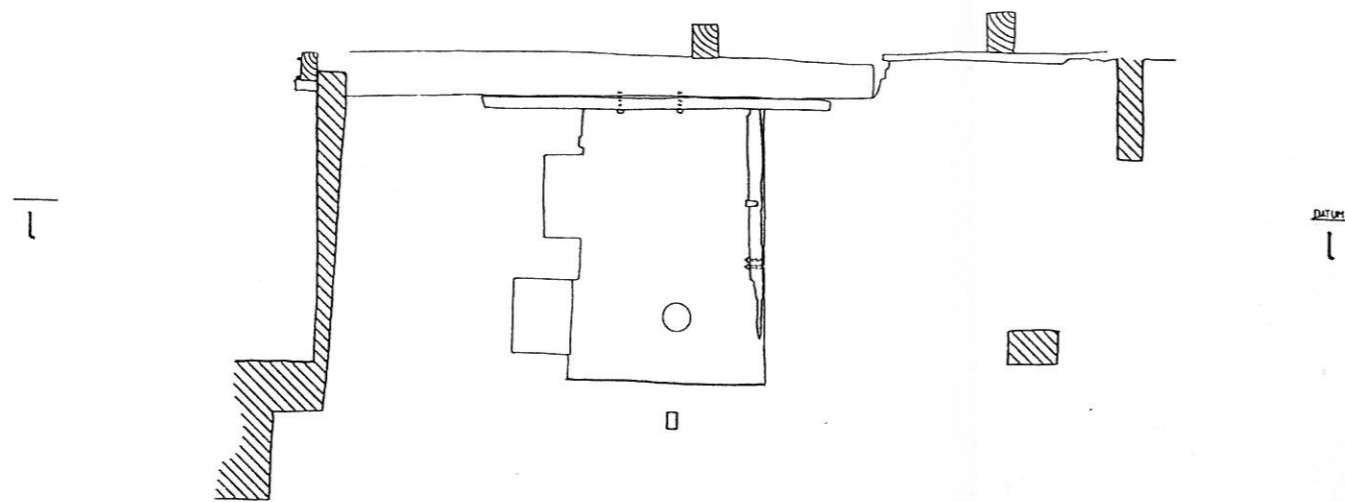


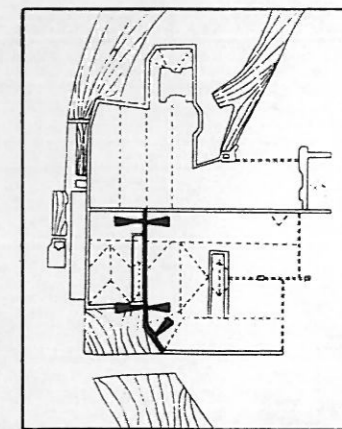
Fig. 13 Saltford Brass Battery Mill
Area C, Internal elevations



a West elevation

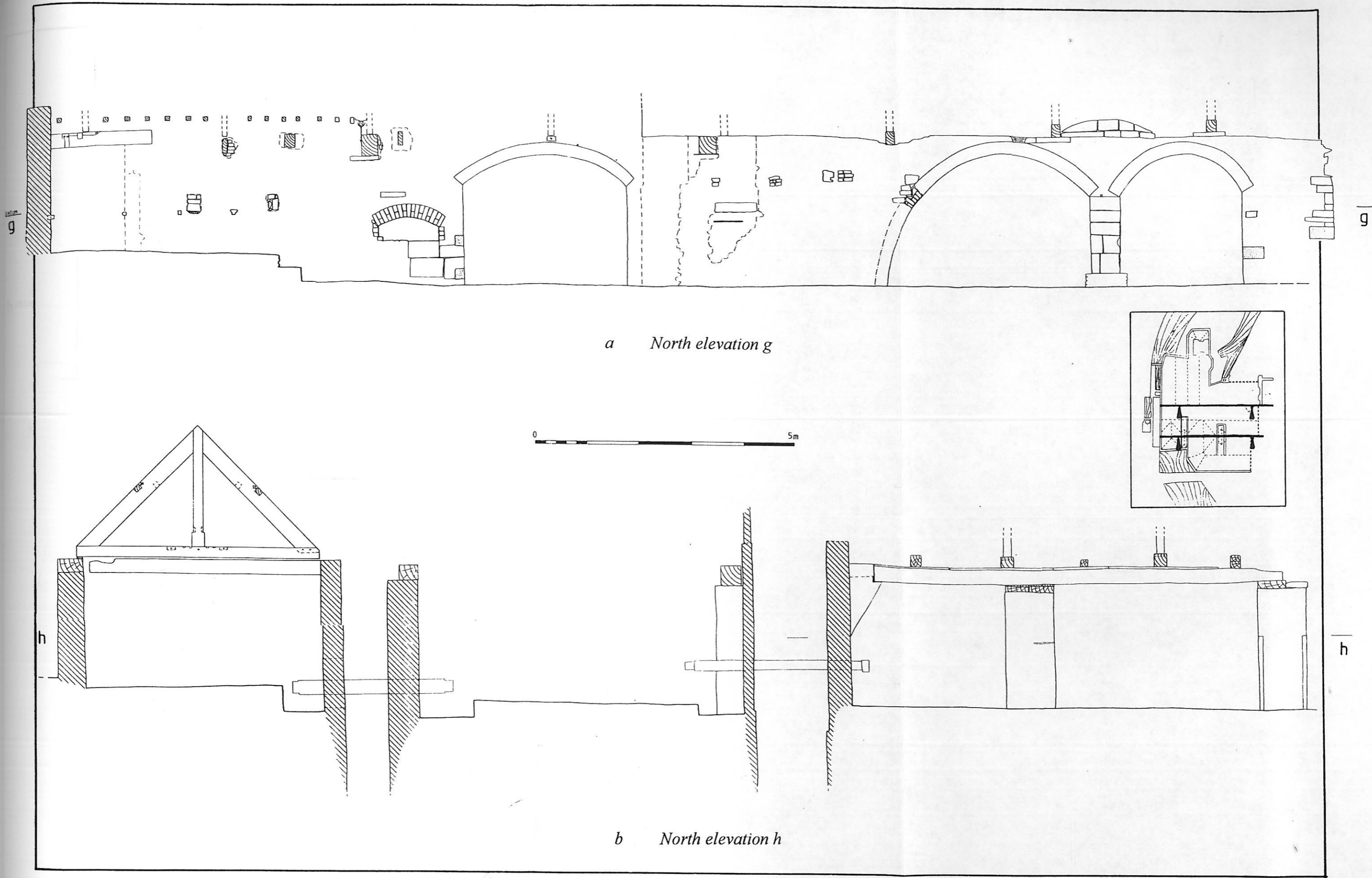


b Wheel-pit No2, East Elevation



0 3m

Fig. 14 Salford Brass Battery Mill
Area C, Internal elevations



a North elevation g

0 5m

b North elevation h

Fig. 15 Saltford Brass Battery Mill
Long elevations E, C, B and D, C, A

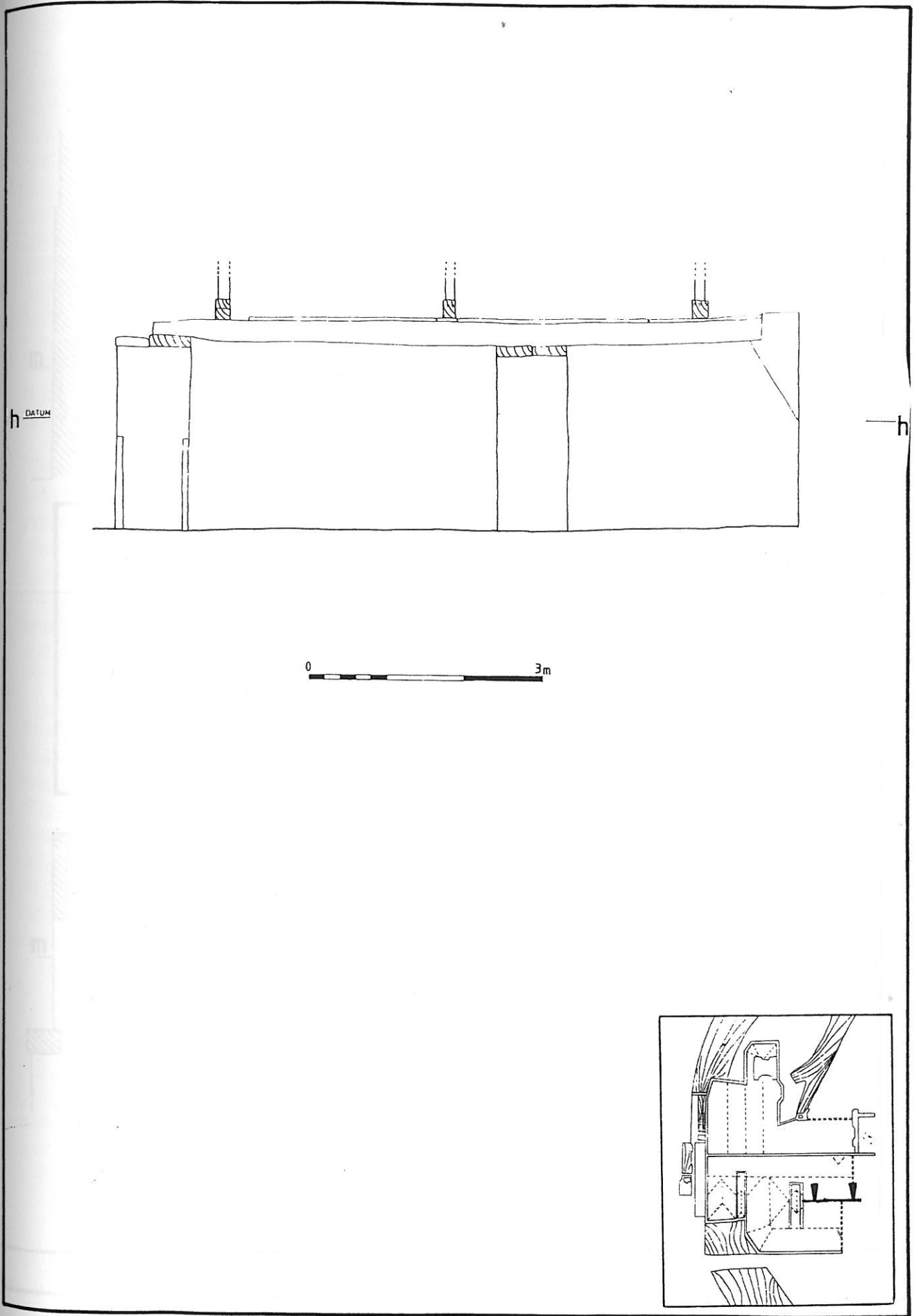


Fig. 16 Saltford Brass Battery Mill
Area B, South elevation

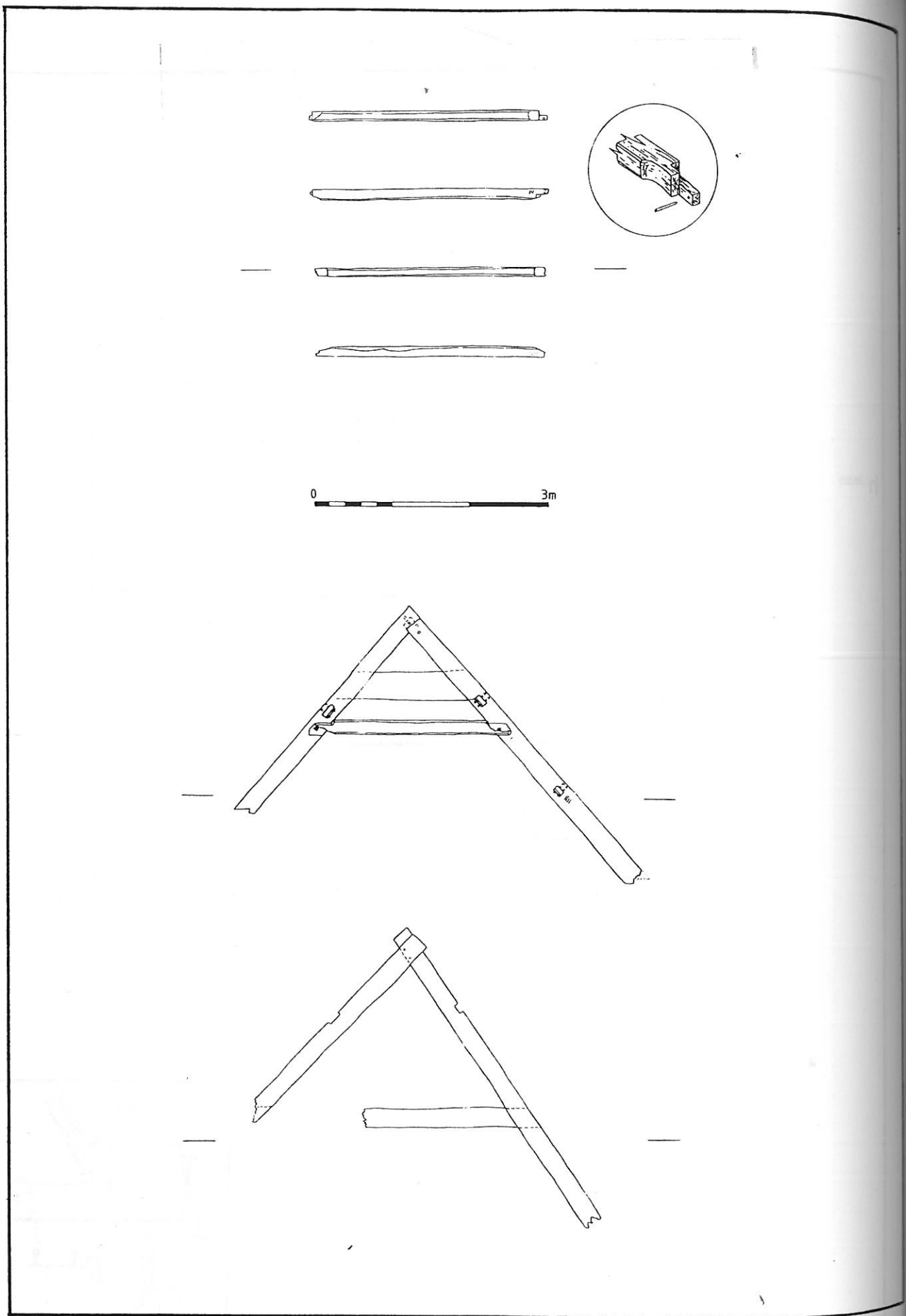


Fig. 17 Saltford Brass Battery Mill
Truss Reconstructions of Area J

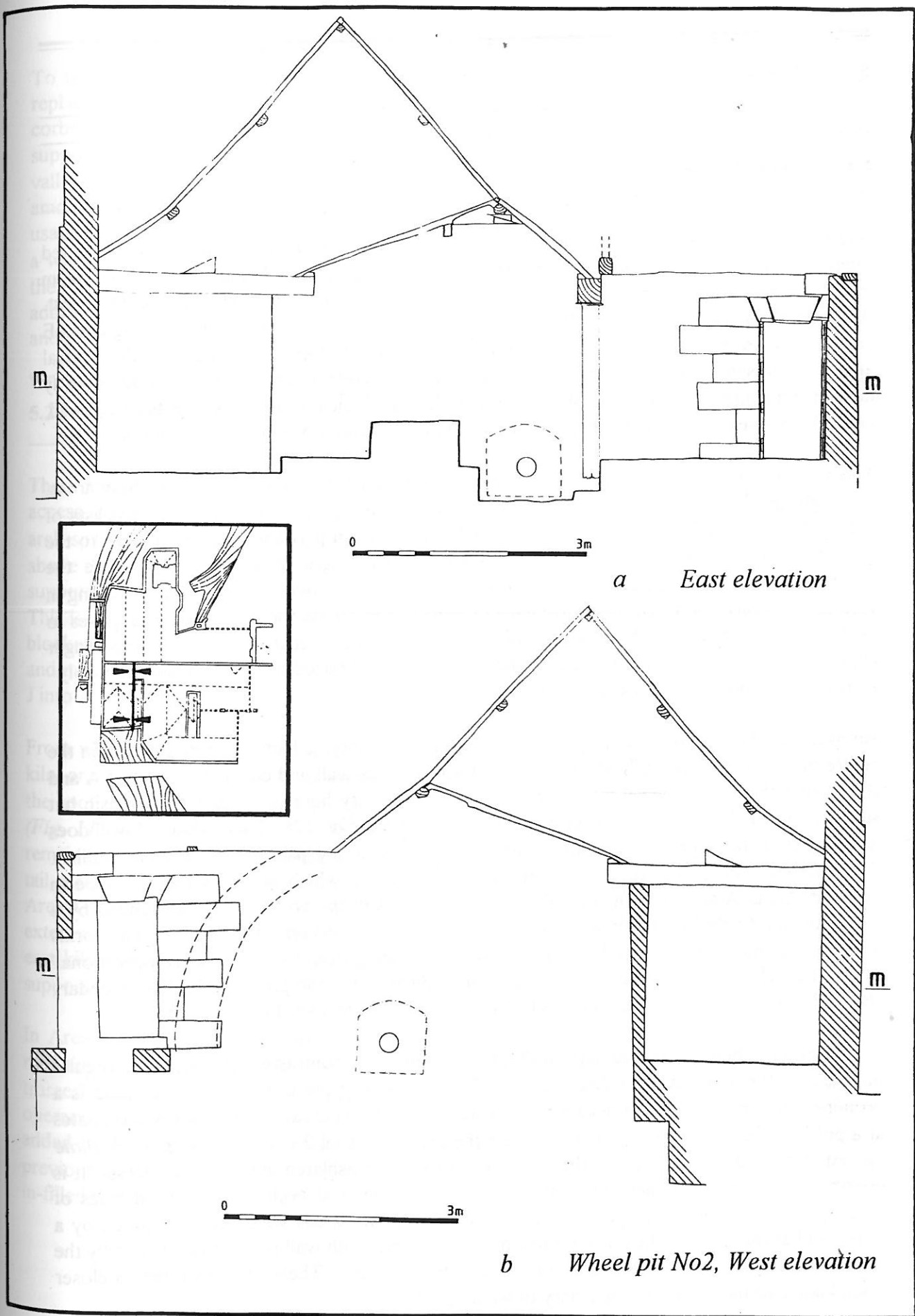


Fig. 18 Saltford Brass Battery Mill
Areas D & E, Internal elevations

Mill
Area J

5 The Interior

5.1 Areas A, B & C

Internally it is immediately apparent that Areas A, B and C, form a comparatively integrated open area, with little obstruction from the internal walling. Areas A and B are parallel from east to west, while C cuts across at right-angles to provide an open area to the west. Although the floor-level varies in these areas, there are no actual steps before entering areas E and I. However Area C does contain several pronounced slopes particularly in the central area. At present these are marked by a section of concrete where the floor slopes sharply down from south to north. This slope and other archaeological evidence suggests that a wall, aligned east-west, once existed here, which would have divided Area C into two parts.

This feature is the only obvious evidence of a construction break in the flooring in these areas, although the flooring fabric varies throughout the southern part of Area C. This consists of regular flagstones (possibly Pennant sandstone) in the eastern part and large lias blocks to the west. In several areas the flagstones contain regular ridges, presumably to reduce the possibility of slipping. A number of large cast-iron slabs also provide a form of floor-paving in various locations. Some of these may have once provided access for maintenance purposes to below-ground features such as the culverted leats or sluice mechanisms, but they no longer appear to provide this function. Area B includes an area of raised brick ribs, which probably assisted with cooling the brass during the annealing process.

An irregular-shaped, free-standing, vertical section of masonry, is located approximately in the centre of the area. This oddly-shaped feature forms a cross-wall and cuts across part of A and B abutting the site of wheel-pit 1 (*Fig. 12*). The masonry here is comparatively basic but substantial and also forms the lower walls of the wheel-pit (*Fig. 12*). This section of wall does not appear to be aligned or to have been connected with any part of the adjacent walling. There is a construction break below the ashlar corbelling which supports the valley-beam between Areas A and B. On the western side of the wall the wheel-pit is surrounded by a later, comparatively thin ashlar wall, with crude brick extensions on top (*Fig. 13*). This forms a screen around the pit, probably to control water splashing from the wheel when operational. Within the wheel-pit, scarring in the ashlar wall, indicates that the present wheel is secondary (*Fig. 13*). The previous wheel appears to have been several feet smaller in diameter.

The random rubble of the eastern wall of wheel-pit 1 is contrasted by the more regular masonry of the south wall of Area A (*Fig. 7*). In this wall the use of ashlar quoining is a prominent feature which continues to the western part of this area. This masonry terminates at a point in the west wall of Area C, where the axle for wheel 2 is located (*Fig. 14 & Plate 3*). At either side of the door in the south wall there is an ashlar arch-headed recess. It is possible that these contained oil-lamps for lighting, directed at both east and west sides of wheel-pit 1 (*Plate 4*). This possibly indicates that the two areas were once separated by a cross-wall at this point. The more refined masonry of the south wall is again contrasted by the primary sections of the north lateral wall of area B (*Fig. 15*). These in general bear a closer resemblance to the more basic masonry of wheel-pit 1.

To the east of wheel No1 a former dividing wall between A and B has been removed and replaced with widely spaced ashlar and copper-slag block pillars. These, together with a corbelled projection built into the wall of the wheel-pit, support a large oak beam providing support for the central valley between the roofs of these two Areas (*Fig. 16*). Below the valley the primary wall-plate is still *in-situ*. This effectively creates an open area which, the amount of wear on the wall corners confirms, was once an important area in terms of past usage. At the east end of the south wall, there is evidence indicating the previous existence of a wheel arch. The open and incomplete manner in which Areas A and B terminate towards the east, indicates that they once continued further in that direction. The valley beam may additionally be seen as being on the line of the ghost-wall that continues west through Area C and beyond (*Fig. 15*).

5.2 Area J

There are two large brick arched openings through the north wall of Area B. These provide access into Area J, the eastern kiln area (*Fig. 11 & Plate 5*). The existence of an ashlar arch-springer indicates that an additional earlier opening also existed to the east. Immediately above these arches there is an oak frame-work, which appears to be secondary. This provided support for the balance-beam mechanism, suggesting that the kiln is secondary to Area B. This is also indicated by the location of the additional opening to the east, which is effectively blocked by the kiln. The western arch was subsequently (precariously) widened still further and much erosion is again evident on its edges, indicating much through movement from Area J into Areas A and B.

From what remains of the kiln masonry, it appears to be of a similar nature to the northern kiln, and the carved date of 1836 indicates that it was in existence at that time. To the north, the roof of Area J was again supported by a substantial beam resting on the kiln to the east (*Fig. 11 & Appendix, Fig. 25*). The west end rests (some 7.0m (23ft) to the west) on the remains of the section of wall that at one time extended north-east. This follows the line of a tail-race that separates this area from the north kiln. Between this point and the raised wall of Area G (near to the north kiln) the masonry takes the form of an infill which contains an external door to the north kiln and the latrine over the tail-race. This suggests that the east-kiln existed prior to Area G and that there was a further structure to the north of the support-beam.

In Area J, the evidence of scarring on the edge of the north beam, in addition to remnant roof-timbers, indicates that the roof-trusses in Area J took the form of oak, open collar-beam trusses similar to those in area E (*Fig. 17*). The balance-beam would presumably have been operational at this lower roof-height, with this type of truss. A fourth truss was subsequently added to the west in order to form a link with Area G. Due to the restricted length of the previously existing support-beam, this later soft-wood truss had to be installed directly into the in-filled section of masonry walling.

5.3 Areas F, G, H & I

To the north of Area C, there is a further brick-built shallow-arched opening leading through into Area G. This is a comparatively large opening of more than 3.0m (10ft) in width, which appears to be secondary to the lias masonry of the wall (*Fig. 15*). In Area C to the west of this opening, there is a small brick-built arched recess which may have contained lighting facilities and the worn corners of the opening again indicate much previous activity in this area. It may be relevant therefore that this opening is aligned with the north kiln as well as with the centre of the gantry structure in area C. Above the opening, a horizontal construction break shows that the wall has been raised in this area, presumably to match the greater roof-heights of Areas F, G, H and I. As these Areas, along with the re-aligned Area C, are aligned north to south, they could have been constructed as part of an integrated development.

The present roof-trusses in Areas F and G are of 20th century date. A surviving end truss (No 18) in area G, suggests that they were previously of a similar type to the existing trusses in areas H and I, but not in the immediate kiln area. Evidence here suggests that at least part of this roof may have been raised having previously been at the same height as the rest of the complex.

The height of the walling immediately surrounding the west of the kiln area is lower than the rest of the walling in this part of the complex. Masonry remains in the floor in area I, indicate that this wall once extended further south. It would then have supported the pivot-beam, which presently depends on a suspended iron stirrup, as well as the previous roof-truss. The presence of tie-beams at this height would obstruct the movement of the balance-bob. This would imply that an open collar-beam truss would be needed here as in areas E and J. This southern wall extension suggests that at this time, Area H did not exist. In area F however, archaeological work has indicated that a single heavy battery-hammer once existed in this area. The area is also known at a later date to have contained heavy shears (Day 1976 20). Unfortunately recent building work has covered or removed most of the early fabric.

In area I, immediately in front of the kiln the floor steps down from area G by approximately 0.30m (12"). The step may reflect the previous existence of a raised turn-table which is known to have been used in this location for moving items in and out of the kiln and through area G. (*ibid* 22) A step here would mean that a constant work level could have existed. In general, the evidence in the northern kiln area suggests that the construction of the north kiln reflects other developments, particularly in the southern part of the complex in relation to Area C. The stone-masonry in the south walls of Areas C and D is of a similar nature to that in the north-kiln area, reinforcing the suggestion of a comprehensive redevelopment, involving these areas.

5.4 Areas E & D

Areas E and D presently contain a water powered electricity generator and a saw-bench. This area has undergone many phases of alteration. In particular, truss No12 that supports the roof of Area D, is an odd king-post truss made from various reused sections of timber (*Fig. 15*).

On the east side, this has its tie-beam resting on a light ashlar wall that forms a screen for water-wheel 2. (*Fig. 18*; Plate 6). This is probably secondary to the adjacent west wall of Area C. Parallel to this tie-beam, a heavy oak beam precariously spans the area and provides support for the principals of trusses 10 and 11. In the west wall, where the beam rests, there is a construction break and evidence for a return wall (*Fig. 8*). This beam evidently replaced what was originally a lateral wall that formed a continuity with the 'ghost-wall', running through the complex from west to east. The existing wall to the south is therefore probably secondary to this previous lateral-wall. (*Fig. 8*).

The evidence in Areas D and E supports the impression of a previously existing, long rectangular structure, aligned east to west. The 'ghost wall' between D & E seems to have formed only a part of the south wall of this structure. Truss No 11 is located less than 0.60m (24") from the west gable-wall and its purlins project beyond this point. This, together with masonry evidence, suggests that the western gable-wall is secondary and that Area E once extended westwards. Externally, the projecting remains of a large oak-beam also seems to support this interpretation. Evidently this was part of a wall-plate which once spanned the western wheel-pit area. Substantial masonry remains here are of a similar nature to both that of the east wall of wheel 1., the north lateral wall of E, and the walling remains between the west wheel-pits and the road. A part of this area is known to have included an annealing kiln. The western gable-wall also interrupts a previous doorway to the north into Area G. The large semi-circular arch in this wall seems to respect a pre-existing feature of machinery in the area. The west axle of water-wheel 2. protrudes into Area E, but does not appear to have a functional relationship with the area.

6 The Roof Structure

In Area C the existing roof-trusses appear to have undergone a process of radical alteration. Additional tie-beams have been added, presumably to provide extra strength. The substantial gantry-type structure (presumably for lifting) has also been added between trusses 6 and 7, above the location of the 'ghost-wall'. In contrast to the primary trusses, the gantry timbers are machine-sawn with stopped chamfers and the joints are held by steel bolts as opposed to oak pegs. The eastern ends of the tie-beams in this area are also supported on a heavy beam and pillar structure, which appears to be contemporary with the gantry. As these pillars are built in brick and the timbers are machine-sawn, this is a more recent development than the similar structure to the east. Above the gantry there is a large roof-light presently made from glass-fibre and it is notable that the wheel-axles below form a parallel alignment across the open area. The secondary window in the west wall allows both water-wheels to be observed from this area during operation.

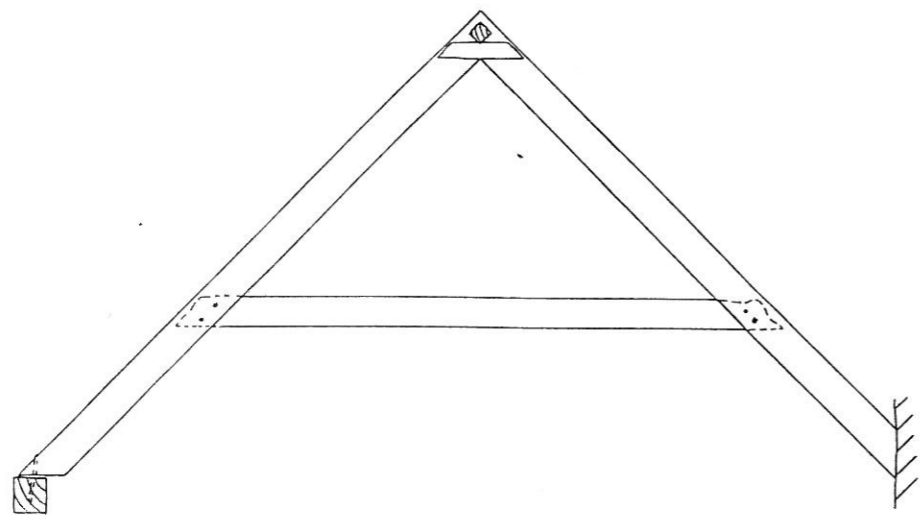
The roof purlins which run through from Areas A and B into Area C, appear to have been severed and discontinued. They are clearly not structurally integrated at the point which they meet the roof-members of C. It is evident that the present roofing arrangements in Area C are the result of radical alterations, which would have involved a complete realignment of the roof-trusses. It seems probable that this development may be consistent with a change of emphasis in terms of activity, from the south-eastern areas into Area C to the west of wheel-pit 1.

In the roof over Area A, the bay spacings running from east to west are interrupted west of wheel-pit No 1 where area C commences. Here the purlins and ridge-piece are only supported by makeshift struts acting as temporary props (*Plate 7*). The ends of the purlins probably mark the point at which a truss was previously located. At approximately 3.0m (10ft) this matches the bay widths of Area A. Based on these dimensions the longitudinal roof members would have reached a point marked by the construction break at the west side of the window in the south wall. On the northern side of Area A, the last point of support is presently provided by the upper parts of the cross-wall, which have been raised to this height in order to perform this task. This may indicate that this section of wall was originally part of a north-south lateral wall as opposed to a gable-end wall that its present shape tends to suggest. In contrast, the last point at which the purlins on the south of A are adequately supported takes the form of a makeshift half-truss (No 3) located opposite the cross-wall.

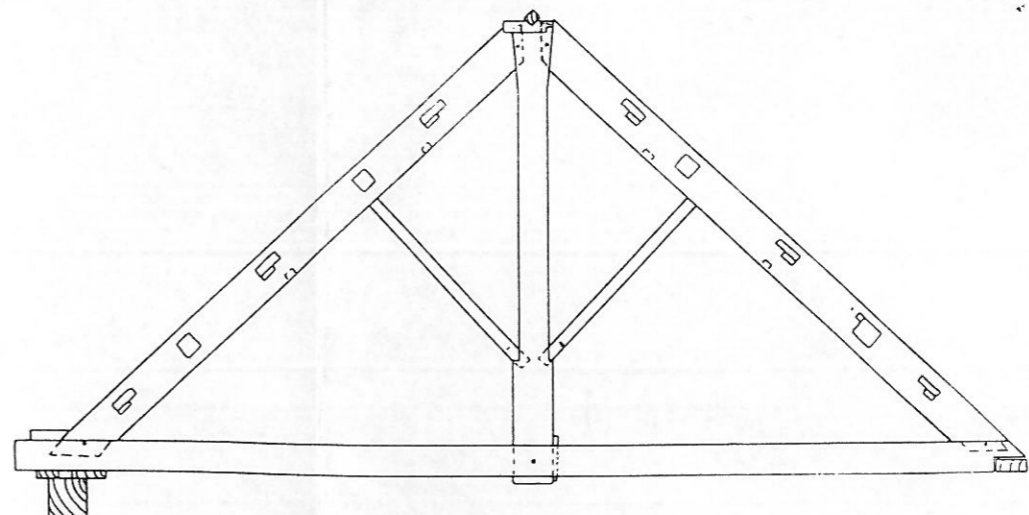
A similar pattern of alteration can be observed in Area B. Here the ridge-piece and purlins on the northern side continue their run effectively uninterrupted in a westerly direction. A significant contrast can be observed at this location however. Truss 8 is the first of a line of open collar-beam trusses which extends west into Area E. Trusses 7a, 8 and 9, are part of Area C and in fact appear to be king-post trusses re-used and re-modelled, while trusses 10 and 11 seem to be an integral part of Area E. Contrastingly, these are open collar-beam trusses which have a distinctive half-lapped dove-tail joint at the collar, held originally here by oak pegs (*Fig. 19a*). Typologically these may be related to an early, pre-industrial truss. In the Bristol region recorded examples with this type of collar joint have been predominantly dated to the 18th century. (Hall 1983 p111) In this instance its use and/or retention, may have been influenced by the comparative lack of height in this area. The floor here is approximately 0.50m (20") higher than the northern parts of Area C. However, the bay spacing between trusses 10 and 11 indicate that this type of truss may also have continued eastwards, prior to their having been replaced by the existing trusses 7a and 8. Trusses 10 and 11 would therefore seem to be primary.

Area A contrasts with B and C in terms of span. The latter have roof spans of approximately 7.20m (24ft) compared to the greater span of (8.20m) 27ft of Area A. The roofs of these three areas utilise the same general type of construction that is found in most parts of the complex. Reflecting the regional location, this consists of a butt-purlin arrangement in conjunction with a king-post truss system. The use of the king-post truss may be seen as appropriate in the context of a brass-mill as its use became almost universal in Britain within industrial buildings from the 18th century onwards. This type of truss was beneficial in comparison to the earlier, open collar-beam truss, as it was more conducive to the construction of buildings of a comparatively greater span. It may be significant in terms of the phases of construction, that examples of this contrasting roof-truss are found in relation to Areas E and J within the complex. In the context of a single-storey building, the presence of a tie-beam can result in restricted height. It is probably for this reason that truss No 16 in area B has had its tie-beam removed.

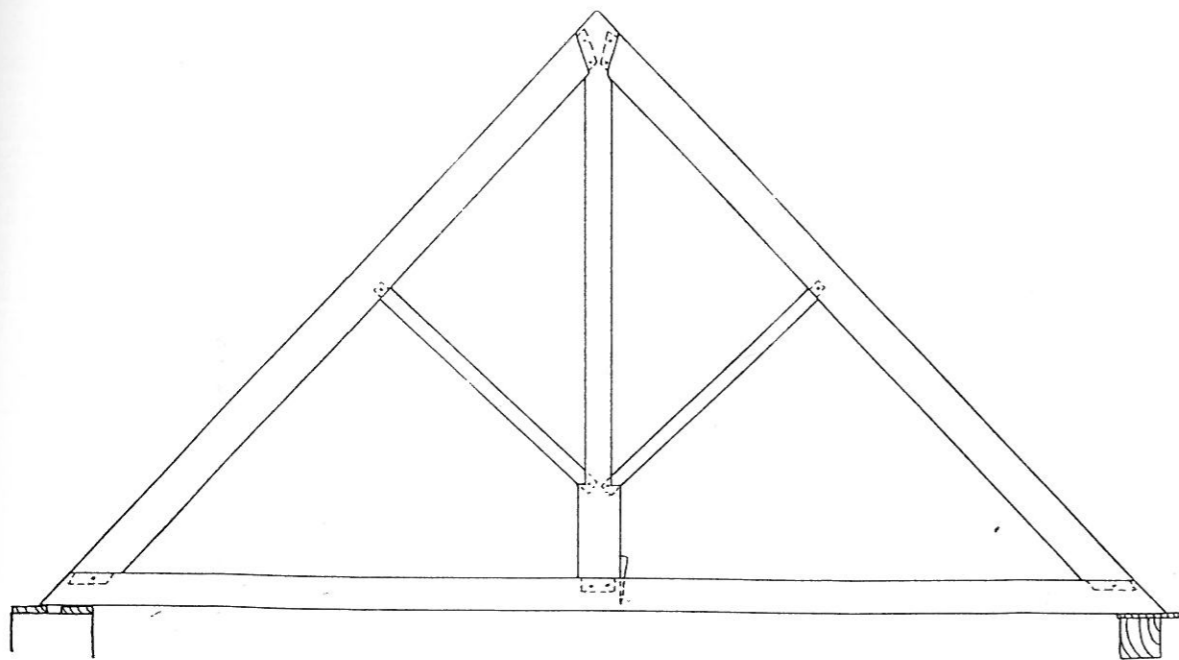
The complex seems to contain three main variations of king-post truss. Many of these show signs of alteration or re-use. Type A trusses (Nos 1 and 2) (*Fig. 19b*) are probably the least altered. These are basic king-post trusses with a flared-head king-post which tapers above the junctions of the single pair of braces. The feet of the king-posts are tenoned into a housed mortice in the tie. The principal rafters support two pairs of interrupted purlins. The half-truss



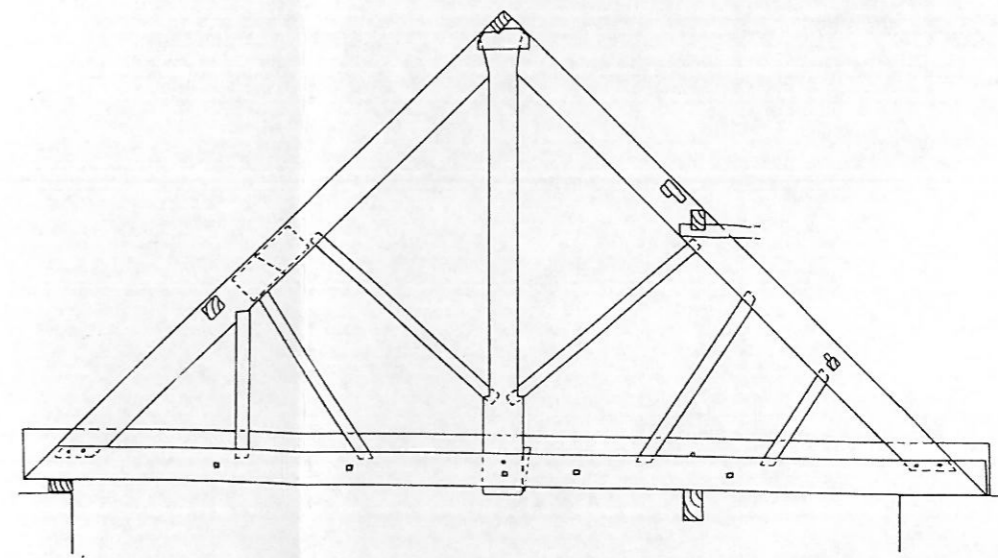
a Truss type E, No 11



c Truss type B, No 14

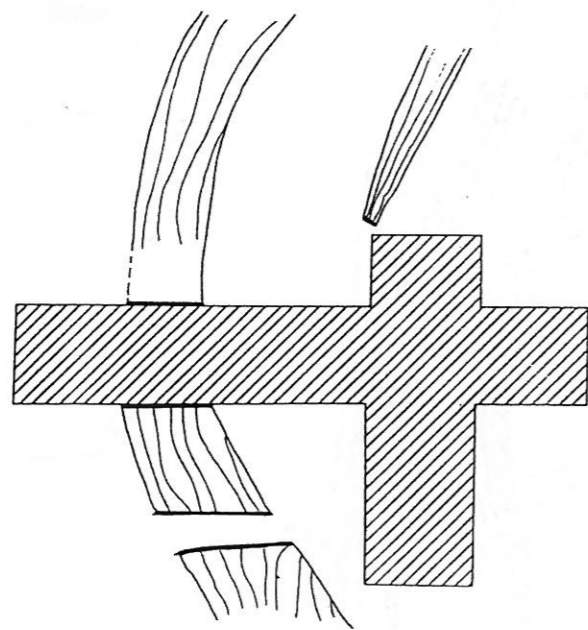


b Truss type A, No 2

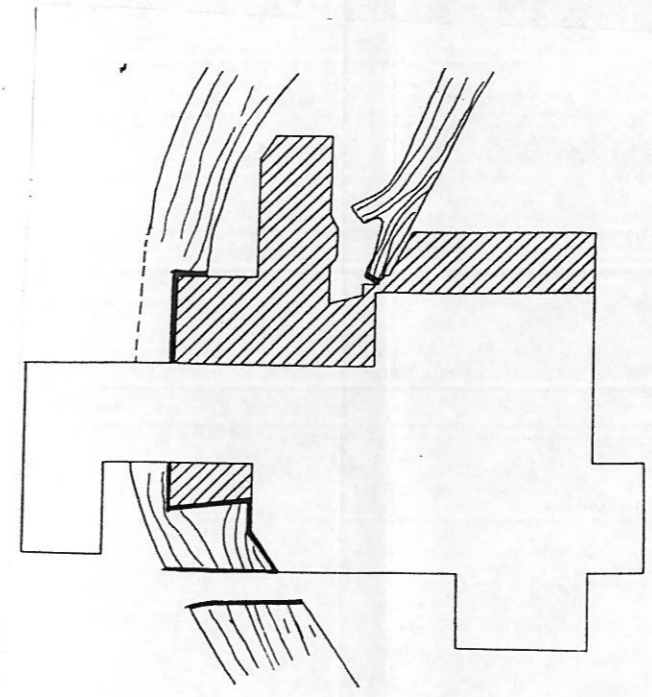


d Truss type C, No 5

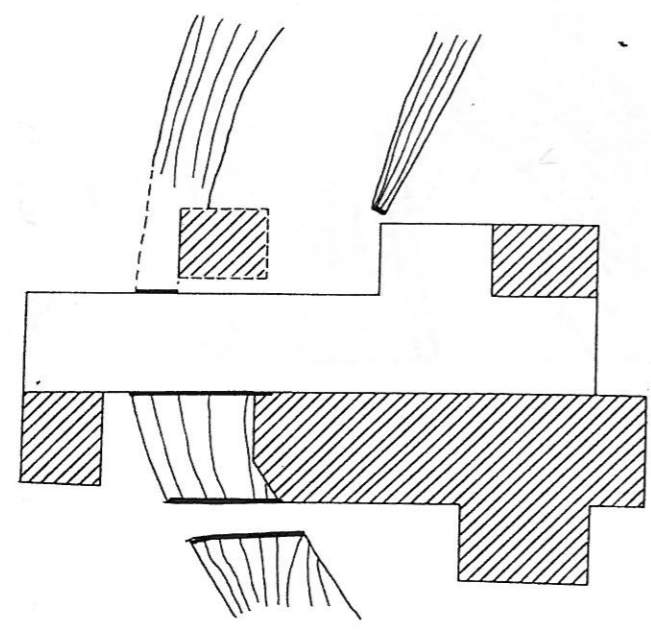
Fig. 19 Saltford Brass Battery Mill
Truss types A, B, C and E



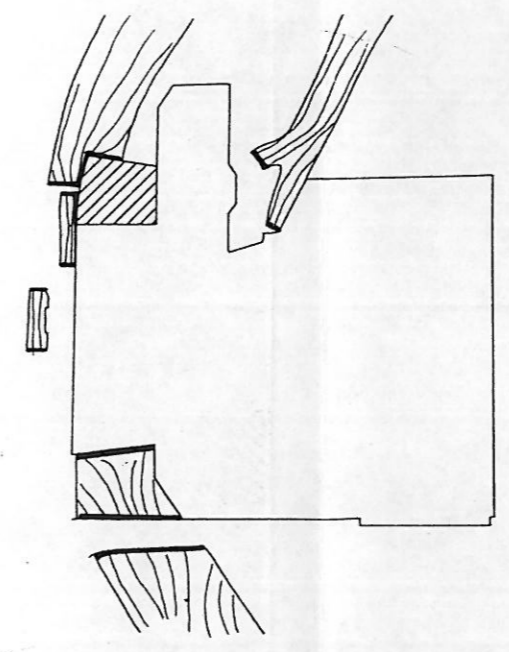
a Phase 1



c Phase 3



b Phase 2



d Phase 4


Key:  — New build

Fig. 20 Salford Brass Battery Mill
Suggested outline reconstruction
Phases 1-4

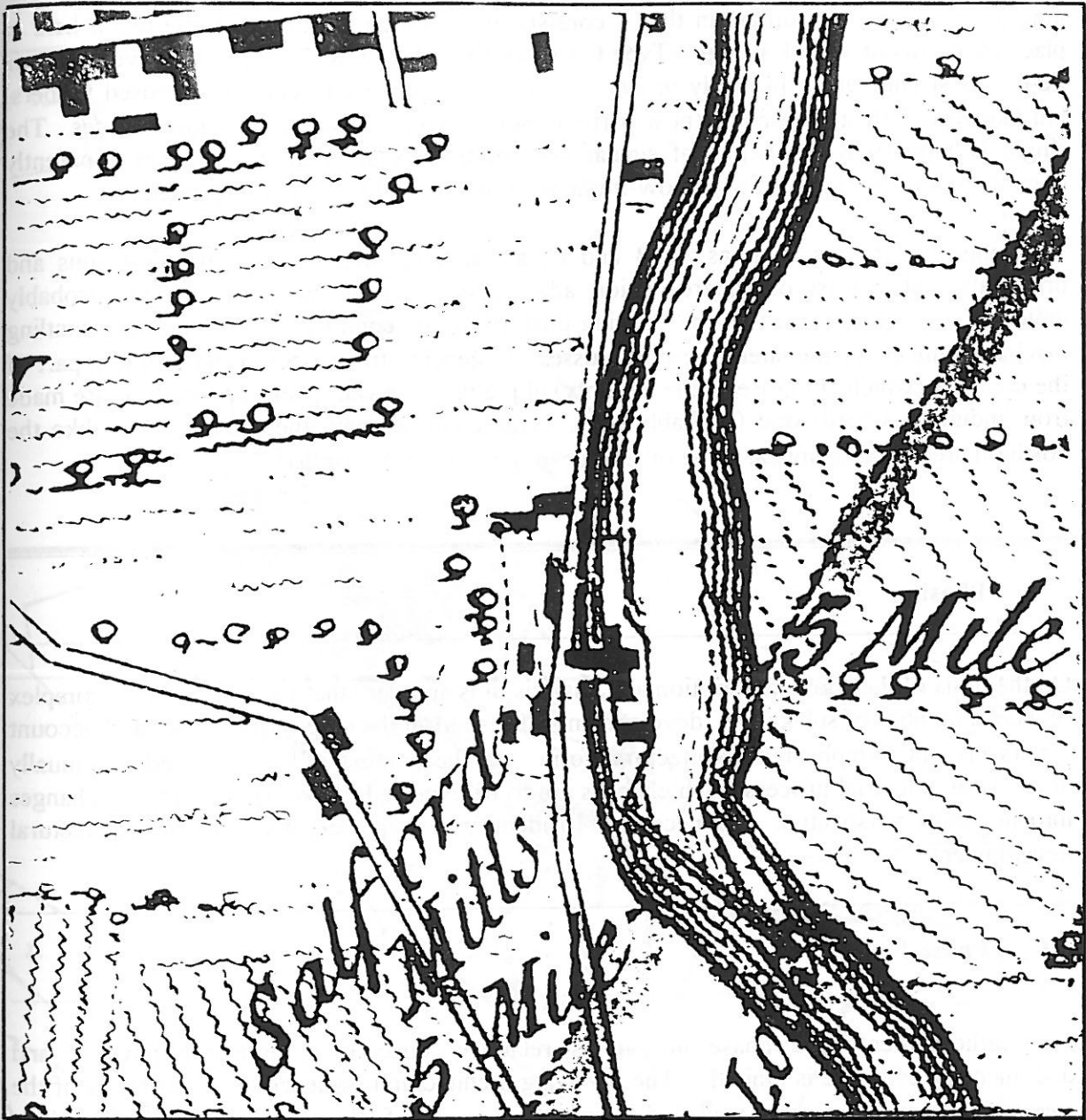


Fig. 21 Saltford Brass Battery Mill

Extract from Thomas Thorpe's Plan of Bath and Five Miles Around, 1742

to the west (No 3) seems to be closely related. Truss types B, (Nos 14, 15 & 16) (*Fig. 19c*) are also of a similar design, only these appear to consist largely of reused members. The king-post housing also differs in that it consists of a through mortice with the tenon held in place by means of an oak wedge. Type C trusses (Nos 4, 5, 6 & 7) (*fig. 19d*) have had their tie-beams strengthened, probably *in situ*. These do not appear to consist of reused timbers, but like type B their king-posts (now partly removed) were housed in through-mortices. The single D type truss (No 12) is of similar construction except that its tie-beam apparently consists of a re-used part of a window-frame with ovolo mouldings (not illustrated).

The king-post trusses in areas A, B and C, are notable in that they have tie-beams and principals that consist of square-section adze-dressed and pit-sawn oak. This probably indicates a relatively early form of king-post truss, in contrast to the regular scantling machined timbers of the later king-post trusses. In general, the trusses in the southern part of the complex (which comprise of the majority) along with the wall-plates and purlins, are made from indigenous hardwood (probably oak). This contrasts with the rafters, which like the northern area trusses, appear to be of European pine (probably larch).

7 Phasing

On the basis of the above description and analysis, it is apparent that the fabric of the complex reflects a number of substantial developments. These form the core of its history and account for its present complicated architectural form. In the context of an early and continually developing industrial process, such changes are to be expected. In order to put these changes into historical perspective, it is necessary to identify a sequence of phases of architectural development.

7.1 Phase 1

The earliest identifiable phase in part is relatively obscure as both the physical and documentary evidence is limited. The surviving architectural evidence of this consists of the free-standing masonry cross-wall that forms the east wall of wheel-pit 1 (*Fig. 12*) as well as providing support for the roof-structure above. The most feasible interpretation indicates that this in its primary phase, may have been part of a western lateral wall of a building aligned north to south. At this early stage this may have been either a fulling-mill or a corn-mill. It is perhaps relevant that No 3 Mill Cottages nearby seems to be 17th century, and the two buildings may therefore be contemporary. From this perspective it seems feasible that the mill-lead in its primary form may have followed the line of the lead which presently feeds wheel-pit 1. This would mean that the present main lead to the west of the complex was a major early development.

Apart from this consideration, the mill lead to the west of the complex would seem to be the earliest probable site for a water-wheel. The fabric of Area E also suggests that it is an early part of the complex as the masonry of the north wall is similar to the cross-wall of wheel-pit 1. and roof-trusses 10 & 11 seem to be an early type. The archaeological evidence suggests

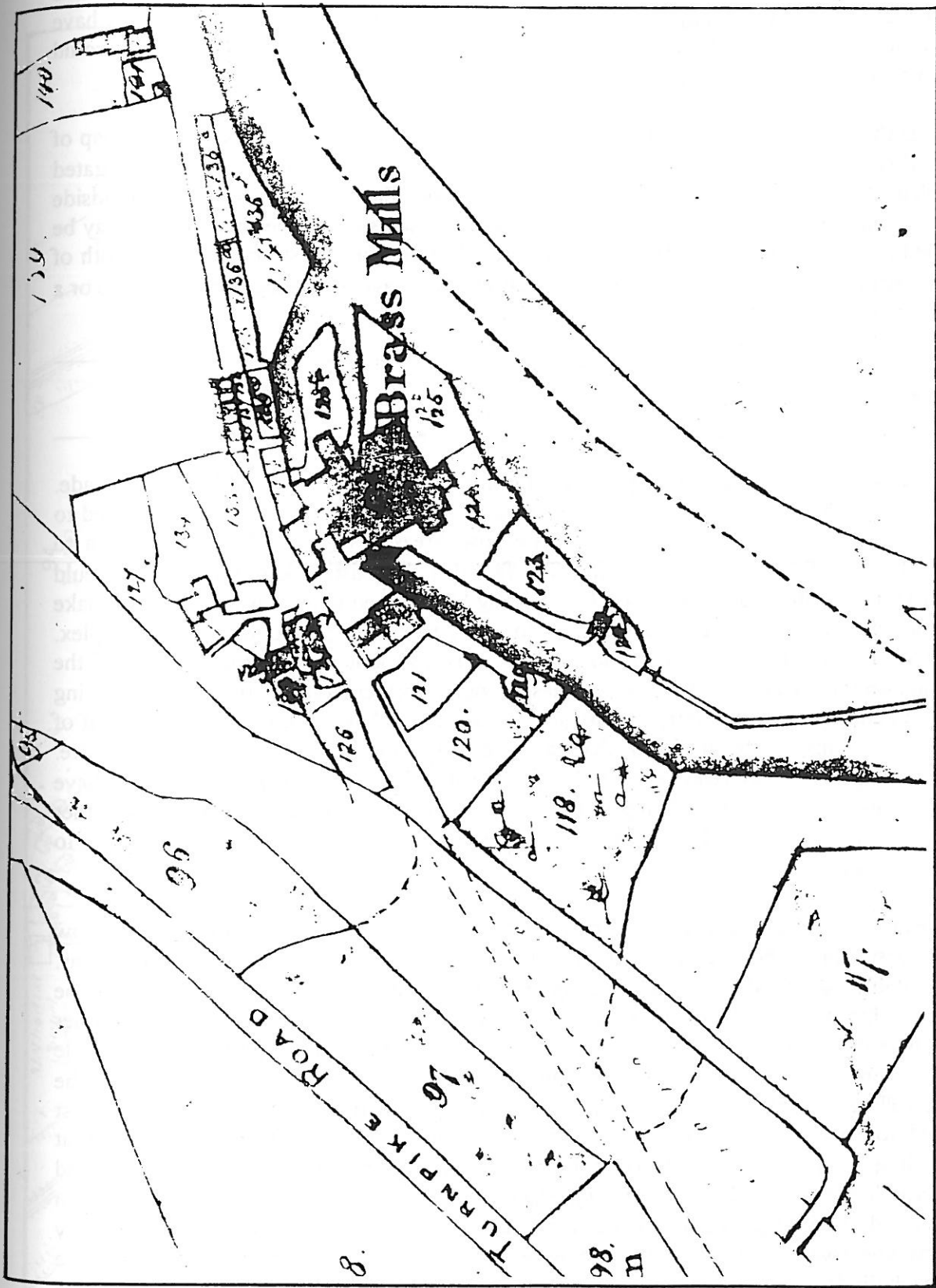


Fig. 22 Saltford Brass Battery Mill
Extract from the Tithe Map of 1839

consequently that at an early point, Area E existed as the north-west-wing of an L shaped structure. This seems to have been extended eastwards to form Area B (Fig. 20) when king-post trusses were possibly incorporated on the first occasion. At this time it seems feasible that a water-wheel may have existed to the west of Area E. This would possibly have been in the vicinity of wheel-pit No 3, as this point is close to Area E. Wheel-pit No1 would seem to be slightly latter as its leat appears secondary to the site.

Buildings that appear to support this possibility are in fact shown on Thomas Thorpe's map of Bath and surrounding areas in 1742 (Fig. 21). This shows the mill-complex as an elongated cross shaped structure, with its central stem extending significantly westwards to the roadside and eastwards almost to the river. This is probably the clearest out-line shape which may be identified in terms of phase 1. The existence here of a free-standing structure to the south of the main structure is also probably relevant. That this may have been either a dying-house or a corn-drying-kiln is clearly a possibility.

7.2 Phase 2

It is difficult to determine at which point the transition to a brass-mill would have been made. It is probably relevant however that Thorpe's map of 1742 shows that an extension existed to the north, approximately in-line with what are now Areas A and B. This would seem to occupy the site of the existing east kiln. The fact that the existing kiln is coal-fired would suggest that it is later than this phase. Copper-slag blocks used in its construction also make the same assertion as they generally appear to relate to a later period within the complex. That Area J was built as an extension to Area B is also indicated by the position of the wall-plate on the dividing-wall. This occupies the outer northern edge of the wall, suggesting that it was constructed as an integral part of Area B and was later used to support the roof of Area J. It seems feasible however, that an earlier kiln could have existed on the same site. The possible previous doorway through the north wall of B at the eastern end, may also have formed a link with an early building in this location. It would appear therefore that either phase one or two, could mark the transition of the buildings into a brass-mill during the mid to late 18th century.

It is relevant in this context that early photographs of the complex (Headington & Day) show that the east kiln at the later stage at least, was in fact one of a pair of very similar kilns. These notably contained a substantial proportion of copper-slag in their fabric. It may be significant that in this instance its use is systematic and relatively early, in contrast to other areas where its use is more ad-hoc and also appears to be latter. Although it seems probable that at the time of Thorpe's map the annealing and hammering of brass was taking place, the start of rolling is unclear. Documentary evidence indicates that the Saltford site was first occupied for brass production purposes in 1721 (Day 1976 20). It is also known that brass-rolling was generally introduced in the region during the middle of the 18th century (ibid 20). Whether or not rolling was taking place as early as 1742 is consequently an open question and confirming evidence is dated no earlier than 1830. At this point an inventory mentions one rolling-mill driven by two water-wheels and two battery-hammers with one wheel each (ibid).

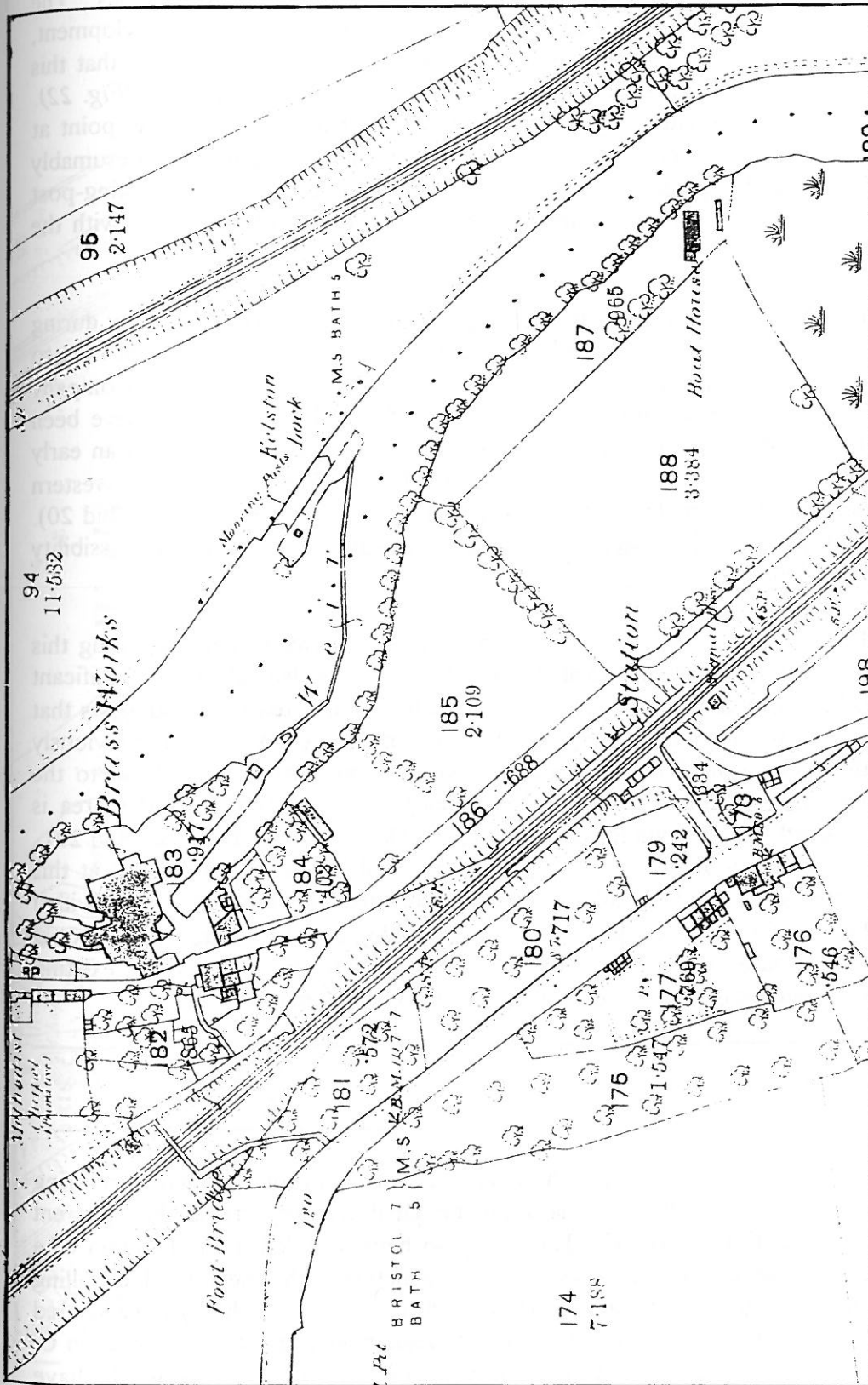


Fig. 23 Saltford Brass Battery Mill

Extract from the 1886 1:2500 OS Map

In architectural terms, phase 2. appears to have entailed substantial developments in the south-eastern part of the complex (Fig. 20). This would probably have included the construction of the south-wall presently external to areas A and C. Construction breaks in this wall at the west end suggest that this may have occurred in to closely related phases. The quality of masonry here also suggests that this was a relatively prestigious development, requiring a substantial amount of capital investment. The tithe-map of 1839 shows that this extended eastwards and a small cross-wing existed at the east end of the south wall (Fig. 22). The west wall of the latter structure appears to be marked archaeologically by the point at which the south-wall presently ends abruptly. The original mill-building is presumably drastically altered during this phase as is the dividing-wall between A and B. King-post trusses presumably covered area A and extended into the southern part of area C, with the party-wall to the north of area C still intact.

The south-eastern part of the complex would seem to be the principal area of activity during this phase, developing in the late 18th or early 19th centuries. It is possibly relevant here to mention that all of the brass-mills in the area were taken over by the Bristol Brass Company during the later-part of the 18th century (ibid 22). The Saltford complex may have been subsequently re-developed. It would consequently be reasonable to assume that if an early site existed where rolling could have taken place, it would probably be in this south-western area. It is notable that an ex-employee did recall that a water-wheel existed here (ibid 20). The archaeological evidence in the eastern part of the south wall also supports this possibility at least in relation to a later phase.

To the west of the complex, the kiln adjacent to the road also seems to emerge during this period. This again suggests that at this point the western area was also subject to significant activity. The possible wheel-arch in the in-filled west gable-wall in Area E also suggests that this area at some point may have contained some form of machinery. A doorway previously existed through the north wall of E during this period. This may have been related to the existence of a single heavy battery-hammer within Area F. At a later period, this area is known to have contained heavy shears for preparing round blanks for battery work. (ibid 20) The evidence of construction breaks in the west external wall indicates that Area F at this point may have existed as a detached building. Support for this assessment may be provided by the fact that the tail-race for wheel-pit 2., instead of running directly north, (which would seem to be the logical route) is directed to the north-east. This implies that the pre-existing building indicated archaeologically in Area F, influenced the chosen route.

7.3 Phase 3

Phase three appears probably to have been the final major phase of development, occurring not long after phase two (Fig. 20). Perhaps the principal feature here is the apparent installation of rolling facilities in Area C. This seems to have included the installation of a water-wheel in Area E (wheel 2) to be operated in conjunction with wheel 1. The rolling machinery (rolls) appear to have been located between wheels 1 and 2, with a gantry located approximately overhead. This would have required the realignment of the roof-trusses in C, together with their being strengthened with additional ties. In addition this would have entailed the removal of the central dividing-wall (See Cross-section h, Fig. 15). It seems feasible that the north-kiln may have been built during this period (this is shown on the 1839

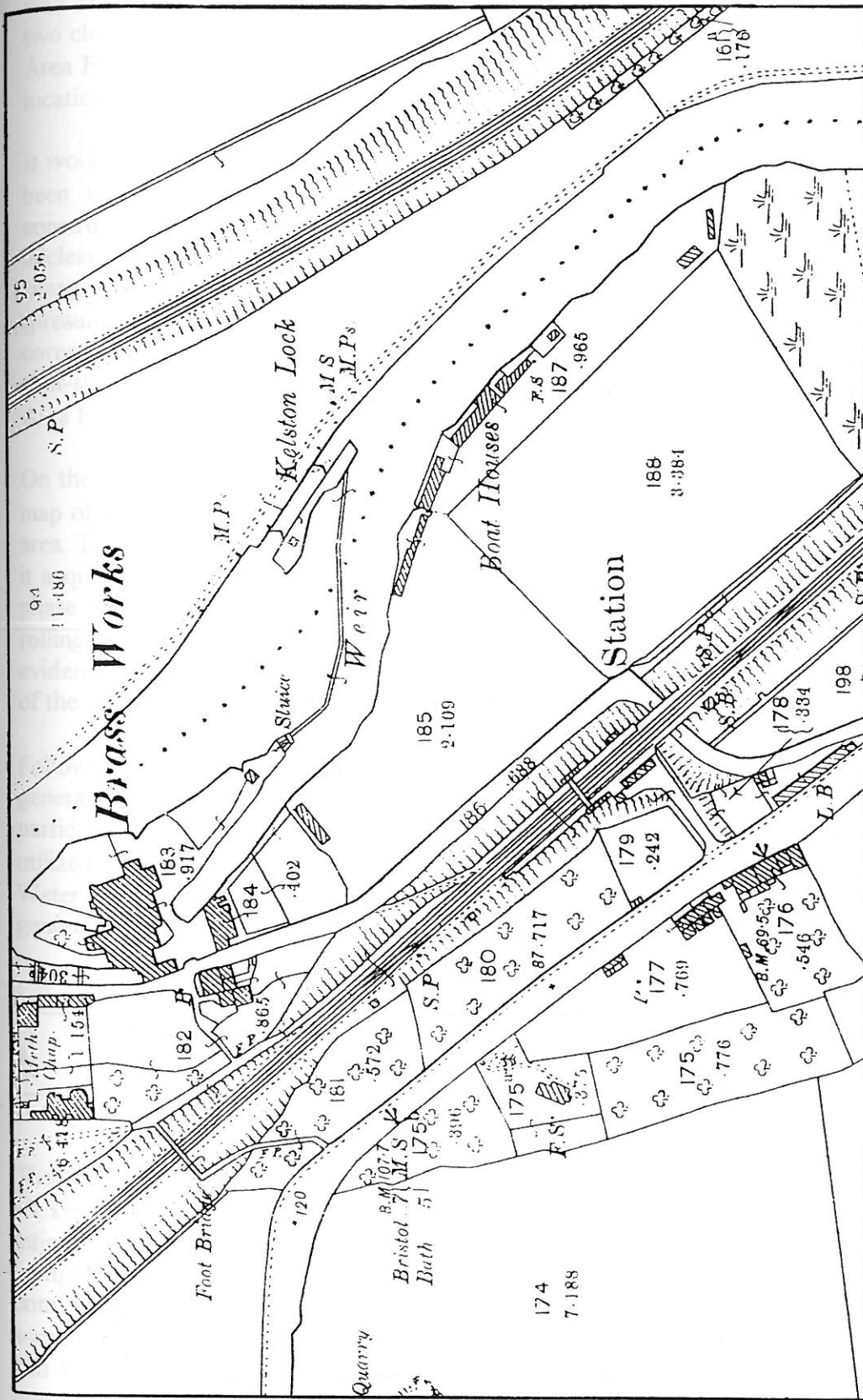


Fig. 24 Salford Brass Battery Mill
 Extract from the 1903 1:2500 OS Map

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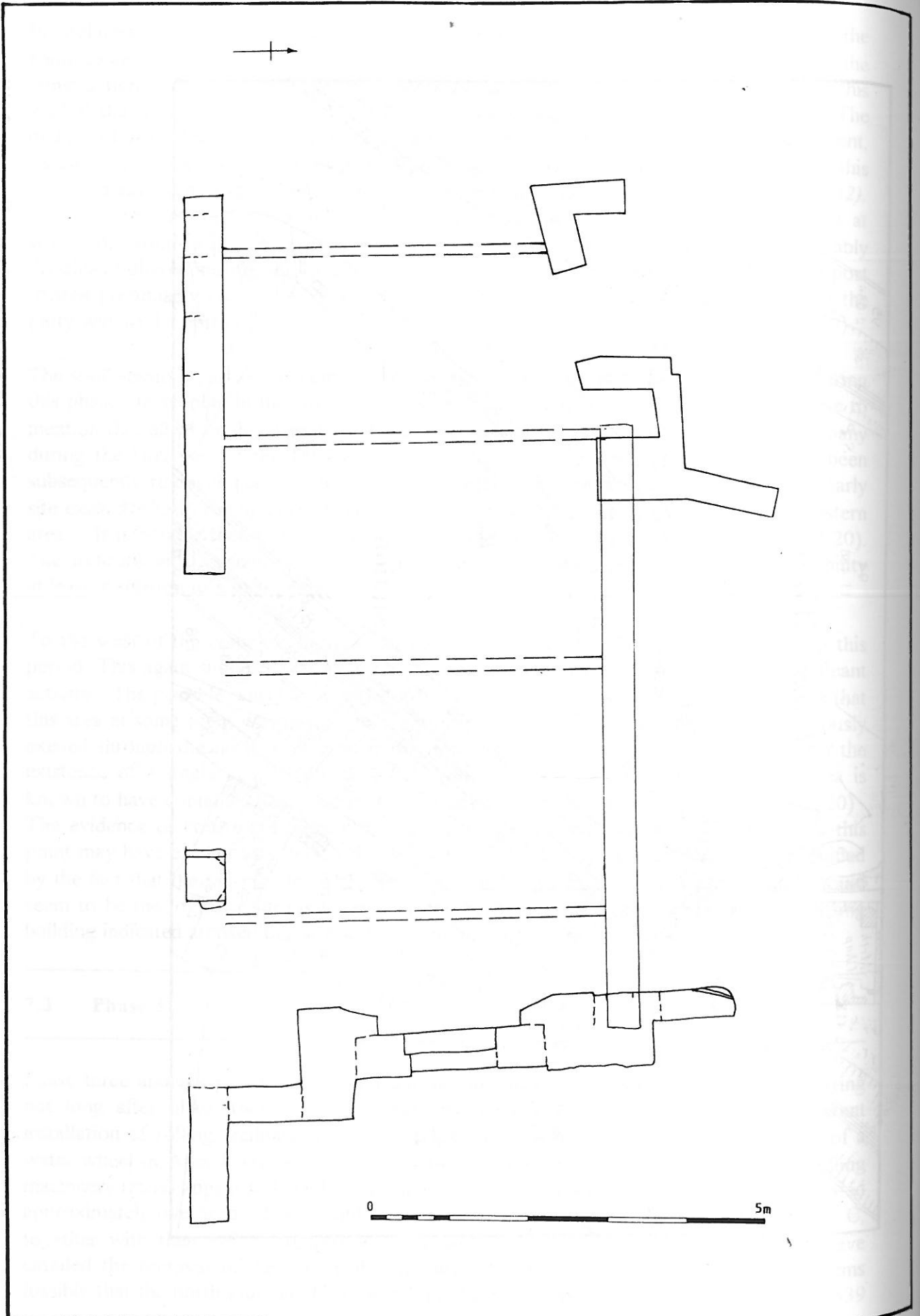


Fig. 25 Saltford Brass Battery Mill
Area J, Reconstruction of Truss Locations

Tithe map) along with the opening in the north-wall of Area C. A through passage-way from north to south, would consequently again have been created. The construction of the south wall of Area D also seems to fit into the latter part of this phase, possibly again occurring in two closely linked phases. This would have entailed the removal of the previous south wall of Area E, together with the installation of truss No12, creating the present 'ghost-wall' in this location.

It would appear consequently that by the early to mid 19th century the brass-mill would have been in what might be described as its hay-day. An additional water-wheel of iron construction appears to have been installed at about this time, though its location seems unclear. (*ibid* 21) The outline shape of the complex that is shown on the 1839 tithe-map changes little during the remainder of the century, apart mainly from the gradual loss of (presumably redundant) sections of the complex by demolition. Area H in the north-west corner appears on the OS map of 1886 (*Fig. 23*). This may also have included altering the roof-structure in this area. The building which possibly contained an early battery-hammer in Area F would also have been integrated into the complex by this time.

On the OS map of 1932 (*Fig. 1*) the small extensions to the south-east (as shown on the OS map of 1903) (*Fig. 24*) have all but disappeared, along with the western kiln and its extended area. The result of this process is that the complex becomes approximately square in outline as it acquires its present form. In general this may be seen as phase four (*Fig. 20*). In the final phase of production, the mill is known to have continued producing brass-wares using both rolling and hammering methods, into this present century (*ibid* 22). The photographic evidence effectively completes the picture by showing that the presently missing eastern ends of the complex previously took the form of hipped ends.

Following the ending of rolling in 1925, the complex ceased to be a brass-mill although in general the buildings would seem to have been in reasonable condition. The north kiln in particular was in a working condition at this point (*ibid* 22). The kiln was subsequently utilized as a wine-cellar and Area F was adapted to provide a full size squash-court. Water-wheel 2 also continued in use and was adapted to drive a direct-current electricity generator.

8 Conclusion

The OS map of 1932 shows that an outline shape has evolved from the elongated cross shown on Thorpe's map of 1742, to an outline approximately square in shape. From a closer, more intimate viewpoint however, it becomes immediately apparent that this outline represents a complex process of historical and architectural development. Although due to this innate complexity the various phases of development are difficult to interpret, it is possible to identify some major conjunctural features, as this report has shown. In this context the architectural and historical value of the complex is clearly illustrated, along with the importance of the measures currently being undertaken in order to ensure its future preservation.

9 **References**

Day, J, 'The Salford Brass Annealing Furnace', *Journal of the Historical Metallurgy Society*, Vol XIII (1979)

Day, J, *et al.*, 'The Old Brass Mills Salford', *Bristol Industrial Archaeological Society Journal*, IX (1976)

Goodall, A R, 'The Medieval Bronzsmith and his Products', in Crossley, D W (ed), *Medieval Industry* (CBA Research Report No.40) (1981)

(pers. comm.) RW Headington

Morriss, RK, *Salford Brass Mill, A Consultative Report*, City of Hereford Archaeology Unit (1992)

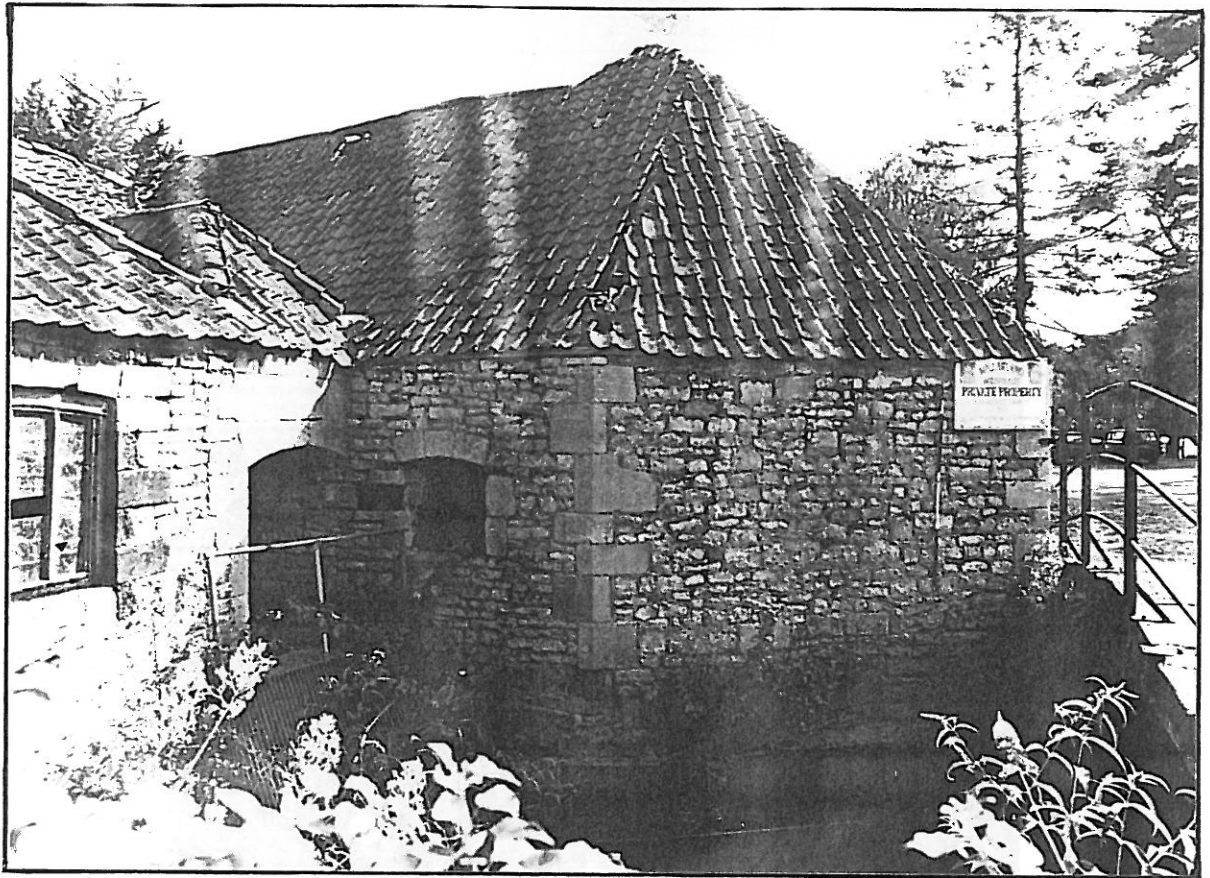


Plate 1 Saltford Brass Battery Mill
Areas D & C, South and South-west external elevations

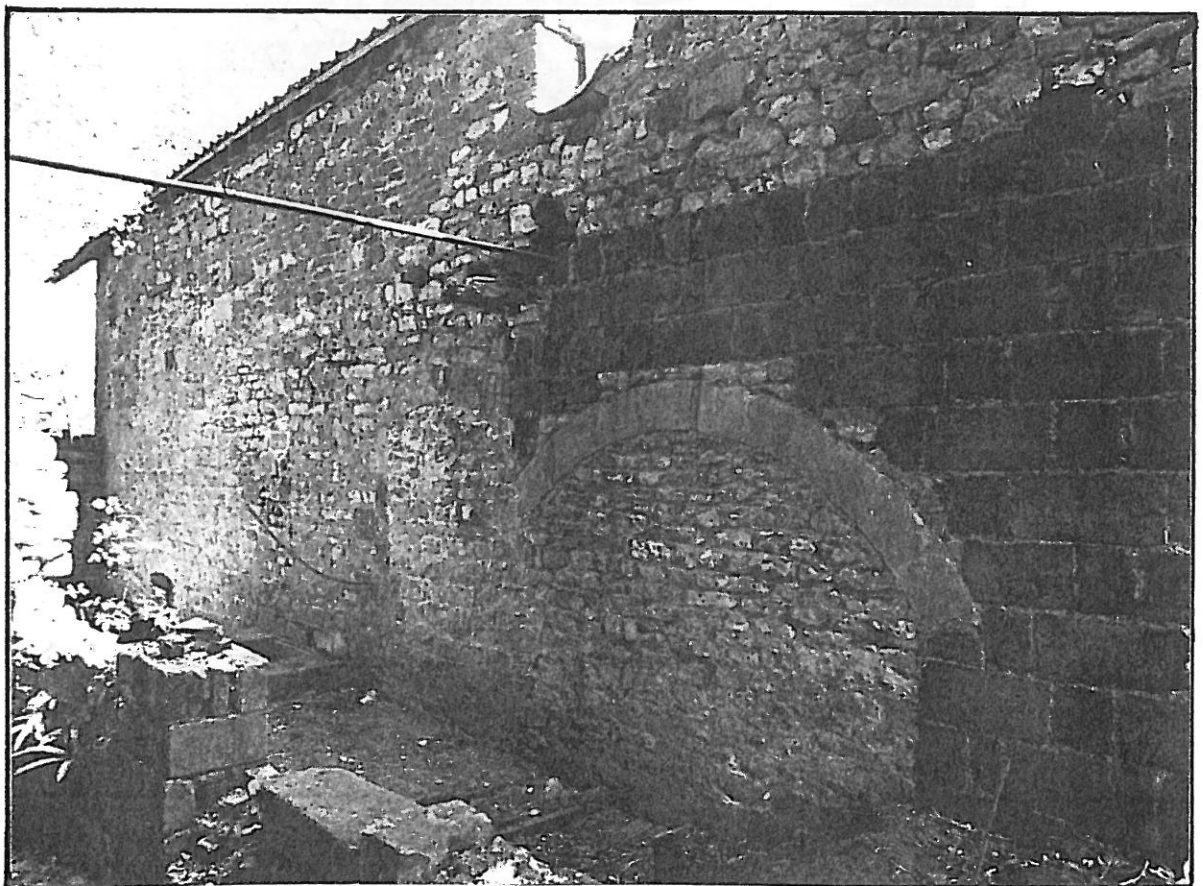


Plate 2 Saltford Brass Battery Mill
Areas H, F & E, West external elevation

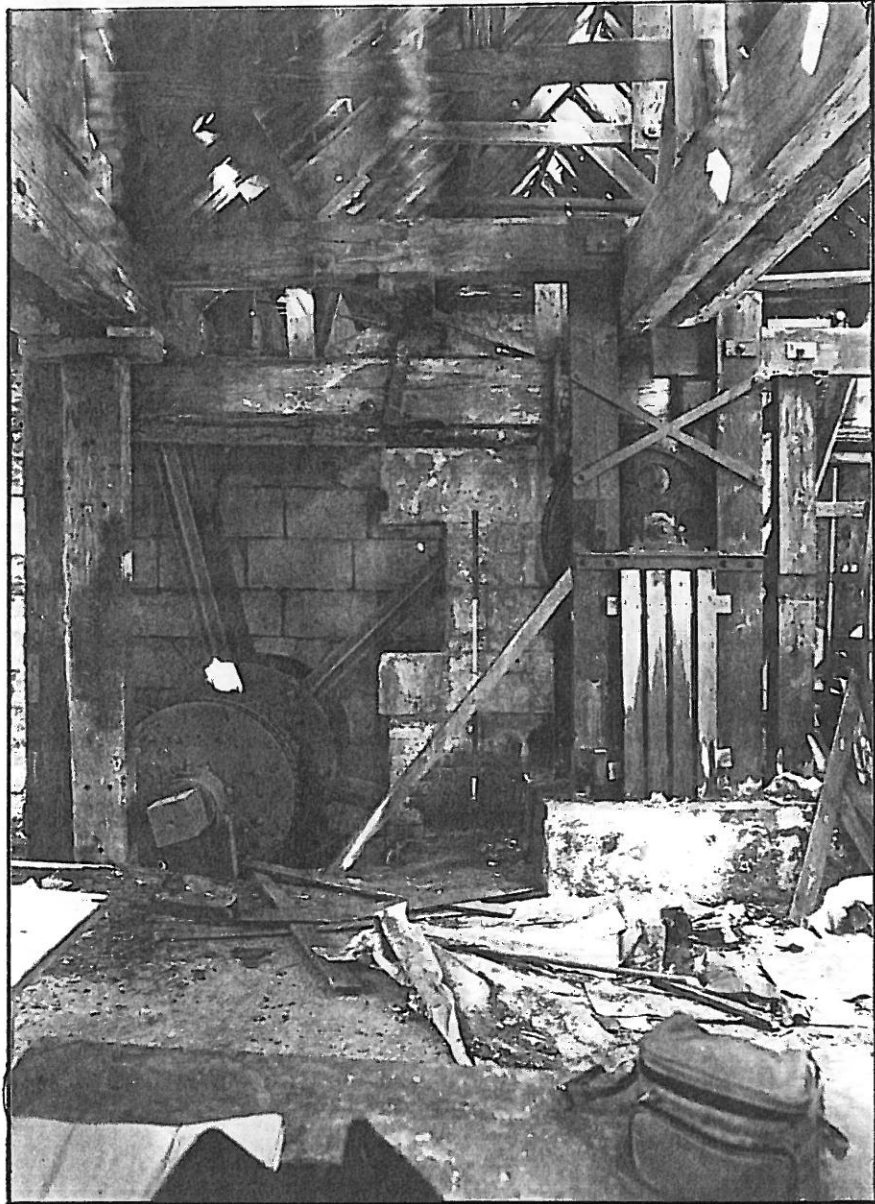


Plate 3 Saltford Brass Battery Mill
Area C, West internal elevation, Water-wheel 2

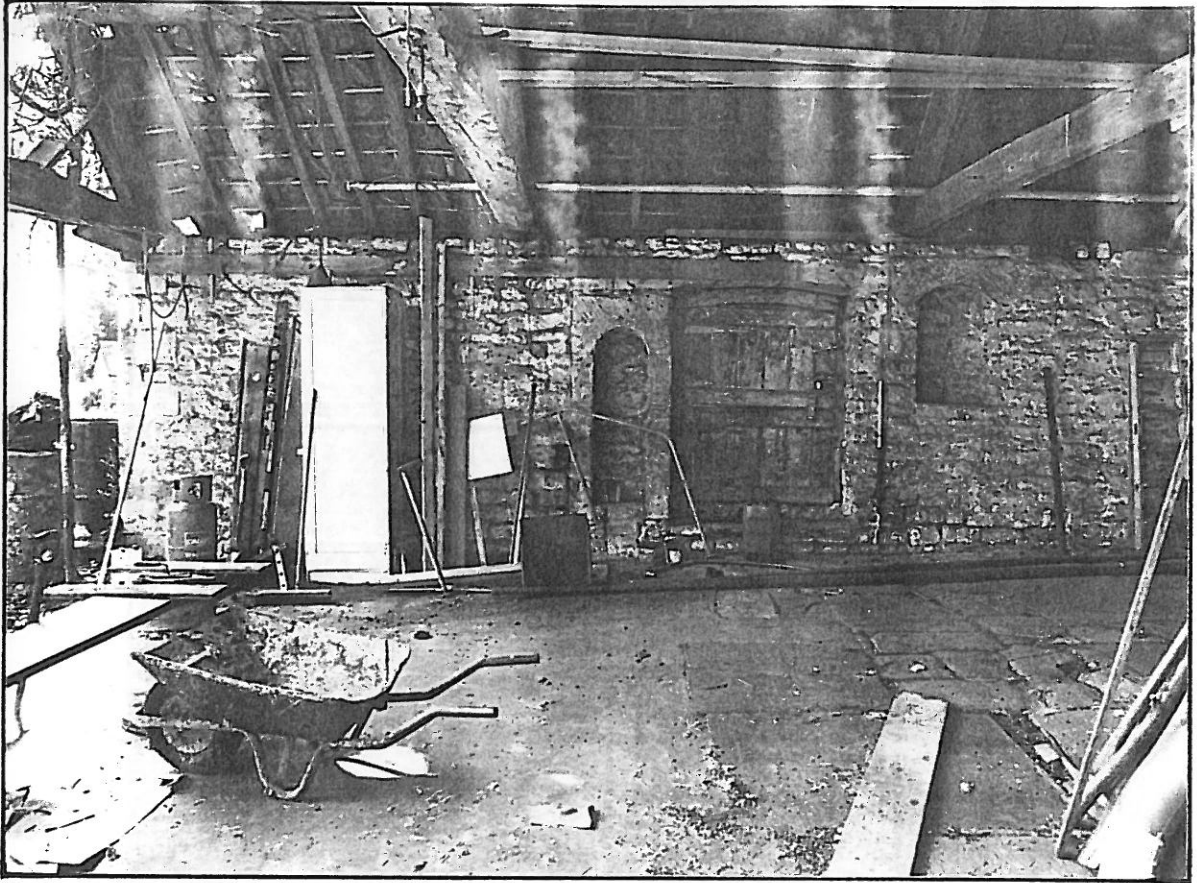


Plate 4 Saltford Brass Battery Mill
Area A, South internal elevation

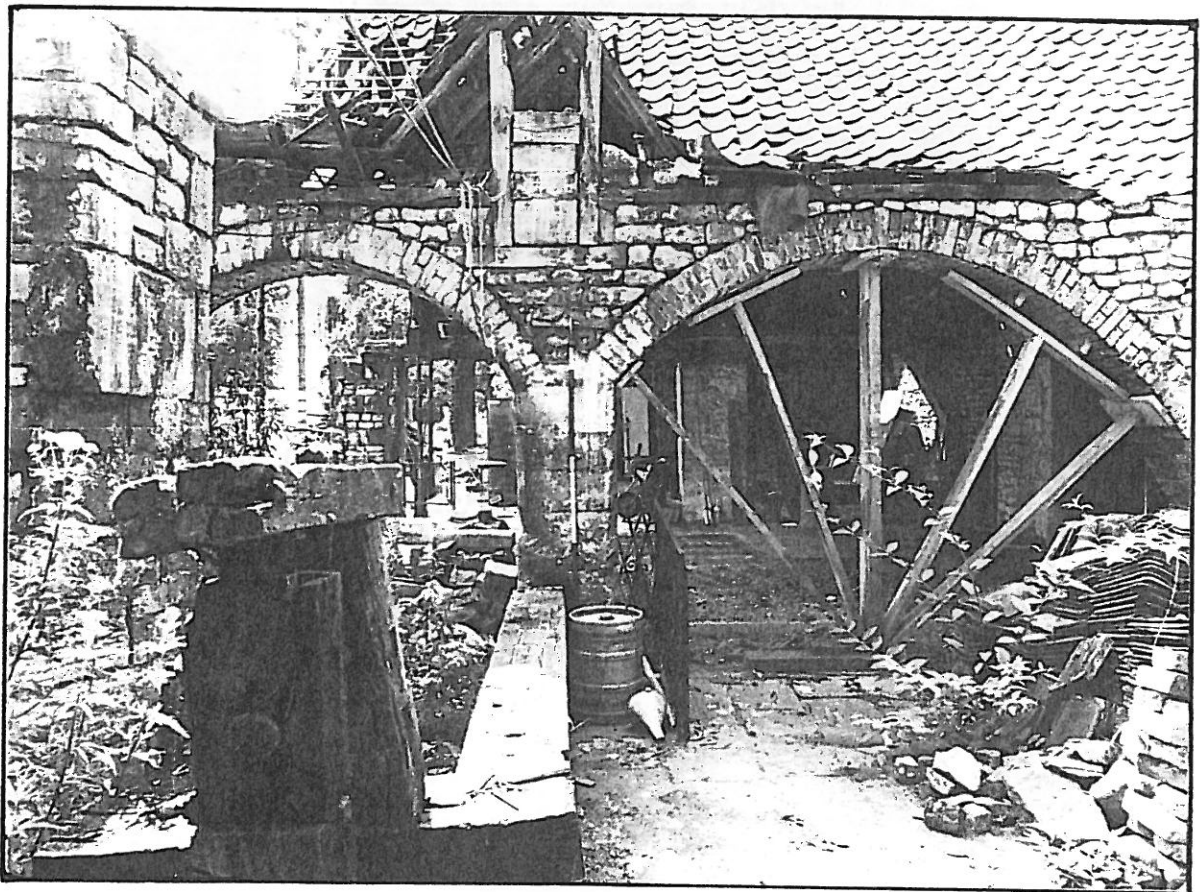


Plate 5 Saltford Brass Battery Mill
Area J, South & East internal elevations

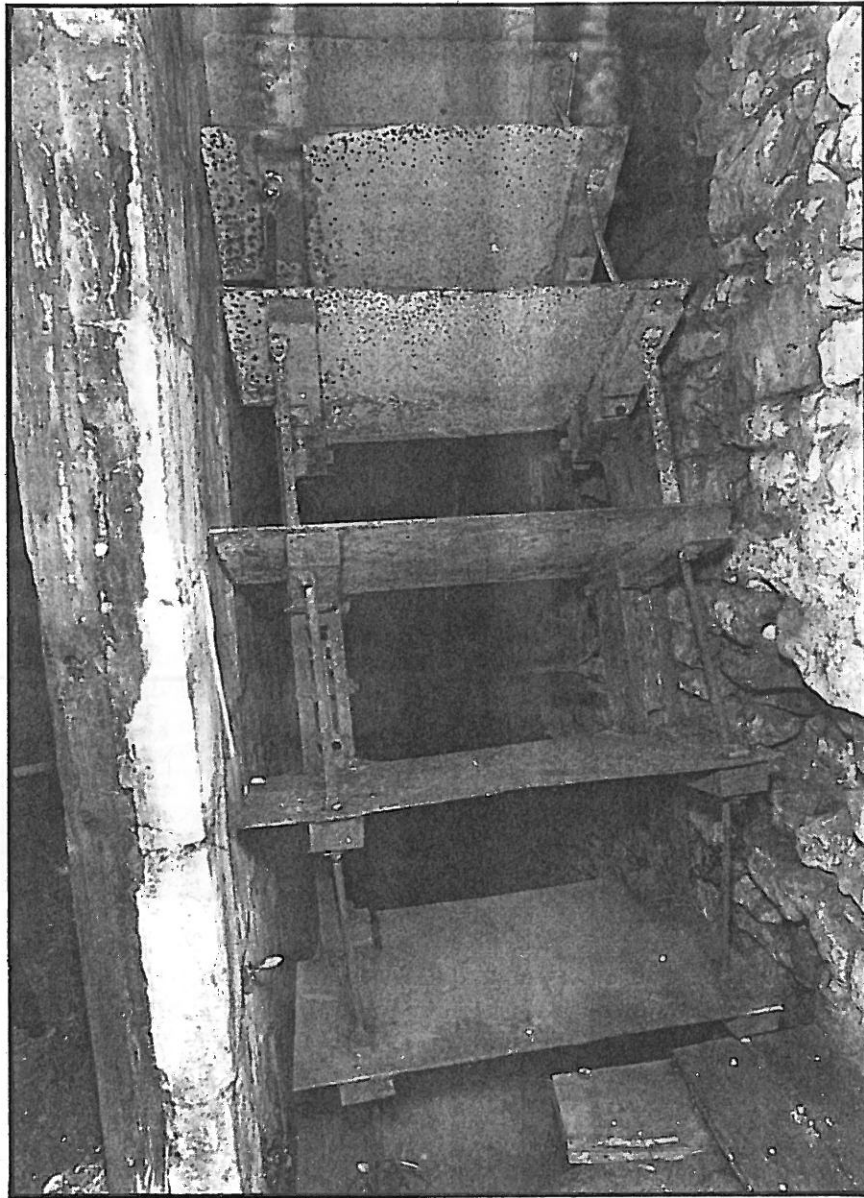


Plate 6 Saltford Brass Battery Mill
South external elevation, Water-wheel 2

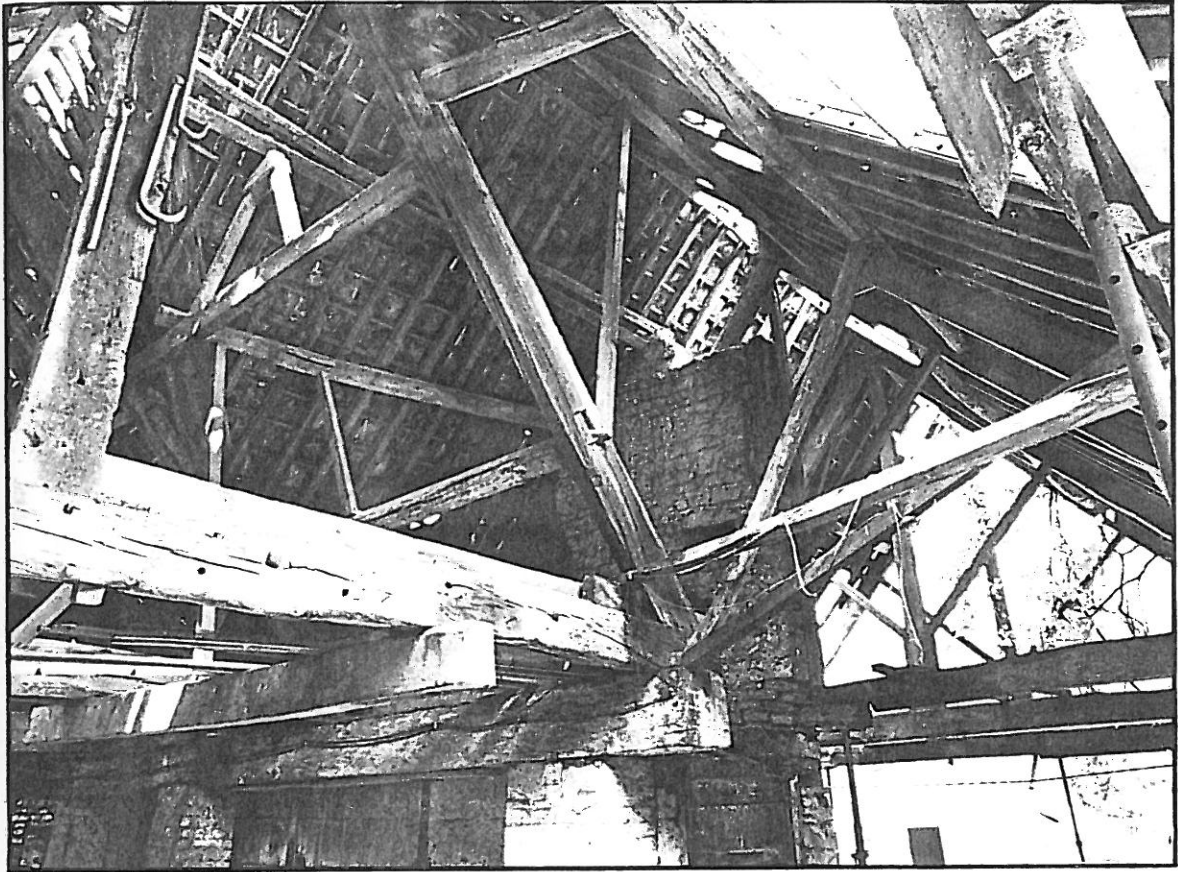


Plate 7 Saltford Brass Battery Mill
Areas A & C, Roof timbers looking East